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Philip Ruijs

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# THESE DE DOCTORAT

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LA COMUE ANGERS – LE MANS

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*Sciences économiques et sciences de gestion - Pays de Loire*  
Spécialité : *Sciences économiques*

Par

**Philip RUIJS**

## The Real Theory of Capital

Towards a Theory of the Real-Side of the Economy

Thèse présentée et soutenue à Angers, le 07/12/2023  
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**The Real Theory of Capital:  
Towards a Theory of the Real-Side of the  
Economy**

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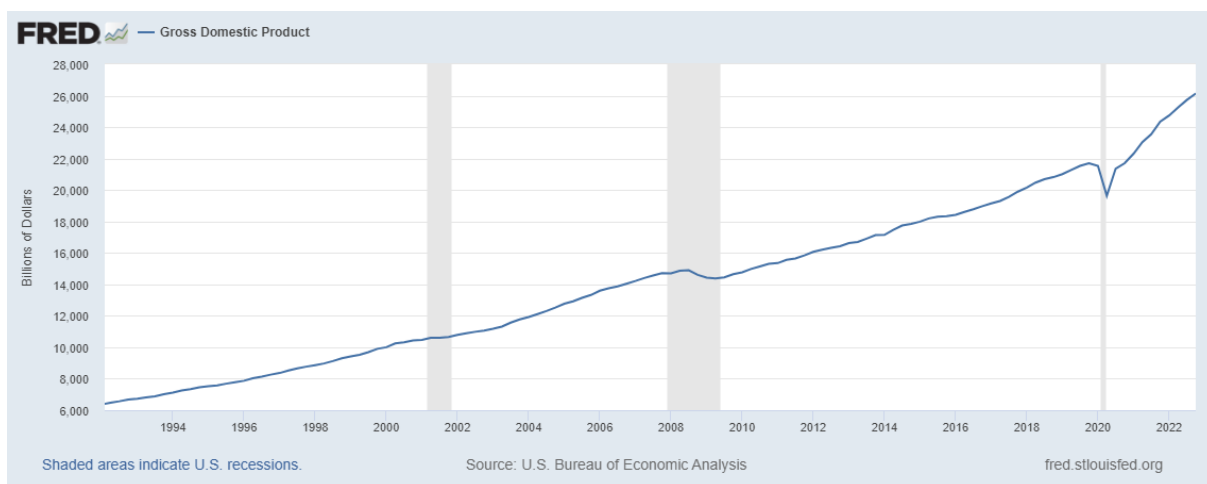
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# Introduction

## 1. The Problem Description of Business Cycles, the Problematic Description of Business Cycles

Virtually all macroeconomic textbooks state the problems of business cycles and growth in more or less the same framework: They all state that, in terms of *national income accounting*, the *Gross Domestic Product* grows over the long-run, but shows certain dips in this growth every 5-10 years or so. That description of the business cycle is often supported with graphs such as the following:



However, the alternations in GDP-growth is not the only thing that is to be said about business cycles. Many different facts that are typical about business cycles - and which are known as *stylized facts* - can be provided by business cycle statistics<sup>1</sup>. It is merely the consensus nowadays that alternations in GDP are regarded as the *central and most important characteristic* of the business cycle. But it is obviously not the only stylized fact one can refer to in order to describe business cycles. One extremely important fact about business cycles is that the *upper turning point* – the point where the upswing changes into a downswing – is usually marked by some sort of commercial- or financial *crisis*. In fact, the field within economics indicated by the term *trade cycle theory* or *business cycle theory* (American English) used to be called *crisis theory* around the year 1900 and before. It should be interesting to note here that around

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<sup>1</sup> Standard works on 'stylized facts' are Mitchell, *Business Cycles* (1913); J.M. Clark, *Strategic factors in business cycles*. (1934); Moore, *Business Cycles, Inflation, and Forecasting* (1983) and Zarnowitz, *Business Cycles: Theory, History, Indicators, and Forecasting* (1992).

the year 1900 the phrase *gross domestic product* did not even exist<sup>2</sup>. Arguably the crisis, rather than the cyclicity, was regarded as the more important and central characteristic of the phenomenon to be studied. Even today we can say that it is the crisis that the general public actually observes and for which the public demands explanations. The alternations in GDP-growth is something presented to the public by national income accountants but which excites the public to a much lesser degree. The business cycle is such a complex phenomenon that it deserves a much broader empirical description than merely stating that it consists in alternations in GDP-growth, and that the upper turning points of business cycles are often points of crisis.

Economists have usually distinguished between the monetary- and pricing aspects on the one hand (often times referred to with the adjective *nominal*) and the physical- or technical aspects on the other hand (often times referred to with the adjective *real*). For example, wages as they are paid in currency are called *money-wages* or *nominal wages* by economists. But the goods that can be bought with the money wage, or a hypothetical wage in kind, is what economists call a *real wage*. This sort of theoretical distinction can also be applied to business cycle empirics: The time-series and stylized facts about business cycles can be distinguished into ‘nominal’- and ‘real’ stylized facts. The first category are facts relating to finance, money and prices. They are the facts that one perceives ‘above’ – what economists have termed – the *veil of money*. The second category comprises those facts ‘under’ that veil of money which refer to quantities of production factors, products and related aspects.

## **2. Real Analysis and Monetary Analysis in Macroeconomics**

Another way of distinguishing between the nominal- or monetary aspects on the one hand, and the real aspects on the other hand, is that the former is about *social constraints* people encounter in dealing with others (especially budgets and prices, but also institutions), while the latter is about the *technical-physical constraints* that all people face in dealing with their environment (the scarcity of resources).

Many economists have attempted to formulate theories that explain economic phenomena from both the monetary and the real side. They see *Real Analysis* and *Monetary Analysis* - as Schumpeter called them - as *cooperating* theoretical instruments (Schumpeter 1954, 276). For example, W.H. Hutt (1899-1988) recalled about how he was educated on economics in the 1920's when he wrote that he was

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<sup>2</sup> This is also true for the German-language area where there was first a *krisentheorie*, which later became a *konjunkturtheorie*.

taught “to think simultaneously in terms of money prices and in real terms-to be continuously aware of the reality under the veil (the very real veil) of money” (1979, 186).

A contemporary of Hutt, F.A. Hayek (1899-1992), argued that the general thesis of his business cycle theory was that “*monetary causes which start the cyclical fluctuations*”, while “*successive changes in the real structure of production [...] constitute those fluctuations*” ([1929] 1933, p.17, his emphasis). In other words, monetary analysis and real analysis must be employed side-by-side, and must each identify different types of causes and effects in the economy, and their interrelation. Hayek’ business cycle theory was partly a ‘monetary’ business cycle theory as it identified the ultimate causes of the business cycle in the monetary- and banking system. However, it was also an ‘overconsumptionist’ theory of business cycles as it identified the proximate cause of crises in a “relative over-consumption” in the real economy (Hayek, 1939, 172). The relation between the ‘monetary’ and the ‘real’ was that artificial credit-creation sets the real economy on a path of relative overconsumption, resulting in a scarcity of raw materials and consumption goods (Hayek, 1939, 30-31 & 29-32). A significant slowdown in the volume of transactions must then occur, something which can surely inaugurate a commercial- and financial crisis.

The importance of using both Real Analysis and Monetary Analysis can also be seen in reference to the stylized facts around raw materials in the business cycle. An important example is Moses Abramovitz’ distinction, in his empirical study published as *Inventories and Business Cycles* (1950), between two types of time-series. On the one hand the *dollar-value* of inventories, which is collected from balance sheets and financial accounts of firms. On the other hand the volume of inventories in terms of *physical units* (tons of coal, steel, rubber, etcetera)<sup>3</sup>.

The importance between money-values and physical units, with reference to stocks of raw materials, was also stressed by economist K. Lacey in the 1940’s. He observed that:

“the market price of raw materials moves in inverse ratio to the quantity of visible stocks, so that even if there were no ‘real’ investment in additional stock quantities during the boom, there would still be new ‘financial’ investment as raw materials moved more quickly forward and were booked by manufacturers, etc., at the higher market prices.

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<sup>3</sup> The latter type of time-series can be derived by inference from corporate balance sheets. Abramovitz finds this procedure somewhat problematic, as: “it is necessary to correct the reported value figures for the influence of changes in prices, an inherently treacherous and inaccurate process” (1950, 31). However, Abramovitz also used more direct sources, a “considerable number of series representing the holdings of Specific corn. modities in physical units”(ibidem, 32).

Similarly there would be ‘financial’ disinvestment after the crisis as manufacturers stocks were written down to market values, and as the new output of raw materials accumulated with producers and dealers at factor cost or at low market values” (Lacey, 1944)

In other words, *money-spending* to keep stocks of raw materials at a certain level – ‘financial’ inventory investment – moves up during the boom. But, the stocks of various raw materials measured in physical units – ‘real’ inventory investment – declines during the boom. One who only looks at price- and money aspects will surely miss this important fact that during the upswing the money-value of inventories can rise, while the physical volume is declining. A situation of declining physical inventories is evidently not sustainable. Unfortunately, modern business cycle research does seem to omit this important ‘real’ stylized fact. For example, in *Business Cycles and Depressions: An Encyclopedia* (2013, 663) one can find under the entry “Stylized Facts” that “[i]nvestment in [...] inventories is procyclical.” This refers to inventory investment in money-terms. There is no mention of a stylized fact of declining inventories in physical terms<sup>4</sup>.

The relative absence of Real Analysis in modern economics has much to do with one very influential economist of the 1930’s, J.M. Keynes (1883-1946). Keynes apparently wanted nothing to do with Real Analysis. He wrote in 1933 about a “divergence between the real-exchange economics and my desired monetary economics” (1933). Thus he suggested that there was a *competition* between the two types of theoretical instruments. Keynes desired the exclusive use of Monetary Analysis and he pushed for that exclusive use. Since the so-called *Keynesian Revolution* in economics, inaugurated by the publication of Keynes’ *General Theory* (1936), we can see that Keynes has so far succeeded in this respect. Because it is indeed Monetary Analysis which has dominated the field of *macroeconomics* – i.e. the wide field of study in economics relating to business cycles, employment, growth, income distribution, monetary policy and fiscal policy<sup>5</sup> - that emerged out of the 1930’s.

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<sup>4</sup> That certain stocks of raw materials (in terms of physical units) move inversely with the business cycle was certainly one of the more remarkable findings that Abramovitz presented in his *Inventories and Business Cycles* (1950). But the entry on Abramovitz in *Business Cycles and Depressions: An Encyclopedia* (ed. Glasner, 1997) does not mention this finding.

<sup>5</sup> Schumpeter writes about the relation between monetary analysis and macroeconomics: “Monetary Analysis, [...] means [...] Aggregative Analysis or, as it is sometimes called, Macroanalysis, that is to say, analysis that attempts to reduce the variables of the economic system to a small number of social aggregates, such as total income, total consumption, total investment, and the like.” (265, footnote omitted). Friedman writes in his *Price Theory*: “Monetary theory deals with the level of prices in general, with cyclical and other fluctuations in total output, total employment, and the like [...] Professional jargon has come to designate monetary theory as

The dominance of Monetary Analysis in macroeconomic textbooks is evident with respect to business cycles. Macroeconomics textbooks will usually not go much further than stating a number of nominal stylized facts<sup>6</sup>. Besides alterations in GDP-growth often the only ‘real’ stylized fact that is mentioned is that the employment-rate is usually higher in the boom compared to the downturn. The stylized facts on changes in total hours worked, the extraordinary high capacity utilization in the machine producing industries and the long delivery lead times for machinery, as well as the fact that many inventories of commodities move inversely to the development of GDP, are usually left out of the description of the stylized facts (e.g. ). Modern macroeconomists are apparently more concerned with time-series and stylized facts about the monetary aspects than about the real aspects of cycles.

### 3. Policy Implications

Keynes completely ignored both the real stylized facts of business cycles (on the side of empirics) and he ignored the Real Analysis (as a theoretical device to understand the business cycle). Keynes assumed in his economic theory that inventories would be larger when an economy is booming and smaller when the economy is declining. His reasoning was simply that businessmen would behave in such a way as to have more inventory on hand when sales went more rapidly and for higher prices (in a boom) and would want to have little inventory of hand when sales went slowly (in a recession). It is not wrong to think that businessmen would *ideally* want to act in such a way, but the reality of booms is that most businessmen are unable to profitably maintain larger inventories.

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*macroeconomics*, price theory as *microeconomics*. This usage is unfortunate because it gives the misleading impression that monetary theory is concerned with things in the large (macro), price theory, with things in the small (micro). Both branches of theory are concerned primarily to understand things in the large (1976, 7)”

<sup>6</sup> Blanchard (2021) does not mention stylized facts or the cyclicity of economic indicators at all. Mankiw (2013, 274-280) names only one ‘real’ stylized fact, which is the employment rate; Williamson, 2018, 105-107 also only mentions employment as a real stylized fact in his section on “key business cycle facts”. Abel, Bernanke and Croushore provide a table of “The Cyclical Behavior of Key Macroeconomic Variables”, but from the accompanying text the only ‘real’ indicators in this table appear to be employment and unemployment (2013, 290). Froyen, *Macroeconomics: Theories and Policies* (tenth edition, 2013 p.24) only mentions unemployment as a real stylized fact of business cycles. Hubbard, Garnett & Lewis, *Macroeconomics* (2<sup>nd</sup> ed. 2014 p. ) mention two “key facts” about business cycles, namely employment rates and real GDP. Of these only employment is a real stylized fact as ‘real GDP’ is simply a nominal fact which is ‘deflated’ (adjusted for inflation) and therefore called ‘real’. Hubbard, Garnett & Lewis furthermore refer to the 21 leading indicators of the business cycle that is compiled by the Conference Board. Only three of those 21 seem to be ‘real’ indicators (‘average weekly hours in the manufacturing sector’; ‘average weekly initial claims for unemployment insurance’ and ‘building permits for new private housing units’). Mishkin, *Macroeconomics: Policy and Practice* (2015, 212): mentions only unemployment a real stylized fact of business cycle. Krugman & Wells, *Macroeconomics* (4<sup>th</sup> ed. 2015, 176 )mentions only unemployment a real stylized fact of business cycle. *The conclusion is thus that real stylized facts are by and large ignored.* Also, the entry for ‘Stylized Facts’ in the *Business Cycles and Depressions: An Encyclopedia* does not list any real stylized facts in its list of the “most striking stylized facts”.

Two rather direct results of the dominance and near-exclusive use of Monetary Analysis should be stated. First is the matter of business cycle theory, and its task of pointing to an ultimate cause of cyclical fluctuations. The picture of the business cycle that emerges when one only points to the pricing-, financial- and monetary aspects, is that it all begins and ends with the money-spending of the general public. It is not much of a vulgarization of Keynesian business cycle theory if we state that its general thesis comes can be summarized as the idea that if the public spends money on consumption goods, business owners will be confident to make investments, and the economy booms<sup>7</sup>. If the public decides to spend less money on consumption goods, business owners will be less confident to make investments, and the economy turns to bust. This first result leads to the second result: It leads to a policy advice in which the government is made responsible to keep expenditure high, no matter what the public or businessmen decide, in the hope of keeping the economy “permanently in a quasi-boom” as Keynes hoped for in his *General Theory* (1936, 322). The underlying idea of the ‘quasi-boom’ is the superficial finding that the boom is a period of prosperity, and that this prosperity must be extended indefinitely.

Keynesian economics argues, in effect, that the *ultimate cause* of the business cycle is rooted in *mass psychology*. In the end Keynesian macro-analysis simply says that if the public is confident and acts as a spendthrift, the economy will boom; if the public is not confident and acts frugal, the economy will decline. It follows that an alternation of boom and recession can only be explained by the mood-swings of the general public. The Keynesian economist thus surrenders the explanation of the business cycle to the mass-psychologist<sup>8</sup>.

#### **4. The Present State of Real Analysis**

##### **4.1 Real Analysis in Business Cycle Theory**

Real Analysis, when conducted systematically, *is* theorizing on the real-side of the economy. In our opinion, the most significant development in Real Analysis of the past century is a model that Hayek

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<sup>7</sup> Keynes once called upon British housewives in a radio address: “whenever you save five shillings, you put a man out of work for a day. Your saving that five shillings adds to unemployment to the extent of one man for one day - and so on in proportion. On the other hand, whenever you buy goods you increase employment”. (Skidelsky, 1986, 456).

<sup>8</sup> Economists and the financial press will often be interested in what we can perhaps call the *psychological aggregates* (consumer confidence- and producer confidence indexes) as cyclical indicators. I am convinced that the trend in economic thinking away from the combination of Real Analysis and Monetary Analysis, towards using Monetary Analysis only, is the same trend that has moved the field of economics towards becoming a branch of psychology (*behavioral economics*). Schiller’s *Irrational Exuberance* (2005) and Akerlof & Shiller’s *Animal Spirits* (2010) are examples of surrendering economic analysis to psychology.

introduced into business cycle theory in the 1930's<sup>9</sup>. That model was about what he called the *structure of production*, by which he meant the duration of methods employed in the organisation of production (1931, 35). It is therefore also called the 'time-structure of production'. Hayek employed a "schematic representation" (i.e. model) of this structure of production in the form of a triangle (ibidem). This model is now often known as the *Hayekian triangle*. In its essence, this triangle can be seen as a reformulation of Böhm-Bawerk's scheme of concentric rings, because in the models of both Böhm-Bawerk and Hayek, the organisation of production is mainly illustrated by way of *stages of production* representing stages in production plans between commencement and completion.

Several contemporary business cycle theorists, have followed Hayek's theoretical outlook on the business cycle (Skousen, 1990; Huerta de Soto [1998] 2020; Garrison, 2000); They share the central thesis of Hayek's 'Austrian' business cycle theory, namely that business cycles are ultimately started by monetary expansion, but that changes in the structure- or organisation of production is what 'constitutes' business cycles. They also re-use the Hayekian triangle as the principle device to portray the changes in the structure of production.

The Böhm-Bawerk/Hayek stages-of-production conception has one main variable. This main variable is in a how far a resources are invested between output for the near-future and for the (very) distant-future. In other words, the thing about the organisation of production that it shows is how all current resources are distributed along the line between investment for the near future and investment for the most distant future. The Hayekian triangle illustrates the *intertemporal trade-off*. There is a time-to-build in which factors utilised to build machinery cannot be devoted to producing consumption goods. This implies foregoing some amount of consumption in the near future. This abstinence is the *cost* of building machinery in the intertemporal trade-off. But the actual constraint is formed by the limited

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<sup>9</sup> Contemporary mainstream economics hardly engages in any Real Analysis. The notable exception is the model of the *production possibilities frontiers* which figures in a few textbooks, among which is Professor Mankiw's *Principles of Microeconomics*. The production possibilities frontiers is defined by Professor Mankiw as "a graph that the various combinations of output" [...] that the economy can possibly produce given the available factors and production and the given production technology" and it "shows one tradeoff that society faces" (2018, 24-26). The production possibilities is, as my thesis supervisor once called it, a "physical boundary that can not be transgressed" (Hülsmann, 2001). In other words, it is a technical-physical constraint. The origin of the production possibilities frontier are not totally clear to me. However, the fact that this term has arisen in a discussion of the Ricardian law of comparative advantage, which clearly premises around the respective production possibilities of two products, makes this a likely origin (Evans, 1972, 8). If that is the case, it has a different origin than microeconomics, which clearly is a continuation of neoclassical price theory.

the means to bear this cost, as we do not have infinite supplies of means of subsistence which would make it possible to wait for the completion of machinery in very long production plans.

The one-dimensional nature of the intertemporal trade-off is perfectly illustrated by what Professor Garrison calls a “tug-of-war (with a stretchable rope) between consumers and investors” (2000, 71). This means that at the end of a cyclical upswing it becomes evident that many people are not willing to forego consumption in the near future, so that many long production plans retain the resources needed to complete them. What happens – according to the Austrian Business Cycle Theory expounded by Professor Garrison and others – is that some of the long production plans need to be abandoned so that resources can be re-allocated to the production of consumption goods. The main technical-physical constraint in the Austrian School’s Real Analysis is thus the availability of the means of subsistence (in a narrow sense) or consumption goods (in a wider sense). If the supply of consumption goods to the consumer markets dries-up, some production plans that are not directly putting out consumption goods will be abandoned in order to re-allocate resources to director production of consumption goods.

The thesis of the intertemporal trade-off is, in our opinion, certainly an important truth<sup>10</sup>. However, it is a very general truth. In the stages-of-production concept, ‘resources’ can be allocated to help produce near-future output or distant-future output by being allocated to ‘later’ or ‘earlier’ stages. But there is hardly a distinction between *types* of resources: the triangle is vague in the sense that it is not a concrete representation of actual steps performed in the construction of machinery. Which stages are there for mining iron ore, for smelting that ore, for cutting and drilling machine-parts, or perhaps for research and development? We cannot tell.

Professor Garrison writes in his *Time & Money* (2000):

“The entrepreneur is not supplied with – and cannot create for himself – a Hayekian triangle complete with a clearly marked sign that reads: YOU ARE HERE. Designed to

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<sup>10</sup> I would completely disagree with the assessment of some prominent Neo-Ricardians about the Austrian School, according to which the Austrian Real Analysis regards production as ‘linear’ (going from labour and land via capital goods to consumption goods). This is an incomplete reading of what Austrians write. In fact, according to the intertemporal trade-off (the centrepiece of Austrian Real Analysis) consumption goods are given up now (partly as an opportunity cost) in order to obtain more consumption goods in the future. This *is* a ‘circular’ view on production, because the process begins and ends with consumption goods. I am not arguing that this circular view is incorrect, my point is that what is between beginning and end should be investigated in more detail.



emphasize the essential time element in the production process, the triangle abstracts from the actual complexities of the economy's capital structure" (2000, 82)

In line of this consideration we can also observe that there is no distinction in the Hayekian triangle between capital goods industries bringing forth machinery ("fixed capital") and a primary sector bringing forth raw materials ("circulation capital").

Professor Huerta de Soto, who also employs the Hayekian triangle in his *Money, Bank Credit and Economic Cycles* ([1998] 2020), writes:

"From a human actor's prospective point of view, the distinction between fixed and circulating capital goods is irrelevant, since it is largely based on the physical characteristics of the goods in question" (Huerta de Soto, [1998] 2020, 299).

The stages-of-production conception is thus characterised by an *aggregation* of sectors and of resources. It does not distinguish between machine producers, consumption goods producers and raw materials producers, and it does not distinguish between flows of materials and flows of machinery. It is also difficult to see what the degree of automation is of the current production capacity, and the degree of automation towards which the economy is moving. Furthermore, the stages-of-production conception does not show the level of employment of the economy of the economy, let alone the capacity utilization in different sectors of the economy.

This lack of disaggregation makes it hard to use the stages-of-production conception as a theoretical device that enables to shed light upon empirical patterns we see in business cycles. In a very general sense, it gives us a thesis why an economic boom should turn into a bust. But it does not give us a more refined analysis of causal chains in the business cycle, because it lacks disaggregation between sectors and resources. For example, Professor Huerta de Soto writes in the introductions of his *Money, Bank Credit and Economic Cycles* about "the rise in the price of raw materials, particularly oil" ([1998] 2020, xxvii) and of a "dramatic rise in the price of the energy products and raw materials" (ibidem, xlii) as a trigger for crisis. But his indistinction between fixed- and circulating capital goods in his Hayekian triangle, and thus between the real aspects underpinning the markets for machinery and for primary commodities respectively, prevents his business cycle theory from shedding more light upon rises of raw material prices as an effect of monetary policy and as a cause of further effects. It also does not provide us with an image of the higher employment and capacity utilisation in the boom-phase, the role of commodity shortages, or increased delivery lead times of machinery.

To summarize: The stages-of-production conception - either in the form of Böhm-Bawerk's ring-scheme or in the form of the Hayekian triangle - illustrates the allocation of an *aggregation of resources* among production plans with earlier and later dates of completion. But there has been little to no advance beyond the stages-of-production concept. The problem that presents itself is whether any kind of *disaggregation* is possible, in order to lay bare other possible technical-physical constraints than merely the supply of means of subsistence. One such technical-physical constraint is, now and then, present in mainstream economic theorising: *Capacity constraints*. It seems obvious that besides the available means of subsistence the capacity of, for example, the machine producing industries will co-determine how fast the economy can grow<sup>11</sup>.

#### 4.2 Real Analysis in Distribution Theory

The *Wage Fund Doctrine* of the classical economists was part of their theory of income distribution (i.e. the theory of wages *and* interest). It was largely given in real terms. It builds on the classical concept of a yearly production cycle in which there is a single point in time for output, that is, there is one harvest per year. An implication of this 'period analysis' is that the landworkers tilling the land must be fed by the product of the previous harvest, as it is chronologically impossible that they are fed by the harvest they are working towards. Wages are thus *advances* out of the previous year's harvest. The Wage Fund Doctrine is partly based on the production-theoretic consideration that means of subsistence must be available before one can engage in a lengthy production process, because it takes some time before its output of consumption goods can be used as means of subsistence.

Mainstream economics abandoned the Wage Fund Doctrine around the last quarter of the 19<sup>th</sup> century (Hadley, 1897). However, Bohm-Bawerk vehemently adhered to this core of the Wage Fund Doctrine in his *The Positive Theory of Capital* ([1889] 1891). Traces of it can already be seen in the introduction of that work in which he puts the notion of a 'National Subsistence Fund' in favourable light, and also in his period analysis that surrounds his ring-scheme of stage-of-production. Obviously, Bohm-Bawerk used a literal 'wage fund' in a numerical model, in the latter part of the *Positive Theory*, that attempts to explain the distribution between profits and wages, *and* the growth of the economy. This numerical model has been called a 'neo-wage fund theory' (Tomo, 1994, 125). Bohm-Bawerk furthermore defended the concept of wages-as-advances against Clark in the 1890's capital debates

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<sup>11</sup> The above does not mean that there are other shortcomings or problems of Real Analysis in general or the stages-of-production conception in particular. However, some seem to be of the opinion that abandoning the stages-of-production conception is the only way out of the problems they see with it, such as Lewin & Cachanosky (2019, 20-21). That seems to us like a retreat from Real Analysis.

(Bohm-Bawerk, 1907, 281). This Real Analysis that runs through Bohm-Bawerk's capital theory has left some traces in the works of some of Bohm-Bawerk's contemporary followers, but explicit recognition of it is sparse, let alone some systematic thought on it.

This probably has to do with the fact that Böhm-Bawerk is also known for the 'three grounds' he gave for explaining the existence of interest. The 'three grounds' are contained in his (so-called) *Agio theory*. One important branch of Böhm-Bawerk's followers (Fisher, Fetter, Mises) are those adhering to the first two 'psychological' grounds for interest that can be found in the *Agio theory*, from which their *time-preference theory* derives. Another branch is the Wicksellian line (Åkerman, Lindahl, Gadolin, Hayek) which follows Böhm-Bawerk's 'technical' third ground for interest (according to which present goods are more valuable due to the higher productivity of roundabout production). In essence, this is a *productivity theory* of interest (Hayek, 1941, 42-44).

However, there is in fact a third branch of Böhm-Bawerk's followers (Van Dorp and Strigl)<sup>12</sup> that adhere to none of the three grounds, but who let their interest theory (which is an integral part of their distribution theory) be inspired by Bohm-Bawerk's 'neo wage fund theory', that in the *Positive Theory* comes after the *Agio theory*. Only recently there has arisen some renewed interest specifically in Bohm-Bawerk's 'neo-wage fund theory' (Magnan de Bornier, 2008; Fillieule, 2012) and his concept of the subsistence fund (Braun, 2014; Braun & Howden, 2017).

Still, in the contemporary literature on interest theory the role of the Wage Fund Doctrine remains largely undiscussed. Consider the time-preference theory in relation to the Wage Fund Doctrine. If present goods are more valuable than future goods, that is, if there is an *agio* (i.e. a price-premium) of present goods over future goods, how can entrepreneurs-capitalists *capture* this agio? Put more concretely, if labour (a future good) applied now for tilling the land matures after some time into corn (a more valuable present good), how is the farmer-entrepreneur going to take-in the value-difference between labour and corn? If the answer is that the farmer-entrepreneur captures the value-difference by advancing corn (a means of subsistence) to the labourer, then the fundamental tenet of the Wage Fund Doctrine has been called in to aid the time-preference theory. This is precisely what Rothbard did ([1962] 2009, 478-479). But in the contemporary literature debating the validity of the time-preference theory, most prominently in Professor Herbener's *The Pure Time-Preference Theory of Interest*

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<sup>12</sup> F.W. Taussig can also be seen as one that interprets and seconds The Positive Theory of Capital also a renewed defence of the wage fund theory. Independently of Strigl and Van Dorp also G. Reisman can be named as a member of the Austrian School and a follower of the wage fund theory.

(2011), the whole matter of the time-preference theory in relation to the Wage Fund Doctrine is not explicitly discussed.

There are other questions we do not see raised in the contemporary literature: The explanation of wages is often put under the heading of *factor price theory*, while the explanation of interest is always assumed to be part of *interest theory*. But the question whether these two problems can be studied separately at all is often not really raised in contemporary discussions on the problem of interest (cf. Valk, 1928). Another question is whether there is a categorical difference between profits (in the sense of a return to equity capital) and interest (in the sense of a return to debt capital). A further question is a slight variation on this: Is there a categorical difference between a capitalist as the mere owner of capital goods receiving an interest-income and an entrepreneur that is the residual claimant of a risky business? A fourth question has to do with the fact that Bohm-Bawerk in his *Positive Theory* first explains the *existence* of interest in the part of that book that has been referred to as the *Agio Theory*, while he explains the *height* of interest in the part of that book that has been referred to as the *neo wage fund theory*. But are the forces that explain the *existence* of interest really different forces than those explaining the *height* of interest?

## **5. The General Contribution of this Dissertation**

### **5.1 A Further Developed Theory and Model of the Real-Side**

The first general contribution, or ‘product’, of this dissertation lies in its development of a theory and model of the real-side of the economy, developed in the first part of this dissertation<sup>13</sup>. In order to identify the benefits, or use-value, of this contribution we should first give a general summary of the main product itself.

Behind the attempt to study the real-side lies an assumption that there exists an organisation of production that can be described and modelled. We study the technical-physical constraints of the economy by visiting and theorising on various aspects of production – such as most importantly: *productivity, plans, capacity, subsistence, reproduction, chronology, structure of industries, natural resources and capacity utilization*. Out of this study arises a model of the organization of production which connects, as far as possible, the various aspects of production. A key feature of this model is that it disaggregates the aggregate ‘resources’. The model distinguishes three types of fixed capital goods, labour, raw materials and natural resources. The model shows interdependencies between consumption goods industries,

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<sup>13</sup> By a theory of the real-side of the economy I mean a production theory on Böhm-Bawerkian lines.

machine producing industries and a primary sector producing raw materials. It also incorporates two *strategic bottlenecks* in the organization of production with which a peculiar intertemporal trade-off can be associated. Furthermore, the model is capable of being used in a *period analysis* in order to help us understand how the organisation of production morphs with the lapse of time. The model can be seen as graphical summary of the main elements of production theory.

The main value of this product of our research is that we have in our hands a richer theory (and theoretical model) of the real-side than has hitherto been provided. With a more extensive theory of production, we are able to understand the technical-physical constraints on economic development (including business cycles) much better than with the Böhm-Bawerk/Hayek stages-of-production concept. Instead of one variable – the variable in how far the aggregate of resources is distributed between provision for the near future and the most distant future – we now are thinking in terms of a multiple of interdependent variables. How the relatively versatile resources are allocated in each period determines how and where the system is moving. For example, if capacity utilization is increased in the consumption goods industries, less versatile resources such as workers and raw materials (real working capital) are left to use as inputs for the machine producing industries and the primary sector. If the versatile machinery of the machine producers is used more to produce further versatile machinery for the machine producers, less machines can be built for the consumption goods industries. If the exploration and development of new mines is neglected because resources must be freed up to exploit existing mines as much as possible, less unexploited mines will be available in the coming periods.

We need also to point out the relation of this contribution to a central part of Austrian business cycle theory, which is the concept of “unsustainable growth” (Garrison, 2000, *passim*) or “unsustainable economic expansion” (Huerta de Soto, [1998] 2020, 361-362). According to this theory, unsustainable growth is commenced when entrepreneurs are led, by ‘easy money’ and artificially low interest rates, to start more ‘roundabout’ (i.e. longer) production plans, which should ultimately lead towards a more capital-intensive or mechanised organisation of production. However, the signals propagated by the easy money and the artificially low interest are misleading, since the means to bring the organization of production to a higher level of mechanisation will turn out to be unavailable. Eventually the entrepreneurs indeed find out that the means are lacking, and many need to abandon their plans. If

the structure of production is compared to the building process of a very big factory<sup>14</sup>, it turns out that this factory cannot be finished and put into operation. The construction efforts were thus unsustainable.

The theory and model of the real-side of the economy cannot strengthen or weaken this thesis about this type of unsustainable growth, brought about through a *misguiding* monetary policy. It is questionable whether models of the real structure of production can help with this, because this seems primarily a matter of *market signalling* rather than the structuring of production<sup>15</sup>. But our theory can elucidate quite a bit about another type of unsustainability, called *overconsumption*. The most likely type of overconsumption in the relatively short-term is a depletion of stocks and deposits of raw materials<sup>16</sup>. The theory and model of the real-side of the economy can point to policies which can exhaust stocks and mines to such an extent that the *depletion pace* cannot be sustained because there is relatively too little investment in replenishment. With the exception of Lachmann & Snapper (1938), adherents of the Austrian business cycle theory have scarcely looked into this matter, in which we believe to make some important steps.

## **5.2 Implications of Technical-Physical Constraints on Distribution and Investment**

A second main contribution, which can be found in the second part of this dissertation, lies in studying some important implications of technical constraints for social interaction. The first topic of this part is the problem of distribution, i.e. the problem how the incomes called wages and profits can be explained. In order to do so we revisit the Wage Fund Doctrine and a branch of Bohm-Bawerkian economics that developed a Neo-Wage Fund Theory out of the older one.

The contribution here is not a renewed Neo-Wage Fund Theory, as we will mainly follow the theory of distribution set out by Van Dorp in her *A Simple Theory of Capital* (1937). However, we provide some elucidation on the role of the Wage Fund Doctrine in Bohm-Bawerk's capital theory, especially that the phrase intermediate products is better understood as *transitory items* with respect to the question of distribution, that is, as goods the buying and selling of which does not affect the distribution of income between capitalists and workers precisely because they are only traded among capitalists

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<sup>14</sup> The construction of a new factor is metaphorical. This is precisely a problem, because the ABCT predicts something to happen, but we cannot see it.

<sup>15</sup> Market signalling, market coordination and the use of knowledge in society are very Hayekian themes, but they lie outside the scope of this dissertation.

<sup>16</sup> Overconsumption of plant and equipment, which is often meant by 'capital consumption', is of course also a possibility.

(Schumpeter, 1935, 50). Furthermore, we argue here that Böhm-Bawerk distinguishes, in effect, between factors of production and sources of income, a distinction that is foreign to neoclassical- or mainstream economics.

Our main contribution is the discussion of the theory of saving and investment, about which we firstly argue that it must be built on the conclusions of production theory on the one hand and the conclusion of the theory of distribution on the other hand. This lands us into the issue on the definition of saving: To one group of economists, especially those that think from a perspective of Crusoe Economics, saving is abstinence, or non-consumption. Another group, that thinks more in terms of the social side that is of significance in the problem of the distribution between labour and capital, sees saving as the relinquishment of consumption goods by one group (capitalists) to another (workers). We show that, on closer look, there are no contradictions, but that we can stretch the conclusions from both into an understanding of the *saving and investment mechanism*.

From the perspective of the Wage Fund Doctrine, we argue that if wages are advances from entrepreneurs to workers, then the revenues and profits of higher-order entrepreneurs must be advances by lower-order entrepreneurs. From the perspective of production theory (or Crusoe Economics) we stress the importance of plain saving (non-consumption) since plain-saving can be expected to cause the profit-rates of lower-order entrepreneurs go down vis-a-vis the profits of the higher-order entrepreneurs, whereby factor of production will be drawn away from the lower orders towards the higher orders.

The value of this contribution is that we are better able to describe in relatively simple terms how the saving and investment mechanism works, with which Keynesian concepts such as the 'Paradox of Thrift' can be disproved. Furthermore, a study comparing the influence of fiduciary credit expansion with a neutral money policy needs a robust concept of the saving and investment mechanism. We present the working of this saving and investment mechanism against the background of the more realistic model of the structure of production that we have concluded with in the first part of the dissertation. Saving and investment is portrayed against the simple but realistic background of a consumption goods industries and a machine producing industries. Therefore, we are not burdened with using the Hayekian triangle, the drawback of which is that it confuses the time-to-build with the degree of automation or degree of mechanization (which is the result of the time-to-built). Furthermore, the saving and investment process is described mostly in real terms. This makes the exposition much simpler than the cumbersome numerical examples of nominal values that often

accompany expositions of the theory of saving and investment by help of the Hayekian triangle (e.g Huerta de Soto [1998] 2000).

### 5.3 The 1930's Capital Debates in the German Periodicals

To conclude this section, we should note that the most important 'joint-product' of our research is that we have elucidated a number of very important aspects of the so-called '1930 capital debates' in the German periodicals. Various economists of that era, that published in the German periodicals on Böhm-Bawerkian capital theory, such as F.A. Burchardt, A. von Gadolin, W. Eucken and E.C. van Dorp, have been neglected in the Anglophonic economic literature of after the second world war. No article in any periodical on the history of economic thought, or any monograph, seems to exist on the German side of these 'capital debates'.

### 5.4 The Order of Economic Theory

Böhm-Bawerk warns his reader, on the very first page of his introduction to the *Positive Theory*, that the word 'capital' means different things in the respective contexts of production theory and distribution theory. 'Capital' means a tool or 'instrument of production' in production theory, while it means the capitalists' 'source of income' in distribution theory. The order in which Böhm-Bawerk theorises is that he treats production first (with at its core his *theory of roundabout production*). The second step is value- and price theory. The third step is that he expounds the so-called *Agio theory* according to which present goods are more valuable than future goods (which contains his 'three grounds'). The fourth and last step is a theory of distribution and growth. Because in this last part Böhm-Bawerk uses classical concepts such as advances and wage fund, this part has been called the *neo-wage fund theory*. In Bohm-Bawerk's complete capital theory there is not a part that is called capital theory. With Böhm-Bawerk's 'capital theory' is a collective noun for various theories that deal in one way or another with 'capital'. Production theory and distribution theory are the most important ones in this respect, as these are the first theories he mentions in his *Positive Theory*.

My main thesis is that there is an *order* to economic theory: Production theory is more fundamental than distribution theory, production theory and distribution theory are prior to a theory of saving and investment. Only if these steps have been properly made can we leap into business cycle theory. Production theory revolves around tools and machinery. What obstructs us in getting more machinery? What are the technical-physical constraints? In distribution theory the question is why *Private Capital* (means of subsistence, raw materials and machines; or working capital and fixed capital) is a *source of interest*. Why is investment a source of income?



## 6. Literature

### 6.1 Hayek's 'Theory of the Ricardo effect'.

Regarding the literature that forms the theoretical starting points of this dissertation, we can name the title-essay of Hayek's *Profits, Interest and Investment: and other Essays on the Theory of Industrial Fluctuations* (1939). The core of this essay is also known as Hayek's "theory of the Ricardo Effect" (Wilson, 1940; Ruys, 2017), which he elaborated in further writings. Hayek touches upon many things in this essay that are very important for developing a theory of the real-side of the economy. Most importantly capacity; capacity utilisation; more or less 'labour-saving' capacity; replacement of machinery; the role of raw materials; linearity and circularity in the structure of production; scarcity of real capital and scarcity of consumers' goods. We will summarize this original theory in what follows:

In *Profits, Interest and Investment* (1931) Hayek postulates that "half-way through a cyclical upswing" (1) the prices of consumption goods will rise, and that partly because of this price-rise, (2) real wages tend to fall during the latter half of the upswing. At the same time, credit is 'elastic' in the sense that (3) the banks continue to expand the money supply by providing entrepreneurs with financial capital.

These three occurrences then give rise to two or three further effects which Hayek calls the "Ricardo effect". This effect relates mainly to the factor of production called *fixed capital*, which is also called *machinery*, and also *capacity*. The phrase "Ricardo effect" was meant to convey a tendency for entrepreneurs to act in a certain way during the upswing. This tendency is that entrepreneurs attempt to reap near future profits, by increasing capacity utilization in the near future, at the expense of reaping distant future profits which could have been feasible by maintaining or increasing the production capacity in the distant future.

This behaviour, to which the Ricardo effect refers, should be manifested according to Hayek by two visible effects: *First*, entrepreneurs will increase capacity utilization, by hiring their workers to be "working over-time and double shifts" as Hayek writes. *Second*, entrepreneurs will order less replacement machinery, or at least less labour-saving replacement machinery. The first type of action implies an increase in operating expenditure<sup>17</sup>; the second type of action implies a decrease in capital expenditure. The first visible effect implies a greater use of the factor of production called labour. The

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<sup>17</sup> Which was then called 'investment in fixed capital'

second visible effect the Ricardo effect implies a declining demand for machinery during the upswing, a lessened use of ‘capital’ (in the sense of machinery). This is way Hayek also words the Ricardo effect as a “substitution of machinery for labour”. By this Ricardo effect alone, Hayek seems to attempt to explain the eventual slump in the machine producing industries that sets in after a crisis.

Apart from the rising prices for consumption goods, the falling real wages and the expanding supply of credit, Hayek then brings in another occurrence of the upswing which will have consequences. Hayek simply states that “[t]he undoubted fact [...] is that during the upswing of the cycle raw material prices rise more than the prices of consumers’ goods”. Hayek does not explain why this stylized fact occurs, but in any case he points out that *when* raw material prices rise faster than the prices of consumption goods, the lower output of machinery caused by the Ricardo effect is reinforced because rising raw materials prices make machinery more expensive.

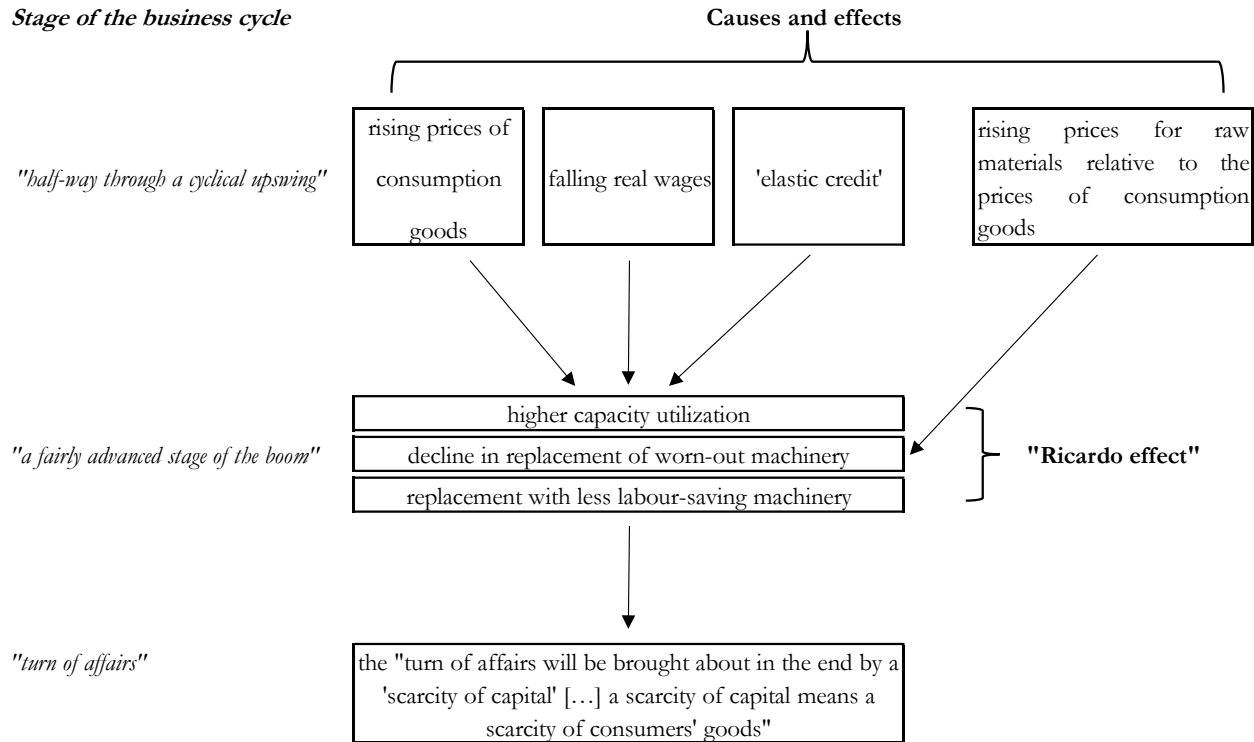
Hayek then hesitantly concludes when he writes that “[o]ur main conclusion reached so far is perhaps that the turn of affairs will be brought about in the end by a ‘scarcity of capital’ independently of whether the money rate of interest rises or not”. This part of Hayek’s theory of the Ricardo effect is rather unclear and forces one to make a small conjecture on what Hayek means<sup>18</sup>. He writes first about “the tendency to change to less durable and expensive types of machinery dominant over the tendency to provide capacity for a larger output” and directly after that he argues that “a scarcity of capital means a scarcity of consumers’ goods” (33). Likely he is trying to convey that a decline in the demand for replacement machinery eventually implies a loss of production capacity in the consumer goods industries, which in turn implies that the output of consumption goods at some point must decline<sup>19</sup>.

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<sup>18</sup> A rather similar explanation of the upper turning point one can find in a monologue Hayek wrote in the 1930’s, but which was only published in his collected works more than half a century later (*Business Cycles Part II*, p.131)

<sup>19</sup> This part of Hayek’s explanation of the upper turning point ignores the ‘stylized fact’ that the activity of the capital goods industry usually lags after what is often considered as the peak of the business cycle. For example, Zarnowitz writes: “Investment realizations -construction put in place, deliveries and installations of equipment-keep increasing long after the decline in these investment commitments as work continues on the backlog of orders accumulated during the busiest stages of expansion. (1992, 26). Also, Mises, Hayek’s close associate in business cycle theory, wrote: “It is a very well known fact that the more the boom progresses, the harder it becomes to buy machines and other equipment. The plants producing these things are overloaded with orders. Their customers must wait a long time until the machines ordered are delivered (1949, 583).

To provide a higher degree of clarity, we can put the cause-and-effect relations that Hayek argues to be present in the cyclical upswing in the following schema:



Hayek's emphasis on explaining why a more or less drastic decline in the demand for capital goods would occur towards the end of the upswing has much to do with a stylized fact of business cycles that he had earlier pointed out to be a major problem for business cycle theory to solve. In his *Monetary Theory and the Trade Cycle* he had already written:

“The real problem is the growth of excessive fluctuations in the capital goods industries out of the inevitable and irregular fluctuations of the rest of the economic system, and the disproportional development, arising from these, of the two main branches of production” (1933, 60)

With this in mind, what Hayek writes in a section of *Profits, Interest and Investment* on the “structure of capitalistic production” is of particular importance (20-24). Hayek here makes a further distinction, besides the distinction between consumer goods industries and capital goods industries. He distinguishes the capital goods industries themselves between a first group belonging to the “the ‘later’

stages” and a second group “[capital goods] industries belonging to the ‘earlier’ stages”. The later stages, or first group, are closer to the consumption goods industries. The earlier stages, or second group, are more distant from the consumption goods industries. About this second group he writes that “the position of the industries in the second group, which specialise in the production of very labour-saving or particularly durable equipment, etc., will be more and more adversely affected [by the Ricardo effect]”. In other words, Hayek is thinking of a subdivision of the capital goods industries in producers of less-labour saving machinery and producers of more labour-saving machinery<sup>20</sup>.

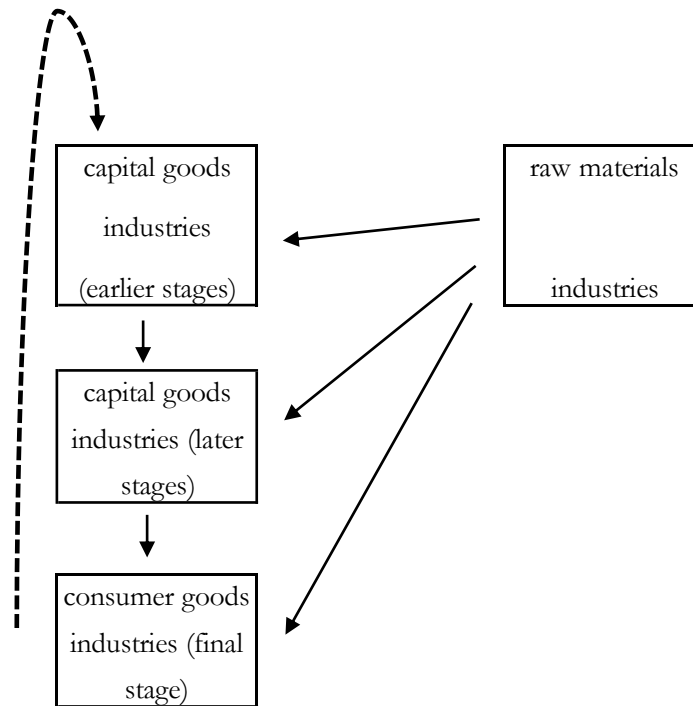
Also interesting is that Hayek admits that a drawback from his stages-of-production schema is that “it still gives an undue impression of linearity of these relationships while in fact they may in many respects be rather circular in character” (22-23). In other words, Hayek makes his reader aware that the output from a stage of production does not necessarily move from earlier to later stages, but can also be moved ‘back’ from later stages to earlier stages.

Obviously Hayek means the production of machinery (fixed capital) when he refers to the capital goods industries. So in this sense it should not be a total surprise when Hayek addresses, for sake of completeness, the production of raw materials (circulating capital) at a certain point in his *Profits, Interest and Investment* (p. 29). Hayek brings now to the forefront that both the consumer goods industries and capital goods industries require raw materials as inputs. And even though Hayek uses the phrase “raw materials industries” only once, he does enough with this to leave the impression that we can, with respect to thinking about the ‘structure of capitalistic production’, extend the dichotomy of consumer goods industries and capital goods industries, into a trichotomy of consumer goods industries, capital goods industries and raw materials industries.

We can put what Hayek wrote about the ‘structure of capitalistic production’ into a schema for our convenience:

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<sup>20</sup> If one follows the footnote to an article by German economist F.A. Burchardt, that Hayek provides in this section, one can see Burchardt arguing that the capital goods industries must produce its own machinery.



The ‘dotted’ line on the left indicates that output of various stages can be put back, so to speak, to earlier stages, which Hayek admitted to be possible but did not put in a scheme.

## 6.2 The Strong and Weak Points of Hayek’s Theory of the Ricardo effect.

Hayek belonged to a relatively wide school of business cycle theorists that believed that the *overconsumption* of resources is the (proximate) cause of economic crises<sup>21</sup>. Assuming this stance is correct, Hayek was justified in asserting that there must occur a type of behaviour on the part of entrepreneurs in bringing about the overconsumption of resources. Where do we find such *overconsumptionist entrepreneurial behaviour* and what causes it? Furthermore, Hayek argued that during the boom there exists “a tendency to use more labour with the existing machinery, by working over-time and double shifts”. This increased capacity utilization is certainly a stylized fact of business cycles. Increased capacity utilization also implies a faster consumption of raw materials. Hayek also argues

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<sup>21</sup> The business cycle theory of Mises and Hayek, today often called ‘Austrian business cycle theory’, was often called the monetary theory of the Trade Cycle by themselves. However, both Mises and Hayek believed that the ‘real’ elements (such as overconsumption) were just as important. See especially Hayek’s footnote on page 41 of his *Monetary Theory and the Trade Cycle*. Also, in one of the essays in *Profits, Interest and Investment*, Hayek writes: “scarcity of capital is simply relative over-consumption” and “the underconsumption theories are logically indefensible” (1939, 172).

that raw materials prices – an important component of costs – rises during the upswing. This seems to be a stylized fact as well. *Prima facie* there is ample reason to study if and how increased capacity utilization and overconsumption are connected. Hayek, however, did not really connect these elements in *Profits, Interest and Investment*.

Also, whether a Ricardo effect actually occurs or not, it is an interesting question to ask under what conditions will entrepreneurs tend to choose to not replace worn-out machinery; under what conditions they will purchase additional machinery of the usual efficiency; and when they will tend to switch to more labour-saving machinery.

Another strong point is that Hayek provides an interesting discussion of how to draw a model of the structure of production, and he speculates about a model with a simple trichotomy of production stages: (1) consumption goods industries; (2) producers of machinery; and (3) producers of raw materials. In his discussion he opens the door to revise his famous triangular model of the structure of production he drew in his *Prices and Production* (1935). But obviously his discussion of the structure of production in *Profits, Interest and Investment* (1939) remains speculative. It is not worked out into an actual improved model of the structure of production.

The weakest point of the original theory of the Ricardo effect is were Hayek could not convince his critics that entrepreneurs face a ‘one of both’ or ‘either-or’ *choice* between, on the one hand, capacity utilization and, on the other hand, capacity replacement and expansion. Hayek recognized this possible objection himself when he wrote: “To this it will no doubt be answered that there is no reason why the entrepreneurs should not do both: provide for the output in the near future by the quick but expensive methods and provide for the more distant future by ordering more machinery” (1942, 278). In other words, when demand for their products steadily rises such as happens in an upswing, manufacturers will hire more workers *and* purchase more machinery *if* financial capital could be obtained without limit. Hayek would therefore soften his standpoint, arguing: “If [...] in a situation where prices of consumers’ goods tend to rise [...] the limited capital resources of the individual firm will be spent in the way in which output can be most rapidly increased and the largest aggregate amount of profit earned on the given resources, i.e., in the form of working capital, and outlay on fixed capital will for the time being actually be reduced to make funds available for an increase of working capital.” (149, [1946] 2009).

But what type of entrepreneurs is Hayek thinking about? His thesis seems to be that the overconsumptionist behaviour (the ‘Ricardo effect’) occurs mainly with the entrepreneurs producing consumer goods, the typical ‘manufacturers’. But he hardly tries to answer the question whether a Ricardo effect would occur with producers of machinery and with producers of raw materials. The question really is whether the typical manufacturers, producing consumer goods, is fully representative of the entrepreneurs producing machinery or raw materials.

To summarize, Hayek discussed some interesting topics in his ‘theory of the Ricardo effect’: The production of machinery or ‘capacity’; capacity utilization; raw materials production and the structure of production. In the following sections we will discuss how these topics are addressed in the literature:

### **6.3 Productivity and Productive Capacity**

The first of the elementary aspects of Hayek’s business cycle theory is the (microeconomic) question under what circumstances entrepreneurs will invest in more labour-saving machinery and when not, and the closely related (macroeconomic) matter of the preconditions and consequences of switching to less or more labour-saving machinery. This topic of *productivity* was a fundamental part in the so-called *capital theory* of an earlier Austrian economist from whom Hayek drew much inspiration: Eugen von Böhm-Bawerk (1851-1914)<sup>22</sup>. Böhm-Bawerk’s ‘theory of roundabout production’ dealt precisely with the preconditions and consequences of switching to less or more labour-saving machinery,

But before we discuss Böhm-Bawerk any further it should be noted that there does not appear to be a separate field or niche in economics dealing with the matter of the preconditions and consequences of switching to less or more labour-saving machinery<sup>23</sup>. However, that does not mean that the topics of productivity or the creation of productive capacity are nowhere discussed. Adam Smith already argued that “[t]he intention of the fixed capital [machinery, plant & equipment] is to increase the

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<sup>22</sup> Böhm-Bawerk was the supervisor of Ludwig von Mises’ doctoral dissertation, and Mises’ business cycle theory built on some concepts from Böhm-Bawerk’s capital theory. Hayek based his own business cycle theory mainly on that of Mises, resulting in the sometimes used phrase ‘Mises-Hayek business cycle theory, although more often the phrase Austrian Business Cycle Theory is used.

<sup>23</sup> One piece of evidence for this is that there is only an entry for the measurement problem of productivity in *The New Palgrave Dictionary of Economics*, but none on productivity itself (Griliches, 2018, 10844-10849). The same goes for the closely related term of *efficiency*. Also the phrase productive capacity is used quite a number of times in the *New Palgrave*, but there is no separate entry for it.

productive powers of labour, or to enable the same number of labourers to perform a much greater quantity of work” ([1778] 1904, 270). In other words, machinery is labour-saving by definition, it makes labour more productive. The rationale for installing more modern – more labour-saving, more productive – plant and equipment is thus known. But Smith did not explore the topic of fixed capital much further. Ricardo included a chapter entitled ‘On Machinery’ in his *Principles of Political Economy* (1817), but he did not discuss the capacity constraints of producing new machinery. His point of view was that of an entrepreneur (farmer) that purchases a machine and the consequences for this with respect to wages, profits, etcetera.

Perhaps the best-known attempt in dealing with the problem of creating productive capacity is probably Eugen von Böhm-Bawerk’s *theory of roundabout production*. That theory was in retrospect pioneering and therefore rather crude, but it is probably the first systematic attempt in economics to deal with the problem of *creating* productive capacity. Böhm-Bawerk starts with the simple but very fundamental question that Adam Smith also asked: Why do men make and use tools? Why do entrepreneurs invest in tools and machines? Of course, tools and machines are more productive than not using tools and machines. So why do men not use more and more efficient and effective machinery for production? The major constraint that Böhm-Bawerk sees is that it takes time to build tools, what he calls the *production roundabouts*.

In modern economics, there is a small field<sup>24</sup> called *industrial economics*, from which one would expect that it would give attention to the economics of machinery, of factories, of plant & equipment. But this field is very little occupied with the questions of the why and how of the realization of capacity. Hardly any discussion on capacity constraints, delivery lead times (sometimes called ‘time-to-build’ in macroeconomics), or industrial bottlenecks can actually be discovered in the field of industrial economics<sup>25</sup>.

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<sup>24</sup> By a ‘small field’ I mean that certainly not a majority of universities will offer courses in this particular field or have economists on their staff that are specialists in this field. Also, the number of journals dealing with this field is very small. For example, the number of journals with industrial economics as a main topic is very small compared to journals dealing with major fields such as microeconomics or macroeconomics.

<sup>25</sup> See for example, Furguson & Furguson, *Industrial Economics: Issues and Perspectives* (1998); Cable (ed.) *Current Issues in Industrial Economics* (1994); The *Journal of Industrial Economics* states that it “covers all areas of industrial economics including: · organization of industry and applied oligopoly theory · product differentiation and technical change · theory of the firm and internal organization · regulation, monopoly, merger and technology policy”.



There is a major field within macroeconomics known as *growth theory* which sometimes touches on the topic of productive capacity, but never really to dig deep into it. Growth theory mostly deals with the topic of the generation of national income. This national income is treated as the dependent variable of various independent variables. In the textbook aggregate production function, these independent variables are labour, capital and technology (or ‘multi-factor productivity’). Often the phrase ‘capital’ or ‘capital stock’ is equated with the term ‘productive capacity’.

However, if one scrutinizes the growth theory literature, one can see that two related concepts are often conflated. On the one hand the term ‘capital’ is used to refer to the book-value of fixed assets, principally the particular fixed assets that would be accounted for as *plant & equipment*. In this strain, the term ‘investment’ is meant to signify the spending on new fixed assets net of depreciation. In other words, it is used to signify what is often called *capital expenditure*. But the words ‘capital’ and ‘investment’ are also used to refer to additions to the plant & equipment themselves, that is, to the productive capacity that these tools and machines represent. The book-value of a machine and the machine itself have much to do with each other, but they are not the same thing.

Domar realized this when he wrote:

“What we want is investment which could be functionally related to an increase in productive capacity; what we get from statistics are capital expenditures as defined by the Bureau of Internal Revenue, with a few corrections. The two need not coincide, and there are many other outlays—on research, for instance—that are not classified as investment but which increase capacity. So do some government expenditures.” (1957, 26)

Despite this recognition that the nominal aspect (investment measured in money spending on newly produced fixed assets) is not the same thing as the real aspect (the productive capacity itself), modern growth literature by and large sticks to studying and theorizing on the nominal data. Precisely for this reason it seems wise to engage the topic of productivity and productive capacity by revisiting Böhm-Bawerk’s theory of roundabout production.

## 6.4 Capacity Utilization

The second elementary aspect of Hayek's business cycle theory is the topic of capacity utilization. A generally observed fact about cyclical upswings is indeed that, as Hayek wrote, factory workers are "working over-time and double shifts" (1939, 14). This implies that machinery (i.e. productive capacity) is utilized longer per day than usual. Fortunately there does exist a small field of economics on the *theory of capital utilisation*, although this field seems to be a niche within microeconomics<sup>26</sup>. The existing theory of capital utilization looks at the problem of capacity utilization<sup>27</sup> predominately from the perspective of a representative firm. "Why is it a common occurrence for the capital stock of factories to be utilized much less than twenty-four hours a day?" is the questions that Professors Betancourt & Clague seems to have put at the beginning of the theory of capacity utilization (1975). One answer given is that the entrepreneur that owns a factory cannot find night-workers at wages which would make it profitable to operate the factory at night. In other words, capacity utilization is discussed from the perspective of the entrepreneur. Other economic considerations, from the point of view of the entrepreneur, may come into play as well (Betancourt & Clague, 1981).

An interesting perspective on capacity utilization was given by *real options theory* which emerged out of economic research in the 1980's and 1990's (Pindyck, 1988; Dixit & Pindyck, 1994, xi). This strand of economic literature viewed overcapacity as a *real option*. Like a *financial option* (e.g. the right to buy a share at a set price at a given moment), a certain amount of overcapacity (i.e. excess capacity) will give the owner of that capacity, similar to the holder of a financial option, the possibility of exercising the option of utilizing that capacity if this actually becomes profitable. The real option perspective has certainly become a standard microeconomic explanation of the existence of overcapacity and capacity utilization<sup>28</sup>.

The problem with the existing literature on capacity utilization is that it concerned almost exclusively with the micro-economic viewpoint of a representative firm. The problem of capacity utilisation is approached from the model of a profit-maximising entrepreneur, an entrepreneur that is constrained

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<sup>26</sup> There is an article in the *New Palgrave* on capital utilisation (Betancourt, 2018, 1360).

<sup>27</sup> *Capital utilization* and *capacity utilization* seem to be used interchangeably. The former term seems to be preferred in economics, while the latter is more common in the field of supply chain management. Betancourt (2018, 1360) implies that capital utilization and capacity utilization mean different things.

<sup>28</sup> One of the big names in the field of *real options*, professor Robert Pindyck, is incidentally also a writer of a textbook on microeconomics.

by his limited resources (existing plant & equipment, budget); by the limited demand for his products which he sells, and by the fact that has to pay prices on factor markets. In other words, the study-object of capacity utilisation is studied in a model in which all constraints are ‘nominal’ or ‘monetary’.

Hayek – who is not necessarily known as a theorist of capacity utilization - addressed the problem of capacity utilization as well, but he took a far more macroeconomic look at the problem. His reasoning was that plant and equipment is never fully utilized since there is a lack of complementary factors of productions: Manpower and raw materials is simply relatively more scarce than plant and equipment, he argued in a lecture called “Technical Progress and Excess Capacity” ([1936] 1984, 163). However, Hayek’s writing on this topic of capacity utilization have hardly been used as springboard for a more systematic theory of capacity utilization.

Capital utilization (or capacity utilization) is treated in modern macroeconomics nowadays as the topic of the *output gap*, although it was originally called the *GNP gap* (Colm, 1963). The underlying idea is that the whole economy has some sort maximum productive capacity with an associated maximum GNP (gross national product) or maximum GDP. The *output gap* is the difference between actual GDP and the potential (maximum, desired) GDP. The difficulty with finding out what this gap is, has to do with the fact the whole economy is not exactly comparable to any given factory. The major problem with the topic of the output gap is that it was born out of national income accounting, and is very much treated and discussed from the monetary point-of-view taken in national income accounting. In other words, the output gap is estimated with the help of accounting techniques, but it would be much better to understand capacity utilization by first reasoning from the real side of the economy. There is also the so-called *Taylor rule*, which says that the central bank should lower interest rates when there is an output gap (when the whole economy is producing below capacity). But in order to judge such a rule, it is really necessary to first get a clear perception of capacity utilization in a macroeconomic sense.

## 6.5 The Theories of Inventory Investment and Inventory Cycles

The topics of *inventory cycles* and *inventory investment* form a niche in theoretical and empirical economics<sup>29</sup>. Inventory investment is a component of GDP. The fluctuations in inventory investment, which are

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<sup>29</sup> These topics are treated in subsequent articles in the *Palgrave Dictionary of Economics*.

correlated with, but more volatile than, fluctuations in GDP, is what is called the *inventory cycle* nowadays. “Investment in [...] inventories is procyclical”, we read in the entry on ‘Stylized Facts’ in *Business Cycles and Depressions: An Encyclopedia* (Dore, 1995, 663).

On the theoretical plain, we can distinguish two major groups of theses on inventory investment. The first one is the group of theories that explain inventory movements on the basis of the *doctrine of derived demand*. These theories assert a “principle of the magnification and acceleration of derived demand to the accumulation and liquidation of stocks” (Abramovitz, 1950, 20). It means that “manufacturers and merchants are both desirous and able to maintain inventories in constant ratio to their output or sales” Therefore, “[i]nventories would vary directly and proportionately with sales or output” (Abramovitz, *ibidem*). The second group of theories seems to have emerged once the key-words in debates on inventories became ‘expectations’ and ‘uncertainty’ (Meltzer, 1941; Arrow, Harris & Marschak, 1951). The consensus that grew out is that *production smoothing* is the main driver behind inventory investment. The underlying thought of production smoothing is that inventories are held by entrepreneurs as a *buffer* between sales and production so that the production volume does not have to be constantly adjusted to sales volume (Mills, 1957). The common element of both groups of theories is, however, that in essence they revolve around the microeconomic question of how businessmen should be expected to behave with regards to inventory decisions.

In the 1980’s Professor Alan Blinder, who wrote that “inventory investment must be the most underresearched aspect of macroeconomic activity”, brought the topic of inventory cycles back to the forefront (1986). Clearly the literature on inventory investment had then turned towards an econometric explanation of the inventory cycle, that is, of the stylised fact that inventory investment (in money-units or value-terms) is more volatile than GDP. Important to note in relation to the literature on inventory cycles is that only a small portion of econometric work in this field of inventory cycles and inventory investment is applied to inventories measured in *physical units*. a term such as ‘physical units’ does not even appear in modern literature on inventories such as *Inventories in National Economies A Cross-Country Analysis of Macroeconomic Data* (Chikán et.al. 2018). The major practical reason for this is likely that measuring and reasoning in physical units requires disaggregation: One cannot add apples to oranges, a ton of iron to a ton aluminium, or a barrel of oil to ton of rubber (Kahn, *ibidem*). But one can add the money-value of apples to oranges. Also, data on the financial side (inventory investment in terms of money) may be more readily available from national income statistics and corporate accounts than data on actual changes in the many kinds of different of stocks

of goods (Abramovitz, 1950, 30-32). However, it is recognised that the distinction between the money-value of inventories (and inventory investment) and their volumes in physical units is important: For example, Blinder & Maccini recognize that the data on nominal changes in inventories suggest that “the variance of production exceeds the variance of shipments or sales in virtually all cases” while it is also found “that production is less variable than sales in a few industries in which data on physical units are available” (1991, 296).

The fact that much of the econometrics on inventories revolve around the money-value of inventories and inventory investment should be concerning, for a number of reasons. A first reason is that the amount of money spent on inventory items does not correlate one-to-one with the amount of physical units acquired by that money-spending. The reason is, of course, that prices fluctuate. More spending during a year on certain inventory items does not necessarily indicate a greater inflow in terms of physical units. For the same reason a stock of raw materials that remains the same in physical units can fluctuate heavily in monetary-value (Lacey, 1944). A second reason is that the *valuation* of inventories is a basic problem in business accounting, and by extension, in national income accounting. Fassler & Shrestha (2003) attest that “[c]hanges in inventories pose one of the most difficult measurement problems in the compilation of national accounts and are usually among their weakest components”. They point to the many problems involved in the account at the firm level and at the aggregate level. For example, they point out that “[u]nder inflationary conditions, the prices implicit in the value of stock of inventories according to the LIFO method will be lower than those implicit in the FIFO and weighted-average cost methods” (ibidem)<sup>30</sup>. So even the data on inventory-value may be very unreliable. A third reason is that the value of finished inventories is given much higher weight under the value-add assumption: The raw materials from which final goods are made are often relatively small in value compared to the final goods themselves. There is a ‘value-add’ between raw materials from which a final product is made and the final product itself. For example, if the steel for a single car is valued in the accounts of an auto manufacturer at \$3.000, the produced car might be valued at \$6.000. When such a car is produced but remains in the inventory of finished cars, while the steel used for this car is not replaced in the raw materials inventory of the auto manufacturer, there

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<sup>30</sup> There are many similar comments to be found. For example, the *ECB Monthly Bulletin May 2012* notes that “[i]nventories are difficult to track and measure, and hard data on them are prone to revisions.” A report of the U.S. Department of Commerce notes: “Measurement of inventories and their changes has always been one of the most troublesome problems in economic statistics, partly because of difficulties in valuing any stock accumulated in different periods at different prices” (Foss et.al., 1981)

will be a \$3.000 net investment in inventory (-/- \$3.000 for raw materials, + \$6.000 for the car). The question, from the standpoint of Real Analysis, is precisely what happens in physical terms when the nominal aggregate called ‘inventory investment’ fluctuates. It is quite possible that if in the whole economy the stocks of raw materials are depleted, while final goods accumulate somewhat in inventories. But under such circumstances the statistic called ‘investment in inventories’ would be going upwards. The reason is that final goods are weighted heavier than raw materials.

In the contemporary literature on inventory fluctuations, the topic of inventory investment is also often treated as a thing that seems to be studied quite independently of either capacity utilization or mining. Even if the topic of inventories is placed in a wider context of the supply chain, the eyes of economists seem to be looking towards the *finish* of that supply chain, namely towards fluctuations in consumer’s demand<sup>31</sup>. From this demand-side the uncertainty of demand fluctuations emanates; because of these demand-fluctuations the entrepreneur’s expectations are deemed so important. However, reasonable as it is to look at consumer behaviour<sup>32</sup>, it is no less plausible to look at what is in between inventories in the supply chain – utilized capacity – and to look at the *start* of the supply chain – i.e. to mining.

## 6.6 Commodity Shortages and Commodity Cycles

After the literature on inventory investment we need to address a topic, and a related literature, which partly overlaps the literature on inventory investment. This is the topic of the occasional phenomena of *commodities booms* – which means a rise in prices for commodities – and *commodity shortages* – which imply a dearth of raw materials. We will emphasise the topic of commodity shortages, because in this topic inventories measured *in physical units* are of central importance, since the word *shortage* principally signifies a dearth of physical units of commodities rather than a fall in the money-value of inventories. However, there is still ample reason to discuss the literature of commodity booms and -shortages together, because they seem to be correlated. For example, one of the bigger commodity booms of the last decades – the commodity boom of 1973-1975, is also known as a period of great commodity

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<sup>31</sup> In a comment on a research paper, Abramovitz did lay a connection between capacity utilization and inventory investment. But his speculation concerns the behaviour of purchasing agents in the supply chain, he does not include causes from the side of mining (Blinder & Holtz-Eakin, 1986).

<sup>32</sup> In the field of supply chain management, the so-called *bullwhip effect* is a supply chain phenomenon which is caused by fluctuations in end-customer demand.

shortages (Cooper & Lawrence, 1975; Radetzki, 2006; Block, 1974; Rudel, 1980; Eckstein & Heien, 1978).

An important starting point for a discussion of the literature on commodity shortages in relation to cycles or ‘supercycles’ is Abramovitz’ *Inventories and Business Cycles* (1951). It is a standard work not only to the ‘standard’ inventory theory that emphasises the money-value of inventories, but it is precisely of interest here because Abramovitz did not only study the money-value of inventories, but he attempted also to uncover data on inventories in physical units. The great and interesting ‘stylized fact’ on inventories, which he uncovered in his statistical work, is that the *stocks* of the mining and agriculture sectors of the economy (*measured in physical units*) are usually at their peaks at the deepest points of recessions in business cycles, and at their lowest levels at the upper turning points of business cycles: “The peaks and troughs of the mining series are more easily matched with those of the business cycle on an inverted basis, and the conformity measures indicate inverted association”, writes Abramovitz (1951, 104). Hence there is a commodity stock cycle, which moves *inverted* with respect to the business cycle.

However, as we have indicated previously in this introduction, Real Analysis, both theoretical and empirical, is not widely practiced since the Keynesian revolution. After Abramovitz there does not seem to be a systematic research into inventories measured in physical units. Evidence for this relative absence of Real Analysis is given implicitly by a number of publications of late, publications that deal with the shortages of commodities that have accompanied the great rise of prices in primary commodities in the years 2020-2022. An example is the recent bulletin of the European Central Bank (*ECB Economic Bulletin Issue 2 / 2022*) which provided some Real Analysis on the shortages which it normally does not provide. The issue of the bulletin in question mentions “supply bottlenecks” no less than 27 times, and one can read terms such as “supply disruptions”, “supply-side constraints”, “severe supply shortages”, “shortages of commodities and critical raw materials” throughout it. According to survey-data which is presented, relating to the question concerning “*the level of inventory of materials purchased (in units, not money) this month compared with the situation one month ago*”, it appears that the stocks of inputs (capital goods, intermediate goods and motor vehicles) generally declined between the beginning of 2020 and halfway 2021. There is even a “heat-map” that illustrates the severest “supply chain pressures” based on information about suppliers’ delivery times, backlogs of work and the orders-to-inventories ratio (Attinasi et al., 2022; Andersson & Le Breton, 2022)

Besides this *descriptive analysis* of the real aspects (a type of descriptive analysis which did not appear in earlier issues of the ECB Economic Bulletin) also some explanation of the shortages and some forecasting about it appears:

“In an environment characterised by high demand and uncertainty about the supply of inputs, as a precaution manufacturing firms tend to hoard inventories of inputs and at times they inflate orders compared with their actual needs. This so-called bullwhip effect might have led to an amplification of the procyclicality of changes in inventories in the present environment.” (Andersson & Le Breton, 2022)

A bit further on it is speculated that “the additional expected stockbuilding could reflect precautionary motives”, but that so far there is no “strong evidence of a general change in firms’ inventory management strategies from just-in-time to just-in-case production” (Andersson & Le Breton, *ibidem*). The *bullwhip effect* that is mentioned had earlier been invoked by the head of research of the *Bank for International Settlements* as an explanation of the shortages (Shin, 2021), and several white papers and articles have invoked this bullwhip effect for the same purpose (Beauchamp & Beauchamp, 2023; Ovezmyradov, 2022).

The fact that a the theory of the *bullwhip-effect*, which has its origins in the field of *supply chain management* and which has been around for at least 25 years, has more or less suddenly found its way into economics, is noteworthy. It shows, in our opinion, that economists have difficulties to explain what is going on in the supply chains of the global economy and why. Economists feel a need to come up with an explanation which is lacking in its subfield of inventory investment. Like a distressed businessman that needs to borrow funds to keep his business running in the middle of an economic crisis, the economist borrows a concept from the field of supply chain management in order to explain some part of the shortages and supply chain problems. In a sense it is opportunistic to borrow the bullwhip-effect from the field of supply chain management<sup>33</sup> as an explanation for the global supply

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<sup>33</sup> The term ‘bullwhip effect’ does appear in *The Palgrave Dictionary of Economics*, however it only appears in the entry on “Supply Chains”, which was written, incidentally, by a Professor of Operations, not a Professor of Economics (Lariviere, 2018). Furthermore, none of the journals published by the *America Economic Association* has of this date ever published an article with the term ‘bullwhip effect’ in it. ‘Bullwhip effect’ is also an



chain disruptions and shortages for a very simple reason. The *bullwhip effect* is a phenomenon that occurs *when* the variability of orders becomes greatest once one moves up the supply chain. But teaching the possibility of bullwhip-effects is precisely done, in courses on supply chain management, in order to manage and mitigate it. In fact, *production smoothing* is a technique that should control the bullwhip effect. Precisely because the phenomenon of bullwhip effects has been taught for a few decades now in business schools<sup>34</sup>, as well as techniques to manage such effects, invoking the bullwhip-effect as an explanation of relatively sudden global supply chain problems is not immediately convincing.

Nonetheless it should be a welcome thing that economists look towards neighbouring fields of knowledge in order to gain some knowledge. The reason for this is that a field such as supply chain management is far less concerned with the financial aspects of the production and distribution of goods, and far more with real aspects such as delivery times, backlogs, inventorying physical units, production bottlenecks, etcetera. These considerations ‘under the veil of money’ have been, by and large, neglected by economists since the Keynesian Revolution.

## 6.7 Mining and the Primary Sector

As mentioned in the previous section on inventories, there is another field in economics which also deals with raw materials. This is the field often called *mining economics*, and sometimes also called *mineral economics* or *economic geology*<sup>35</sup>. Mining economics is, in contrast to the theory of inventory investment, not so much concerned with what happens throughout the supply chain, but as the name implies with the start of the supply chain, that is, the extraction of raw materials from the earth<sup>36</sup>. The first purpose

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unfamiliar term in macroeconomic textbooks and journals. In the literature of supply chain management one can find the term abundantly.

<sup>34</sup> A famous way of teaching supply chain dynamics, especially the bullwhip effect, is the so-called ‘Beer Distribution Game’.

<sup>35</sup> From the German *Wirtschaftsgeologie*.

<sup>36</sup> Associated with mining economics is the so-called *economics of exhaustible resources*, inaugurated by mathematician Harold Hotelling almost 100 years ago. But this assertion of exhaustible seems to be rather detached from reality. Hotelling wrote on the “world’s disappearing supplies of minerals, forests, and other exhaustible assets” which had “led to demands for regulation of their exploitation” (1931). However, 100 years on, the mining capacity for most minerals has increased and forests have certainly not disappeared. There have been plenty in the economic literature to regard the resources of the primary sector as reproducible rather than exhaustible (Bradley, 2007, 82).

of mineral economics is not to aid business cycle theory in particular or macroeconomics in general. Its first purpose is to explain the economics of mining, to explain “essential concepts of mineral exploration, mine valuation and mineral market analysis, and international mineral policies”, as Gocht *et.al.* state in *International Mineral Economics* (2012). But occasionally mineral economics will touch upon the wider economy, of which mining is after all just a part. Nevertheless, mineral economics isn’t very much integrated or connected with macroeconomics in general or the macroeconomic field of business cycle theory in particular. Economists that have specialized in this field of mineral economics have typically refrained from integrating their research into business cycle studies. Also, macroeconomic textbooks will also typically not discuss the topic of mining and raw materials in separate sections or chapters. Even the problem of the commodity price-cycle, and the closely associated problem of the backwardations in forward markets for commodities during upswings, are left out of the typical macroeconomic textbooks.

There are quite a number of fields in economics that focus on a given part of the economy, such as mining economics, financial economics, consumer economics, agricultural economics, transport economics, urban economics, etcetera. A typical standpoint of such fields is that the part of the economy that is the object of study – be it the mines, the banks, households, farms, etcetera – are always subject to the cyclical fluctuations brought about by the rest of the economy. In mining economics the standard viewpoint seems to be that mining activity and the prices of metals are largely driven by the rest of the economy, and that the cyclicity of the rest of the economy is the reason for the cycles in commodity prices and the cyclical nature of the mining industry.

However, there is much reason to believe that the mining industry is not so dependent on the cyclicity of the rest of the economy as is commonly suggested. The grade of ore worked or smelted is not an independent variable in the longer-run. This is because the lower (higher) the grade of ore worked, the less (more) mining resources – such as engineers, miners, machinery – can be utilized for putting into operation new mines. If little new mines are put into operation, because resources are used to increase extraction of existing mines, the effect will be that the average head grade decreases. This effect of the declining head grade will be that the operating cost of supplying a metal increases. *Hence a high price of a metal can, for the longer-run, entice away factors of production which would make its supply (and hence its price) decline.* The mining industry is not just a passive respondent to demand-fluctuations.

The way in which the mining industry supplies the rest of the economy is not just an effect, but also a cause of price-movements (Tilton, 2014).

Mining is also a topic that can and should be placed in a wider context of the exploitation of natural resources. Mining, fishing, farming and forestry have in common that they are about the exploitation of nature, which is the reason why many economists have classified these sectors of the economy as the *primary sector* (Fisher, 1939).

### 6.8 The Structure of Production

A wide-ranging issue that Hayek addresses in his business cycle theory is the modelling or schematization of the *structure of production*. The goal of that effort must have been to be better able to understand the effects of monetary policy on the ‘real economy’, i.e. on the production of actual goods. The topic of the structure of production can also be seen as the *binding element* in everything relating to production and the real economy, because the concept of the structure of production should, in principle, be the heuristic device in which one can combine elements such as productivity, the creation of productive capacity, capacity utilization, inventories, the supply chain and mining. The literature on the topic of the structure of production may therefore be of great help.

The concept of the structure of production itself can be seen as one part, the so-called *real side*, of the concept of a general economic model which also contains a *nominal side*. The topic of the structure of production also seems to have emerged out of the first schema or model of general (i.e. real and nominal) economic interrelations, the *tableau économique* of the Physiocratic School. In the vast secondary literature on the Physiocrats one can also find the alternative phrase for a scheme of economic interrelations that is often used: The *circular-flow*.

The best known schema’s of production from the 19<sup>th</sup> century are probably Marx’ development of the *tableau économique* (which is called the *departmental scheme*) and Böhm-Bawerk’s *scheme of concentric rings* of capital formation. In fact, Hayek’s triangular schema of the structure of production, which he displayed in his *Prices and Production* (1935), but about he had some reservations later on (1939, 20-24), is generally seen as an adaptation of Böhm-Bawerk scheme of concentric circles, also called the *Ringschema*. In the 1930’s some interesting developments and debates on the structure of production developed in the German economic literature. These developments are very little explored in the

history of economic thought. Burchardt (1931) criticized and discussed Böhm-Bawerk's ring-scheme, which Burchardt compared to Marx' departmental scheme. Interestingly however, Burchardt in fact proposed to combine the schemes of Böhm-Bawerk and Marx. Nurkse (1935) brought Burchardt's innovation into the English economic literature, but it has not been picked up by anybody. In Germany some discussions of the structure of production or the 'circular-flow' have continued after the 1930's, most notably Reichardt (1967) and Helmstädter (1965).

Delving into some history of economic thought about the schematization of the structure of production will be necessary since in modern (mainstream) economics we do not actually encounter many non-mathematical models of the structure of production, with real aspects. The main concern in modern economics is with studying and (mathematically) modelling the *nominal data* of the economy, such as GDP. The well known *production function*, which deals with explaining a nominal dependent variable (GDP) with the help of nominal independent variables (such as the aggregate book-value of capital equipment), is a case in point.

## **7. Method and Organization**

### **7.1 Method**

We will not answer each individual question all at once, but we will address each question partially. The main line of inquiry we will follow in this dissertation is a layered approach, we will adopt the *method of decreasing abstraction*. The general idea is that the problems we will be dealing with are relatively complex. The way we deal with this complexity, and thus with the problems, is to take out a number of complications in order to arrive at a less complex, more simple problem. After solving the simple problem we proceed to introduce complications which were initially left out.

We will first address the research questions by looking at the core of all constraints, the *physical constraints*, the constraints that mankind encounters when he engages nature. The next fundamental layer consists of the *social constraints*: Participants of a capitalist economy are constrained in the amount of cooperation they can expect from fellow participants. Entrepreneurs need to pay wages to workers, or pay prices to other entrepreneurs in order to obtain machinery and raw materials. We will first take a look at such social constraint from 'under the veil of money', that is, we will assume that all payment are made *in natura*, i.e. in kind, rather than in money. Only in the last chapter we will look at the social constraints in terms of money, we will look at how things work 'above the veil of money'.

The main division in this dissertation is between two parts. The first part is on production theory, the second part is on the theories of distribution, saving & investment and the business cycle. The reason why we adopt this approach is that we must find the economic laws of production that are valid for *any* kind of political-economic system, be it pure capitalism or pure communism, or valid for all kinds of economic phenomena<sup>37</sup>. Production must be treated prior to distribution because consumption goods must be produced before they can be distributed to their consumers, regardless of whether the mechanism of distribution is capitalistic or socialistic.

Within the two parts we will adopt a certain order in discussing the different topics and questions. In the first part, on production, we will deal first, from an economic perspective, with the general anthropological fact that mankind is a toolmaking and tool-using being. Tool-use is the most general characteristic of human productive efforts, it is one of the general things that outwardly distinguishes human action from animal behaviour. It is, at first sight, reasonable to inquire into that specific topic first when the general topic is production. We will first take a look at tool-making within the scope of a single production plan or production period, then we will inquire after tool-making from the perspective of a sequence of production periods. The reason hereof is that inquiring after a single production period is more limited and less complex in scope than dealing with multiple production periods.

We will subsequently inquire into two topics that follow from a first inquiry into the why and how of toolmaking and tool-using. The first of these two is the topic of the structure of production. The observation that mankind is toolmaking and tool-using already reveals a certain structure of production: Toolmaking comes first, then the use of the tool that is made. The second of these topics is capacity utilization, which deals with the question in how far, how intense, tools and machines are used.

In the second part we deal with aspects of the economy which are specific to a capitalist market economy, and are therefore less general issues than production itself. The first topic of the second part concerns the distribution of income between entrepreneurs and workers, which is a problem peculiar to the capitalist market economy. The same goes for the topic of saving and investment when saving and investment is regarded as a process of interaction between entrepreneurs and workers, and

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<sup>37</sup> Böhm-Bawerk emphasized this matter in *The Positive Theory of Capital* (1891, 11-117) and Lowe in *The Path of Economic Growth* (1976, 17).

between entrepreneurs themselves in different stages of the economy. Lastly, the business cycle is a problem which is specific to the capitalist economy. Of these three topics, the theory of distribution is the least complicated, or most basic problem. For the theory of saving and investment we need to build further on conclusions from the theory of distribution, because it deals with how distribution and economic growth can interact. Lastly, the problem of the business cycle is a most complicated problem that cannot be solved without a prior understanding of how the economy progresses with the lapse of time, which is why the theory of saving and investment is prior to the theory of the business cycle.

Second, since the business cycle occurs in a capitalist economy, which is based on private ownership of the means of production and on wage-labour<sup>38</sup>. Therefore we must attempt to understand the workings of profit as the driving force of the system, as it is the main incentive for investment and enterprise by capitalist-entrepreneurs. In the capitalist system, entrepreneurs face *social constraints* that encapsulate the physical constraints. Entrepreneurs must invoke the help of workers and of other entrepreneurs in order to obtain the labours services, materials and machinery with which to produce and obtain profits. *Under* the veil of money, such social constraints can only be lifted by paying for labour, materials and machinery with consumption goods. Lastly, the capitalist system is not only a system of private ownership of the means of production and one of wage-labour, it is also very much a *money-economy*. *Above* the veil of money, social constraints are lifted – by definition – through the payment of money. Resources such as labour, materials and machinery are begotten with money. In other words, above the veil of money, everything must be paid for and one has a limited amount of money. That is, there are *price-constraints* and *budget-constraints*.

The method of decreasing abstraction is a rather orthodox approach in economics. It is in fact used by those economists that first start with the imaginary construction (or thought-experiment) of Robinson Crusoe on his desolate island. Crusoe represents man and the island represents nature. This is a very simply situation to contemplate, although in a sense far removed from everyday reality. The

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<sup>38</sup> We can think of an economy, with private ownership of the means of production, in which only producing and exchanging households exists. Then there would be private ownership of the means of production, but no one would be employed outside of his household. The capitalist economy, however, characterizes itself not only by private ownership of the means of production, but also by the fact that many people produce outside of their households in the service of capitalist-entrepreneurs. See, for example, Robert Torrens, *An Essay on the Production of Wealth* (1821, 33) where he writes “In that early period of society which precedes the separation of the community into a class of capitalists and a class of labourers”.

next step along the line of decreasing abstraction is to introduce another actor (e.g. Friday) into the analysis of the Crusoe Economy. Thereby the pure production environment of Crusoe also gets an additional dimension, a dimension of exchange. Hence, the imaginary construction is brought a step closer to reality, because we assume that Crusoe and Friday can barter the products they both make. Further steps, to bring this imaginary construction even more close to reality, would be to introduce the possibility of wage-labour, and to introduce money as a medium of exchange.

Economists have also used two other ways of decreasing abstraction, which will be adopted to a limited extent in this dissertation. One of these ways of decreasing abstraction is to assume firstly a completely free market economy, in which no state intervention is present. The next step is to introduce interventions and to compare the results of such interventions to the pure free market economy. The only intervention we will consider in this dissertation is the protection, by the state or central bank, of fiduciary money-creation by banks. In reality there are countless types of interventions in many different economies in the world, but a discussion of them would increase the scope of this work by a too great degree.

The other way of decreasing abstraction, one can see adopted in economics, refers to time. Typically economists will start with the ‘static method’, meaning to abstract from the passage of time. The next step towards reality would be to take regard of the passage of time, often called the ‘dynamic method’. In this dissertation we will not use the static method, but there will be two different ways of taking regard of the passage of time. The first way is what we may call *plan analysis*. This means to limit the scope of the analysis from the start of a plan until the *plan-horizon*, i.e., the end of the plan. The other way is to transcend a single production plan, by adopting a field of view on an potentially indefinite sequence of periods (of unit-length) in which production take place. This second way is what has been called *period analysis*. Both perspectives help to obtain a view on what happens in both the ‘short-run’ and the ‘long-run’.

Besides following the principle of decreasing abstraction, we will delve into the relevant literature at each step of the way. Necessarily this dissertation will partly be a literature study, a comment on the history of economic thought, and an extension of previously developed theories.

## **7.2 Organization**

We will organize the dissertation along the following lines:

The first part of this dissertation concerns *the theory of production*. *Production* can be defined (I believe rather non-controversially) as a transformation of materials into a more desired form<sup>39</sup>. All actors in the world economy are constrained by the physical aspects of the earth, by the physical environment, in their attempts to transform their surroundings into a more desirable state. Those constraints must partly explain why people act as they do. A *theory of production* must provide a working understanding of the structure of production in which the physical constraints, and the way in which physical constraints are partly lifted, are explained. This theory of production will give partial answers to our research questions, although these parts will prove to address the core of the matter we are dealing with.

The first chapter - *The Theory of Productivity: Böhm-Bawerk's 'Theory of Roundabout Production' Revisited* - of the part dealing with production theory addresses the question of the *productivity* of tools or machines. *What constrains does mankind face to obtain more labour-saving machinery?* In a sense this question is broader than our first research question, but an answer to it will bring us a first major step closer to its answer. In order to arrive at completing this first step we will mainly revisit Böhm-Bawerk's *theory of roundabout production*. Böhm-Bawerk, after all, was a great pioneer of production theory. He started this theory by beginning with the general anthropological fact that mankind is a tool-making and tool-using creature. The scope of Böhm-Bawerk's theory of roundabout production is essentially that of a single *production plan* in which a set of inputs (labour, nature) is turned first into tools in an intermediate stage, and then into consumption goods in a final stage. Böhm-Bawerk also (implicitly) takes a plan-analytic perspective on the *lapse of time in this theory of roundabout production*.

The second chapter - *The Theory of Reproduction: Böhm-Bawerk's "Theory of the Formation of Capital"* - revisited deals with the topic of *productive consumption*, that is, the wear and tear, depletion and consumption of resources during production, while at the same time new products (machinery, raw materials and consumption goods) are produced. This the *theory of reproduction*. We will address this topic again from the perspective of mankind, inquiring after the very general conditions of reproduction, by which we will be able to give a partial answer to all four research questions. In order to form a working conception of reproduction we will again revisit a theory of Böhm-Bawerk as the initial step towards our answers. This theory is Böhm-Bawerk's 'theory of the formation of capital', which has also been called Böhm-Bawerk's "theory of reproduction processes" (Stavenhagen, 1969,

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<sup>39</sup> Econometrician Ragnar Frisch, for example, used such a definition in his *Theory of Production* (1965).



658). The central question of the theory of reproduction is the same with regards to all types of things that can be reproduced: *Under what conditions will a stock (the stock of capital goods, the stocks of raw materials and consumption goods; the population) remain stationary, will decline, or will grow?* The distinction of the theory of reproduction to the theory of productivity is that in the latter we consider a consumption good as an end in itself, it is a *final* good. However, apart from viewing the consumption of consumption goods as an end in itself, we can also see that consumption goods form the *means of subsistence* which enable people to carry on production. The scope of the theory of reproduction is that of an indefinite sequence of production plans or ‘economic periods’ (weeks, months, years) in which production takes place.

Chapter 3 - *The Schematic Representation of the ‘Structure of Production’ in Economic Thought* - concerns a history of economic thought with respect to modelling the structure of production: The reproduction of machinery, raw materials, consumption goods and the population are interconnected phenomena. Economists in the past have developed various models or schema’s of the structure of production. We will revisit these models in their chronological order of appearance, and revisit some aspects of the discussions and debates about their qualities and defects. *The question here is to derive a list of required qualities that a model of the structure of production should possess.* Again this will be an inquiry after general, macroeconomic conditions of production. However, this should also bring us closer to an answer to (especially) our third research question.

Chapter 4 - *The Theory of Capacity Utilisation* – addresses the question *what the pre-conditions and consequences are of capacity utilization in various sectors of the economy.* It is here where we will develop a *pie-chart model of the structure of production* in detail. In this chapter we will also discuss the topic of the depletion of raw materials in relation to (increased) capacity utilization. The end-result of the preceding chapters will be summed-up mainly by the presentation of a pie-chart model of the structure of production, in which three sectors and their interaction will be shown. The knowledge of the general pre-conditions and consequences of capacity utilization in various parts of the economy should bring us closer to an answer to (especially) our second research question, but also our fourth research question.

Human action is either constrained in a physical sense by the non-human elements that we simply call ‘nature’, and by the human elements, which we can call ‘human’ or ‘social’. In the second part of this dissertation - on *the theories of distribution - saving and investment and the -business cycle* - we will start to inquire

into this second type of constraints. We will study the interaction between members of the economy, and as such, attempt to arrive at full answers to our research questions. We will take note of the fact that certain key members of the economy, *entrepreneurs*, are not only constrained by the forces of nature, but also by the fact that they will have limited means at their disposal to obtain the cooperation of both workers and other entrepreneurs.

The first question in this part that we will attempt to answer, in chapter 5 - *Austrian Capital Theory reconsidered as a Neo-Wage Fund Doctrine* - is the question how entrepreneurs in general obtain the cooperation of workers in general, and how entrepreneurs in general are able to derive a profit (income) from their entrepreneurial activity? This question relate especially to the second of our research questions. The initial and superficial answer to the question how entrepreneurs obtain the cooperation of workers is, of course, that entrepreneurs pay wages (sums of money) to their workers. We know that underneath the 'veil of money' the money-wages are 'real incomes', i.e. streams of goods and services which sustain the workers in their livelihoods. But how do entrepreneurs generally obtain the funds to pay theory workers? Furthermore, how is it possible that the competition between entrepreneurs in hiring workers does not seem to result in a situation in which wage-costs are drive up to the point where wages equal revenues, and profits disappear? In order to do answer these questions we will revisit, in chapter 5, an old theory in economics, the *Wage Fund Doctrine*. This Wage Fund Doctrine is actually a theory of income formation 'under the veil of money', i.e. a *real theory of distribution*. The fundamental thesis of the Wage Fund Doctrine is namely that entrepreneurs *advance* consumption goods (means of subsistence) to labourers. In other words, the fundamental thesis is that entrepreneurs provide labourers with a real income *before* what those labourers produce (in the service of the entrepreneurs) results in a gross real income to the entrepreneur themselves. The prime example of this thesis is that the farmers must pay their landworkers some means of subsistence - while the landworkers are working on the farmer's land towards a *new* harvest - out of the proceeds of a *former* harvest. Chapter 5 will therefore discuss this Wage Fund Doctrine of classical economics mainly in light of its relatively modern development by Böhm-Bawerk, Taussig an Van Dorp.

In the chapter 6 - *A 'Real' Theory of Saving & Investment* - we will address a further part of the first research question by asking *what social constraints do entrepreneurs encounter in order to obtain more labour-saving machinery?* We want to explain the incentives to expanding the capacity to produce, given the

constraints that current productive capacity poses on the will to expand. The theory of saving and investment deals with the allocation of resources with respect to the near future and the distant future. The main thesis will be that, if wages are advances from entrepreneurs to workers, the revenues of entrepreneurs in earlier stages of production must be advances from entrepreneurs in the later stages of production. How does the market mechanism determine how much means of subsistence will be allocated towards workers in later stages of production, and how much to workers in earlier stages of production? In this chapter we will attempt to extend the advances-thesis of the Wage Fund Doctrine into the theory of saving and investment.

In the last chapter 7 – *Real Stylised Facts of the Business Cycle* – we will round off by elucidating the real aspects of the economy, especially of the business cycle, by using some of the tools of Real Analysis that we will have forged in the chapters before it. In order to apply Real Analysis we will provide a description of the typical patterns of business cycles – ‘stylised facts’ in both monetary- and real terms. In this last chapter, we will discuss how fiduciary credit expansion can incentivise the entrepreneurs in the machine production industries and the primary sector towards behaviour which gives rise to (what Hayek described as) the *Ricardo effect*. This effect implies a re-allocation of resources from providing for the more distant future towards providing for the nearer future, and we survey how this Ricardo effect may contribute to an eventual decline in output.

# **PART I: THE THEORY OF PRODUCTION**

# 1. The Theory of Productivity: Böhm-Bawerk's 'Theory of Roundabout Production' Revisited

## 1. Introduction

The tools and machinery that enterprises use form a *capacity* to produce. Tools and machinery are obviously productive, which seems to be the prime reason why enterprises should want to own tools and machinery. We can also observe that certain tools are more productive (more capable, more efficient) at certain tasks than other tools and machinery. For example, a loader is more labour-saving in moving sand than a spade. Hence our first research question: What circumstances constrain and induce entrepreneurs towards adopting more labour-saving machinery (more productive capacity)? Obviously enterprises need money (funds) in order to acquire machinery. Since any enterprise will have limited cash, there must be a *budget constraint* in acquiring machinery. However, when we stop looking at individual firms, but observe mankind in its entirety, the problem cannot be one of budget constraints. By looking at mankind as whole, we are able to peel off a layer of the aforementioned research question. We then arrive at what likely is the core of that problem: *What constrains does mankind face to obtain more labour-saving machinery?* The Austrian economist E. von Böhm-Bawerk provided a production theory, at the beginning of his *The Positive Theory of Capital* (1891), which deals with this question. This approach is rather original in economic literature, which in itself justifies a revisit of Böhm-Bawerk's production theory. Or, to be precise, the first of two parts in Böhm-Bawerk's production theory which is known as the *theory of roundabout production*.

Böhm-Bawerk's production theory deals with mankind as a toolmaking and tool-using creature (1891, 75-84). Tools are made and used in order to be better able to unleash the powers of nature in such ways that are desirable to man. In his production theory Böhm-Bawerk equates the term 'capital' with 'tool'. The central tenet of Böhm-Bawerk's 'theory of roundabout production' is a theorem that has become known as the 'law of roundabout production' (*Gesetze der Produktionsumwege*) – although there are some alternative names<sup>40</sup>. This 'law of roundabout production' asserts a trade-off between - on the

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<sup>40</sup> E.g. „das Gesetz von den Produktionsumwegen“ (Schumpeter, 1911, 20); “the law of the higher productivity of longer production roundabouts”; “theory of production roundabouts” (“Theorie der Produktionsumwege”) (Morgenstern, 1935); (das ‚Gesetz von der Mehrenergiezeitraubender Produktionsumwege‘)”, R. Gocht; (1939; 385-406); “the theorem that roundabout processes of production are more productive” (Hayek, 1941,

one hand - the length of the time to produce tools or ‘instruments of production’, and – on the other hand - the output that can be achieved with that tooling and machinery.

In this chapter we will pass through the stations essential in the theory of roundabout production. We will first deal with the definition of ‘roundabout production’ and the question what it has to do with productivity. After that we will deal with Böhm-Bawerk’s analysis of production, which is to divide production into ‘stages’. We will then deal with the law of roundabout production itself and the premises and assumption on which it is based, especially the notions of (1) *given technology* and (2) *plan analysis*. At certain points of the way we will certainly refer to some of the more interesting aspects of the secondary literature about the theory of roundabout production. After passing through this core of the theory of roundabout production we will deal also with a corollary to the ‘law of roundabout production’ (the corollary proposition that there are *diminishing returns to roundabout production*); and we will discuss Böhm-Bawerk’s concept of the ‘average period of production’, which can be seen as Böhm-Bawerk’s attempt to come to a more precise statement of his law of roundabout production.

## 2. Roundabout Production and Productivity

Böhm-Bawerk’s ‘theory of roundabout production’<sup>41</sup> makes a fundamental distinction between production of consumption goods by ‘direct methods’ and by ‘indirect methods’: *Direct methods* are methods with which humans do not use tools to get the consumption goods that they consume. Examples of ‘direct methods’ are picking berries and plucking other foods in nature (quite realistic), drinking water directly from a water-source (also quite possible); catching fish with bare hands (which for most people would be highly unsuccessful), etcetera. *Indirect methods* are methods of production in which first a tool is made before the actual production of the consumption good commences. Böhm-Bawerk regards this indirectness as going through a ‘detour’ or a ‘roundabout way’<sup>42</sup>, since one does

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77); ‘Boehm-Bawerk’s thesis about the higher productivity of ‘Roundabout Production’ (Lachmann, [1956] 1977, 73); ‘Böhm-Bawerks Law of Increased Productivity of Increased Roundaboutness’ (Weizsäcker, 1971, 36); ‘his theory on the law of the superiority of more roundabout methods of production’ (Faber, 1979, 10); ‘[t]he law of superiority of roundaboutness’ (Faber, 1980, 617); ‘Böhm-Bawerk’s principle of the “greater productivity of more roundabout production” (Weizsäcker & Krämer, 2021, 6).

<sup>41</sup> Book I, Chapter I of the *Positive Theory* (1891, Smart-translation) may be regarded as the introduction to the theory of production. Book I chapter II and Book II, chapter I can be seen at the ‘theory of roundabout production’.

<sup>42</sup> The German word *Ummweg* would usually be translated into English as ‘detour’. Böhm-Bawerk’s first translator, William Smart, apparently chose to use the word ‘roundabout’. Dutch economists use the cognate ‘omweg’ for the German *Ummweg* and in French the word ‘détour’ is used for Böhm-Bawerk’s *Ummweg*.

not go directly at the consumption good that one wants (as in plucking berries or attempting to catch fish with ones' bare hands). Hence with Böhm-Bawerk, production by indirect methods is the same as 'roundabout production'; and the 'roundabout' is essentially toolmaking.

Of course, 'direct methods' are by and large the exception in all economic systems. Why is this? Böhm-Bawerk argues that 'roundabout methods', i.e., methods using tools, are more *productive*, at least in the great majority of cases. Hence, at the bottom of Böhm-Bawerk's theory of roundabout production stands a very simple and straightforward explanation of the general anthropological fact that mankind is a tool-making and tool-using creature. Generally speaking, toolmaking and tool-using is simply more productive. Böhm-Bawerk's 'theory of roundabout production' is thus a *theory of productivity*; and the notion of *productivity* revolves around the making and usage of tools<sup>43</sup>.

Here we also have a justification for starting our treatment of the theory of production (in general) and the theory of productivity (in particular) with Böhm-Bawerk. Böhm-Bawerk essentially starts with what *is* a proper starting point: The very general anthropological phenomenon that mankind is a toolmaking and tool-using creature; and Böhm-Bawerk provides a very general and irrefutable explanation for this phenomenon – tool-making is generally productive. As such he provides a solid first step for a theory of production – even though it may only be a small step. However, if one looks at other treatises of 'production theory': e.g. Schneider's *Theorie der Produktion* (1934), Carlson's *A Study on the Pure Theory of Production* (1939) or Frisch's *Theory of Production* (1965), we see that the starting-point is the phenomenon of production *within a business firm* and all the things surrounding it: cost-prices (factor markets); selling-prices (product markets) and the availability of capital funds. Production within the firm is indeed a problem, but it is already quite a specific problem since it is a problem which is about much more than only production<sup>44</sup>.

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<sup>43</sup> Schaller, *La notion de productivité* (1975), offers a survey of the different notions in existence in the economic literature on the term 'productivity'.

<sup>44</sup> Carlsson's 'pure' theory of production is thus not a *pure* theory of production at all since it *mixes-in*, right from the start, facets of price theory and capital theory with the problems of the theory of production.

### 3. Staged Production

Böhm-Bawerk analyses the ‘capitalist’ (i.e. toolmaking, tool using) or ‘roundabout’ production process by dissecting it into stages. The principle division of the capitalist or ‘roundabout’ process is clearly between tool-making and tool-using:

“[...] when we speak of capitalist production taking time, it is not relevant to raise the objection that, with a piece of concrete capital *once made*<sup>[45]</sup>, say a tool, a definite product can be made more quickly than it could be without the assistance of capital; that, for instance, a tailor takes three days to sew a coat by hand, and one day to do it with a sewing-machine. For it is clear that the machine sewing forms only one part, and indeed the smaller part, of the capitalist process; the principal part falls to the making of the sewing-machine, and the total process lasts considerably longer than three days.”(1891, 84, italics in original)

Unsurprisingly, Böhm-Bawerk agrees with the distinction of Karl Rodbertus between - what is in English usually called - ‘indirect labour’ (*mittelbare Arbeit*) and ‘direct labor’ (*unmittelbare Arbeit*) ([1891] 1930, 87):

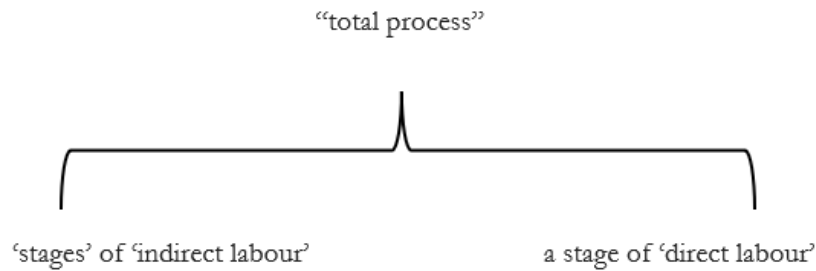
“It scarcely, perhaps, requires to be proved that the capitalist production of consumption goods, although carried out in roundabout ways and by many stages, does not, on that account, cease to exhibit an intimately connected and united work of production. The labour which produces the inter mediate products—the mediate labour, as we shall call it with Rodbertus —and the labour which, out of and with the intermediate products, produces the desired good—the immediate labour—both form a part of the production of the consumption good.” (ibidem, 87, footnote omitted)

Schematically we can exhibit Böhm-Bawerk’s principle dissection of the ‘roundabout’ production process as such:

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<sup>45</sup> Böhm-Bawerk clearly takes the point of view from *before* a tool is made.





It should be noted that Böhm-Bawerk is not always very neat in using this terminology. First of all, he switches between using the terms ‘roundabout ways’ and ‘stages’ (in the plural<sup>46</sup>) on the one hand to the terms ‘roundabout way’ (in the singular<sup>47</sup>) and ‘production period’. In other words, sometimes he treats indirect labour as containing multiple distinct ‘roundabout ways’ or ‘stages’. But sometimes he treats of indirect labour as a single thing, as if the indirect labour can be seen as *one* single ‘roundabout way’.

Böhm-Bawerk only refines this terminology by pointing out that in his conception the ‘indirect labour’ can consist of various stages. The complete production process of tool-making and tool-using is what Böhm-Bawerk calls the “total process”.

“Thus far we have considered capitalist production as an undivided whole, and have contrasted it with production carried on entirely without capital. But here we are reminded of a fact that has to be reckoned with, viz. that in capitalist production there are stages and degrees; to speak accurately, there are innumerable degrees of ‘Capitalism.’ In the making of a consumption good the possible roundabout methods are of very varying length. We may make intermediate products from which the final good will be obtained in a month, or a year, or ten years, or a hundred years. The

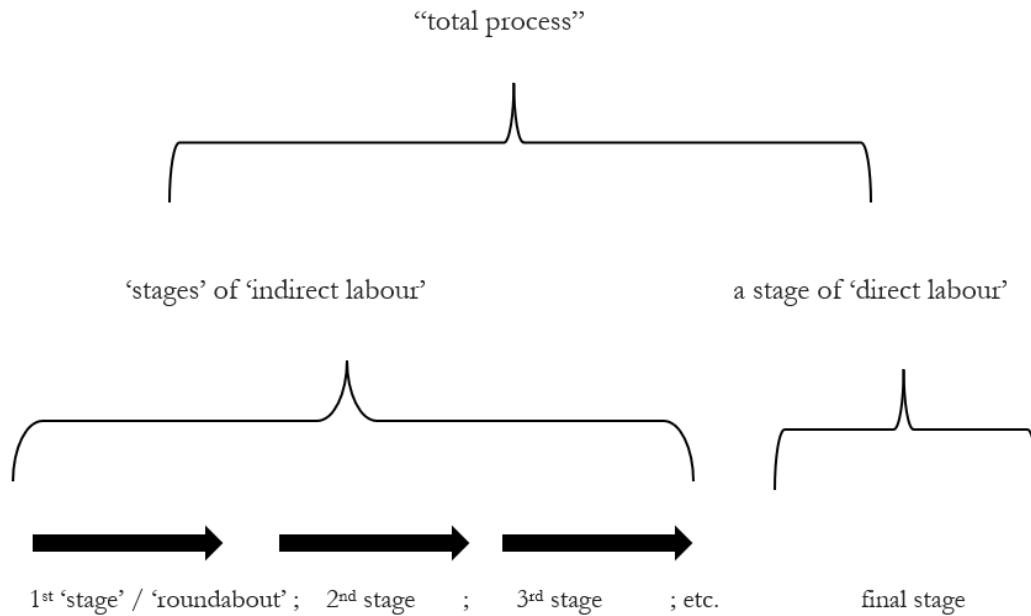
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<sup>46</sup> E.g. “die auf dem Umwegen der indirekten Produktionsmethoden entstehenden Zwischenprodukte“; „Die kapitalistischen Umwege sind ergiebig“ (Ger. 4th ed. P. 111); „den kapitalistischen Produktionsumwegen“ (112); and „dass die kapitalistische Produktion von Genuss gutern, auch wenn sie auf Umwegen und mehrerer Etappen vollzogen wird“ (116).

<sup>47</sup> “einem Klug gewählte kapitalistische Umwege“ (p.111); „mit Rohstoffgewinnung und Werkzeugsbau begonnene Umweg seine reife Genussfrucht liefert“ (112); „Ein laengere Umweg fuehrt dazu“ (114); „eine klug gewählte Verlaengerung des Produktionsweges“ (115) „absoluten Dauer des Produktionsweges“ (119)

question now is, what influence such differences of degree have on product.” ([1889] 1891, 84, his emphasis)

Schematically we can summarize it as such:



By the 1930’s economists also came to use the terms ‘construction period’ for ‘indirect labour’ and ‘utilisation period’ for ‘direct labour’, to distinguish between the making of capital goods and the mere utilisation of capital goods respectively (Machlup, 1935).

#### 4. The ‘Law of Roundabout Production’

From Böhm-Bawerk’s analysis of the ‘roundabout’ (i.e. tool-making and tool-using) production process, we can now go to the core of the matter: The ‘law of roundabout production’. The passage in Böhm-Bawerk’s *Positive Theory* in which we find the proposition that he would later refer to as his ‘law of roundabout production’ is probably the following:

“The adoption of capitalist methods of production is followed by two consequences, equally characteristic and significant. One is an advantage, the other a disadvantage. The advantage [...] consists in the greater technical productiveness of those methods. With an equal expenditure of primary productive powers (that is to say, labour and valuable natural

powers) more or better goods can be produced by a wisely chosen capitalist process than could be by direct unassisted production. [...] We found the explanation to be that, when roundabout methods are skilfully chosen, new allies are obtained from the immense stores of natural powers, and their activity is enlisted in the work of production. [...] The disadvantage connected with the capitalist method of production is its sacrifice of time. The roundabout ways of capital are fruitful but long; they procure us more or better consumption goods, but only at a later period of time.” ([1891] 1930, 82, footnote omitted)

During Böhm-Bawerk’s lifetime he got entangled in plenty of disputes about the validity of this proposition. This led Böhm-Bawerk to expand his two volume *Kapital und Kapitalzins* (of which *The Positive Theory of Capital* is the second volume) with a third volume. This third volume, the *Exkurse*, contains two essays in which Böhm-Bawerk defended this ‘law of roundabout production’. It would take many pages to review all these debates, but the dispute that Böhm-Bawerk had with his contemporaries on the law of roundabout production (most notably Otto Conrad, Karl Diehl and Emil Saxen) have been extensively reviewed by one of Böhm-Bawerk’s students, Frans Weiss<sup>48</sup>. He has drawn those things that Böhm-Bawerk wrote that contain the most concise defense of his law:

“The thesis put forward by Böhm-Bawerk of the increased productivity of production roundabouts states ‘that a wisely chosen approach or extension of time-consuming production roundabouts usually leads to a technical surplus, which is to obtain more or better products with the same expenditure of original productive forces’ ...” (1921, 494)<sup>49</sup>

Weiss explains that everything hinges on what Böhm-Bawerk means by ‘wisely chosen’:

“When Böhm says that longer production roundabouts generally make production more productive, he does not mean, as we have seen, of course, that every lengthening of the production path must result in greater productivity; rather, he restricts the

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<sup>48</sup> Weiss (also spelled as Weiß) was according to Suranyi-Unger “one of [Böhm-Bawerk’s] most zealous disciples” since Weiss has “has undertaken to defend the master’s teachings” ([1932] 2003, 118)

<sup>49</sup> Weiss quotes Böhm-Bawerk from *Positive Theorie*.

validity of his thesis to ‘wisely chosen’ production roundabouts. On the other hand, this restriction is by no means to be interpreted in such a way that it depends only on the wisdom of the choice and not on the length of the production roundabout, i.e. that with a wise choice, greater productivity can just as easily be achieved in a shorter way.

Rather, according to Böhm[-Bawerk], the facts are as follows: There is a whole series of production methods of the same duration for the production of every good; so several one-year-; several two-year-; etc. production methods. Of all the one-year methods, one will be objectively the most productive. [...] If, for certain reasons (the rate of interest), you see yourself being motivated to use a one-year production method, you will surely choose the best of the one-year methods. Likewise, of course, if one is required to take a two-year method, one will choose the most productive of the two-year methods; [...] In the same way, as already noted, there will always be one best of all three, four, and five-year methods. The thesis of increased productivity says that the best one-year-old is usually not as productive as the best two-year [method]; this again is not as productive as the best three-year [method] etc. If, however, the best is always selected in this way from all the methods of the same length, which Boehm calls a ‘preselection’, because it is initially only determined which production methods should be taken into account from the outset. Whether the best one-year-old, the best two-year-old, the best three-year-old etc. is to be considered, is only a matter of a second choice, the main choice.” (Ibidem, 528-529; cf. Hayek, [1927] 2015, 23)

It is not possible that the most productive two-year method is less productive than the most productive one-year method, since obviously the one-year-method could be performed within two years. Of course, a one-year-method could be performed twice in two years.

Hence, the ‘law of roundabout production’ is derived by reasoning through these steps:

1. There is a *preselection*: One always takes the most productive method possible in each possible time-span which can be chosen.

2. This has implications for the *main selection* which one faces: Namely the choice of what timespan one will actually take to build tools. Here now there is a trade-off: Out of the preselected production methods, the longer ones deliver its product later, but will be more productive in terms of output per manhour in the final stage of production. In other words, there is a trade-off between the ‘construction period’ or ‘time-to-build’ of a capital good on the hand, and on the other hand the efficiency, effectiveness, ‘degree of automation’ or ‘degree of mechanization’ that the tool will provide once it is build<sup>50</sup>, <sup>51</sup>.

## 5. The Law of Roundabout Production as a Trade-Off Between Time-to-Build and Productivity

What remains a bit obscure in Böhm-Bawerk’s exposition of his theory of roundabout production, is whether the ‘production period’ refers to the ‘total process’ of building and using a tool – the construction period *and* the utilization period; the indirect labour *and* the direct labour – or only to the ‘roundabout’ – the indirect labour; the construction period; the *time-to-build* a tool. There are reasons for each of the two interpretations<sup>52</sup>. However, if we interpret the ‘production period’ as referring to

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<sup>50</sup> The trade-off can be exemplified as follows: A water source is a mile away from ones’ cabin. One can construct a bucket. The bucket will take a day of *indirect labour* to make, and the bucket will provide a certain efficiency: One hour of *direct labour* is needed to bring a bucket of water to the cabin. Another technique is to build a water-pipeline from the source to the cabin. Depending on the availability of piping material this may take weeks to months of *indirect labour*. But once the pipe is installed, the amount of *direct labour* to bring the equivalent of a bucket of water to the cabin is practically reduced to zero.

<sup>51</sup> Böhm-Bawerk’s expressions such as a “wisely chosen capitalist process” (Böhm-Bawerk [1891] 1930, 82; [1921] 1959, 213n) means that “among the longer processes there are always some which are also better” of which the better are, of course, the wisest choices. Böhm-Bawerk makes clear that his theses about lengthening roundabout processes are limited to such wisely chosen sections and extension (1891, 22, 79, 82, 86; German edition; 1921, 2-10, 213). Put in more modern terms, the ‘wisest choice’ for a production process would be termed a *dominant technique* and could simply be defined as the production technique that, out of all known techniques, yields the highest output for a comparable amount of input. Some contemporary opponents of Böhm-Bawerk did not seem to understand that his theses were limited to dominant techniques and criticised him for it (ibid, 213). It seems that later writers on capital theory have adopted the wisest choice of technique as a leading principle. Hicks, for example, seems to have taken it as a matter of course that an entrepreneur that has a choice of “a certain number of alternative production plans that are technically possible” will (in statics) be “maximizing his surplus of receipts over costs” or (in dynamics) prefer the production plan “whose present capitalized value is greatest” (1946, 194-195). Robinson also reasoned from the principle that: “any technique which involves a greater cost than another for the same or a smaller rate of output is ruled out, for it is uneconomic” (1953, 91).

<sup>52</sup> For example, Blyth argued that “[t]he period of production was defined by Böhm-Bawerk, for the case of the construction of a machine, as the average of times elapsing between the date an input is made and the date the output-the machine-appears” (1956, footnote omitted, which refers to page 89 of the Smart-translation of Böhm-Bawerk’s *Positive Theory*). This is clearly an interpretation that the production period refers to only the ‘construction period’, not also to the ‘utilization period’.

only the ‘roundabout’ to produce a tool or machine, then it becomes fairly simple to define the law of roundabout production in a clear and concise way:

The longer the *construction period* – given the same amounts of inputs to build the tool and given that for each possible construction period only the optimal tool will be build – the more productive the tool or machine will be that is to be completed at the end of the construction period (and to be used in the *utilization period*)<sup>53</sup>.

## 6. ‘Given Technology’

The validity of the law of roundabout production hinges on the point of view that Böhm-Bawerk takes. He is not always very explicit about this point of view. However, in a debate with his most famous former doctoral student, Joseph Schumpeter, Böhm-Bawerk has explained that the “law of roundabout production” refers to the choosing of a production plan *at a single point in time* in which the amount of methods is given to the planner (Böhm-Bawerk, 1913a). Böhm-Bawerk points out that technology will certainly develop over a course of time, and he even argues that also at a moment in time a new technology may be conceived of<sup>54</sup>. But obviously Böhm-Bawerk makes use of the *ceteris paribus*-assumption in expounding his law of roundabout production. He assumes that, at the moment the subject chooses his production plan, all possible plans to be chosen from are given.

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<sup>53</sup> Weiss (1928) argued that there is a problem with the law of roundabout production, namely that it refers to an “equal expenditure of primary productive powers”. Weiss argued that if the production roundabout is *lengthened*, then *more* expenditure of primary productive powers (more expenditure of labour) is called for. This makes it impossible to state that a longer roundabout results in a greater ‘technical’- or ‘physical’ product from an equal amount of input, according to Weiss. Weiss’ solution was to reformulate the ‘law of roundabout production’ from a law of technical productivity towards a law of value-productivity. Eucken disagreed with Weiss on this point (1934, 79-81). His argument in favour of the original formulation of the law of roundabout production can best be explained with the help of a certain terminology on how the use of inputs can be measured. Such input can be measured in two dimensions: In its *breadth* and in its *depth* (Gadolin, 1939, 510). When Böhm-Bawerk refers to an “equal expenditure” he means the *breadth* of ordinary sources (e.g. 1 worker; 2 workers; 3 workers; etc.) rather than the *depth* for which the breadth of ordinary powers are employed (2 workers for a week; 2 workers for 2 weeks, 2 workers for 3 weeks, etc.). Obviously, the law of roundabout production refers to a situation in which the breadth remains the same, but the depth varies.

<sup>54</sup> Adam Smith provides an example of an invention made at an instant: “a boy was constantly employed to open and shut alternately the communication between the boiler and the cylinder, according as the piston either ascended or descended. One of those boys, who loved to play with his companions, observed that, by tying a string from the handle of the valve which opened this communication to another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to divert himself with his play-fellows. One of the greatest improvements that has been made upon this machine, since it was first invented, was in this manner the discovery of a boy who wanted to save his own labour”([1776] 1904, 11).

## 7. Plan Analysis

Much debate about Böhm-Bawerk's theory of roundabout production would disappear if his analytical framework, with respect to time, were clearly stated and distinguished from other frameworks. The point of view, from which the law of roundabout production is formulated, is that of an actor contemplating a production plan *the length of which can be varied*. The production period or production roundabout has been called a 'planning period' with a time-span of variable length. It can be distinguished from the strict meaning of the term 'period', when 'period' refers to durations of unitary length (day, week, year). In fact, in another part of his production period, Böhm-Bawerk uses the phrase 'economic period' for the non-variable duration of a year's production.

According to Joseph & Bode, in a contribution on the debates surrounding Böhm-Bawerk's theories of production and capital in the 1930's, the difference between the planning period (Böhm-Bawerk's production period) and the economic period is explained as follows:

“We [...] would like [...] to emphasize that the ‘planning period’ differs significantly from the ‘economic period’ if the latter is understood, as is often the case, as an ‘observation period’: the economic period becomes in this sense [...] *fixed by the theorist* and usually refers to collective phenomena; the planning period, on the other hand, is *discovered* by the theorist and its establishment is a matter for the *acting economic subject*, i.e. in the case of an individualistic economic constitution of the individual. Statements that use one term can therefore not simply be transferred to the facts meant by the other term.” (1935, 178-179)

The first point of view – that of the ‘planning period’ – is to assume the subjective perspective of a planner, who, standing at a point in time, determines – among other aspects – the duration of his plan. The end of the plan – the *planning horizon* – can be shifted further into the future or closer to now. Joseph & Bode invented the term “plan-immanence” to refer to what remains within a plan (ibidem, 179). Gadolin (1937 & 1939) made use of this term by describing a theory as *plan-immanent* in so far as it refers to a single production plan, in so far as it considers a ‘one-off’ situation. Gadolin argued that Böhm-Bawerk's concept of the ‘production roundabout’, if it is to make sense, “must be characterized by plan-immanence” (1937, 66) and that the production roundabout also refers to a “one-time construction period” (ibidem, 63).

## 8. Diminishing Returns to Roundabout Production

Böhm-Bawerk extends this ‘law of the higher returns of roundabout productivity’ into two directions. One is that he intends to establish a corollary of this law, namely that these returns to roundabout production will diminish eventually. The other direction in which Böhm-Bawerk extend his theory of roundabout production is that he wants to provide some sort of measurement of the production roundabout or ‘period of production’ - the *average period of production*, which we will discuss in the section after this one.

The corollary, of the diminishing returns to roundabout production, is in fact a limitation on the validity of the ‘law of roundabout production’. Böhm-Bawerk arrives at this limitation by applying the previously established economic theorem called the ‘law of (diminishing) returns’ to his own ‘law of roundabout production’.

This limitation is that:

“every lengthening of the roundabout process is accompanied by a further increase in the technical result; as the process, however, is lengthened the amount of product, as a rule, increases in a smaller proportion” (Böhm-Bawerk, *ibidem*, 84).

Böhm-Bawerk gave no lengthy defence of this corollary proposition at all. He simply stated that “[t]his proposition also is based on experience, and only on experience” (*ibid.*).

However, one thing is certainly clear, which is that Böhm-Bawerk tried to apply the law of (diminishing) returns, an economic theorem dating back to Turgot, to his own ‘law of roundabout production’<sup>55</sup>. So, let us first discuss the *law of returns* (or: *law of diminishing returns*). This theorem traditionally refers to the scope of a *single* stage of production. For example, we may consider an agricultural production stage of tilling, sowing and reaping the land in a season: We have on the one hand a plough, some spades and other tools (‘fixed capital goods’), as well as piece of land of a given size. These tools and land are our ‘fixed’ factors, they are ‘constant’ or ‘given’. On the other hand,

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<sup>55</sup> This procedure is markedly different than applying the law of returns to a ‘capital’ which is considered as a collection of heterogeneous tools, see Taussig (1908).



there is a variable factor, for which one can take the number of man-hours of agricultural work. Now according to the law of returns, a continual increase in the variable factor – in this case the number of workers working on the land – will after some point result in diminishing increasing returns.

Now the theoretical innovation that Böhm-Bawerk tries to accomplish is to extend the scope of the law of diminishing returns by drawing an earlier stage of production into the scope. When we return to our agricultural example, we can now consider two stages. There is a first stage of indirect labour, i.e. a ‘roundabout’ for making an ‘instrument of production’. We assume that a plough is made in this first stage, which nicely fits our agricultural example. Then there is a second stage of ‘direct labour’ in which the plough is used in tilling the land. The variable factor now is *not* the amount of ‘direct labour’ in the second or final stage, but the amount of ‘indirect labour’ in the previous stage. More indirect labour means more work put into finishing the plough. The question is this: What will be the consequence on agricultural output if we imagine more labour is going to be bestowed on making and perfecting the plough, in order to make that plough a more effective instrument of production? Böhm-Bawerk thus studies the consequences of increasing the amount of indirect labour on the productiveness of the direct labour.

He concludes, so to speak, that a better plough can be made by extending the production roundabout. Therefore, output will go up in the final stage in which the plough is used. This is the ‘law of roundabout production’. However, Böhm-Bawerk also argues that the productiveness of this indirect labour will diminish, that the *marginal returns* will decline, when the amount of indirect labour is increased.

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If the question now is whether it is correct that there are diminishing returns to increasing the amount of the variable factor of ‘indirect labour’ in a single indirect stage of production, we can invoke the logical evidence traditionally used to demonstrate the validity of the traditional law of diminishing returns: In this single indirect stage, there must be some ‘fixed’-, ‘constant’-, or ‘given’ factors of production with which the plough is made, besides the (indirect) labour which cooperates with the given factors to produce a plough. If more and more labour would ultimately result in an increasingly better plough, then the ‘fixed’-, ‘constant’-, or ‘given’ factors of production would not really be limiting

the effectiveness of the labour performed in this stage of production. But it is in the nature of factors of production that they give *limited* results, so this cannot be the case. Since factors can only cooperate to a limited degree, holding one type of factor constant means that increases in the variable factor cannot endlessly result in a greater product.

Thus, when applying the law of returns to *an* earlier stage of production, the result is the same as the law of returns says: There will be diminishing returns. The marginal output quantity in the final stage will diminish, because the plough that is put out by the earlier stage will be of diminishing additional efficiency the more and more labour is planned to be used in that earlier (plough-making) stage. Of course, the diminishing marginal output of the final stage is the result of the diminishing additional efficiency of the product to be made in the earlier stage.

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But even though we may conclude that each *individual* stage of production will be subject to the law of (diminishing) returns, we cannot agree with Böhm-Bawerk that his corollary theorem of the diminishing marginal returns to roundabout production is correct. Böhm-Bawerk has precisely brought to our attention the way in which one can resist and escape diminishing returns: One can add another stage of production, another ‘roundabout’ (cf. Lachmann, 1956, 78-82). One is not *necessarily* confined to a *single* indirect stage of production, to a single roundabout<sup>56</sup>.

As Böhm-Bawerk has pointed out himself, indirect labour comes in degrees: By increasing the amount of labour in a first stage of indirect labour that is precursory to a second stage of indirect labour, one can temporarily resist diminishing returns. Now these two degrees of indirect labour can be extended to three degrees, these three degrees to four degrees, etcetera. The very notion, that ‘roundabout production’ is a phenomenon that possibly involves multiple ‘roundabouts’ provides the reason why diminishing returns to increasing the amount of indirect labour of a single stage, can be resisted.

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<sup>56</sup> In most textbooks of economic theory, marginal productivity analysis will be exemplified by considering a produced means of production, such as a machine, as the factor that is constant in quantity and the amount of labour as the variable quantity. But it is also possible to apply marginal productivity analysis to a stage of indirect labour. To my knowledge, this type of marginal productivity analysis has only been recognized so far by Strigl ([1934] 2000, 49-51).

The corollary of the diminishing returns to roundabout production cannot be true in the long-run, precisely because in the long run many indirect stages of production follow each other. There is also no experience in the long-run, that demonstrates diminishing marginal returns to tool-making and machine-making. Much of the tooling and machinery that mankind has at its disposal today is far more efficient than that of even a few decades ago.

However, if Böhm-Bawerk was referring, with his corollary of the diminishing returns to roundabout production, to the 'short-run' of a single plan, there is certainly some validity in his corollary. Not all diminishing returns can be expected to be resisted in the short-run.

### **9. The Average Period of Production**

Böhm-Bawerk's argumentation, leading up to his measuring of the average period of production, is as follows:

“the production period of a consumption good is, strictly speaking, to be reckoned from the moment on which the first hand was laid to the making of its first intermediate product, right down to the completion of the good itself. In our times, when unassisted production has almost entirely disappeared, and one generation builds on the intermediate products laid down by earlier generations, the production period of almost any consumption good could, in any strict calculation, trace its beginning back to early centuries.

The boy who cuts a stick with his knife is, strictly speaking, only continuing the work of the miner who, centuries ago, thrust the first spade into the ground to sink the shaft from which the ore was brought to make the blade. Of course the finished product of to-day owes a quite infinitesimal fraction—not worth calculation even if that were possible—to the firstlings of labour in these far-off centuries, and it would therefore give a very false view of the degree of capitalism expended in the cutting of the stick, if we were to estimate it by the absolute period of time intervening between the atom of labour first put forth and the completion of the work.

It is more important and more correct to look at the period of time which elapses *on the average* between the expenditure of the original productive powers, labour and uses of land,

as successively employed in any work, and the turning out of the finished consumption goods.” (1891, 88, italics in original).

Now we have here a different perception of production-time when Böhm-Bawerk moves from his law of the higher returns of roundabout production, towards a *measurement* of the production roundabout or ‘period of production’.

In the 1930’s the complaint against Böhm-Bawerk’s terminology of ‘originary factors of production’ and intermediate goods, and his concepts of the period of production and average period of production, was that it led to a “backward looking” capital theory (Burchardt, 1931; Hill, 1933; Nurkse, 1935, Hayek, 1934). These complaints are not without substance, given Böhm-Bawerk’s statement that “[t]he boy who cuts a stick with his knife is, strictly speaking, only continuing the work of the miner who, centuries ago, thrust the first spade into the ground to sink the shaft from which the ore was brought to make the blade”. Even those such as Gadolin and Van Dorp, who can be said to be ‘Böhm-Bawerkians’, agreed on this complaint. Van Dorp wrote:

“In this strain of thought there is only *one endless-production process*, beginning with the making of the first tool by the hand of man and going on always, new tools being made with old ones, ending only with the world’s end” (1937, 151, italics in original).

Gadolin has argued that Böhm-Bawerk entangled himself in a contradiction as Böhm-Bawerk overlooked that his theory of the production roundabout is in essence ‘plan-immanent’. That is, that his theory of roundabout production basically refers to a *single plan*. Böhm-Bawerk’s mistake was that he was “extending the production roundabout beyond periods of time that are not linked by any planning community” (Gadolin, 1937, 77). Obviously, the 19th century boy-with-pocket-knife is not bound by a shared production plan with the miner in the time of the Roman Empire. The iron ore, that the miner of hundreds of years ago dug up, is only ‘historically-genetically’ related to the iron in the boy’s pocketknife. But the plans of the miner and the boy are unrelated. What the boy is doing with his pocketknife is extremely far beyond the planning-horizon of the miner.

Gadolin does note that resources can be left-over out the end of a production plan, that many durable capital goods outlive the purpose for which they were made:

“Actual production works with large masses of capital goods taken over from earlier plans; [...] The possible remainder of a capital good from an old economic plan returns in the new one as a residual product [*Restprodukt*] of dynamic origin. The static theory of capital can only be valid for a technically constant and plan-immanent period of time.” (1939, 514-515)

To Gadolin, ‘static capital theory’ is plan-immanent or plan-analytical. However, he does not seem to offer a ‘dynamic’ capital theory in which the influence of capital goods that outlive production plans is studied. Nonetheless the implication is there that a plan-transcending (‘dynamic’) theory of capital is possible.

## 10. Conclusion

The theory that is often referred to in economics as Böhm-Bawerk’s *theory of roundabout production* is essentially a theory of productivity, that is, a theory that explains the constraints in adopting more productive tools and equipment. It is very important to underline that Böhm-Bawerk gives this theory within a certain scope. The theory of productivity is ‘plan-immanent’; it refers to the scope of a single production plan or a single production period. Böhm-Bawerk, however, was not explicit (or explicit enough) about this scope, leading to many confusion in the history of economic thought.

The core thesis of the theory of roundabout production is that there exists a trade-off between the length of the production period of the tool or machine to be made (on the one hand) and the productivity (effectiveness or efficiency) of that tool or machine on the other hand. That thesis, the law of roundabout production, we find convincing. The following question is, however, how to apply such a thesis into a scope or perspective in which we transcend the point of view of a single production plan or production period.

We have concluded furthermore that Böhm-Bawerk’s corollary to his law of roundabout production, his thesis on the diminishing returns to roundabout production, cannot be true in the long-run. In the long-run a practically infinite number of stages of production can follow one another, by way of which the diminishing returns of increasing a variable factor in a single stage of production can be resisted.

We also agree with Gadolin’s observation made in the 1930’s, that Böhm-Bawerk essentially contradicted himself by arguing that “[t]he boy who cuts a stick with his knife is, strictly speaking, only

continuing the work of the miner who, centuries ago, thrust the first spade into the ground to sink the shaft from which the ore was brought to make the blade”. When Böhm-Bawerk’s intention was to put two factors of production, centuries removed from each other in time, in the same production plan, this does not make sense from the point of view of a ‘plan analysis’. However, Gadolin also points out that production plans leave certain remaining outputs (*Restprodukten*) – such as partially worn-out machinery – to be used as inputs in new plans. But precisely that complication falls outside of the limited scope of plan analysis.

## 2. The Theory of Reproduction: Böhm-Bawerk's 'Theory of the Formation of Capital' revisited

### 1. Introduction

Böhm-Bawerk's theory of roundabout production, discussed in the previous chapter, is about identifying a major constraint in acquiring more – and more efficient – tools and machinery. This major constraint is that it takes time to build tools. The time between the commencement of a production plan and the finalization of that plan will increase when more efficient machinery must be built during that plan. However, in the previous chapter we also came to the conclusion that this way of indicating the major constraint on the production of productive capacity has its limitations. It is precisely the scope of the *plan analysis* underlying the theory of roundabout production which limits its applicability. One cannot regard long stretches of economic history as a single production plan.

The question which follows is how one can apply the conclusions of the theory of roundabout production to a different perspective on the lapse of time. We must make a step towards a 'plan-transcending' perspective in which (1) plans or periods follow each other in sequence and (2) different production plans are executed simultaneously but in various stages of completion. The perspective that transcends a single plan has been termed *period analysis* or *sequence analysis*. When we observe economic activity as divided in a sequence of periods, one will see that in each periods similar products are put out as in previous periods. There is thus a repetitive element of production emphasized by the phrase *reproduction*. Hence period analysis can be associated with what has been called a *theory of reproduction*.

In order to form a working conception of reproduction we will again revisit a theory of Böhm-Bawerk as the initial step towards our answers. This theory is the theory around Böhm-Bawerk's chapter IV of his *Positive Theory* entitled the 'theory of the formation of capital'. This part of Böhm-Bawerk's capital theory has also been called Böhm-Bawerk's counterpart to Marx' theory of simple reproduction (Burchardt, 1931) or Böhm-Bawerk's "theory of reproduction processes" (Stavenhagen, 1969, 658). That Böhm-Bawerk there deals with reproduction is not a mischaracterisation.

With his theory of reproduction, Böhm-Bawerk ultimately investigates into determining what circumstances constrain and induce entrepreneurs towards adopting more labour-saving machinery (more productive capacity). By putting this question in the light of the topic of reproduction we can make it more specific: *Under what conditions will a stock (the stock of capital goods, the stocks of raw materials and consumption goods; the population) remain stationary, will decline, or will grow?* We will keep this question within the scope of production theory, that is, we will inquire after what mankind has to do vis-à-vis his natural environment. Conditions that are part of interaction in the market economy will be left out of the scope of this chapter.

## **2. Böhm-Bawerk's 'Theory of the Formation of Capital' considered as Theory of Reproduction**

In chapter III of book II of his *Positive Theory*, Böhm-Bawer indicates he is changing scope:

“Robinsonades and pictures of primitive circumstances are very good when the object is to present clearly the simplest typical principles—to give a kind of skeleton of economical procedure,—and to that extent, I trust, our Robinsonade also has done good service. But, naturally, they cannot give us an adequate picture of those peculiar and developed forms in which this skeleton clothes itself in the living actuality of a modern economic community. And it is just at this point that it becomes important to fill out the abstract formula with explanation and illustration taken from life. We shall, therefore, leave the lonely shore of our Crusoe, and come to the industrial conduct of a great nation with its millions of people.” (1891, 104)

If we study the first two chapters of book II of Böhm-Bawerk's *Positive Theory*, and compare them two the three chapters that follow, there is indeed a change of scope. In the first two chapters the scope is that of a production plan, in which labour is applied to build tools, and tools subsequently used to produce consumption goods. Consumption goods are considered the goal of the production plan, and Böhm-Bawerk studies the role of tools in producing consumption goods. The main economic variable is the length of the plan, what Böhm-Bawerk calls the 'production period'.

There are only two main elements about Böhm-Bawerk's change of scope that we must consider: First, his changing perspective on the role of consumption goods in the production process; and second the



adoption of a different perspective on the lapse of time – a period analysis - and Böhm-Bawerk's peculiar model – the ring-scheme – by which Böhm-Bawerk describes the economic activity of subsequent periods. Out of these two things, especially of the second one, arise Böhm-Bawerk's general conclusions on the growth, stationarity and decline of an economy's capital stock.

### **3. Consumption Goods as Inputs to the Production Process**

The first of these two main elements comes to light when Böhm-Bawerk reconsiders the role of consumption goods in the production process, since these consumption goods only played the role of an end-station in the theory of roundabout production:

“man must already have capital before he can enter on roundabout ways of production; that want of capital prevents man taking advantage of far-reaching and profitable methods of production, such as the laying of railways, building of canals, irrigation schemes, altering of river-beds, and so on. It would be quite incorrect to understand this proposition as meaning that a community must have, finished and ready to hand, that kind of concrete capital with which the methods of production in question are carried out, or even the concrete capital (raw materials, tools, etc.) out of which are made the forms of capital first needed. All that is required is, that the community possess so much capital, whatever its shape, as will cover—while it is being gradually changed into consumption goods—the demand of the present and near future for such goods sufficiently to leave the current production powers free for investment in intermediate products of the kind required. In this sense, but only in this sense, is it correct to say that man must already have capital before he can enter on roundabout ways of production [...] It would be essentially more correct to say that we require *consumption goods* before we can enter upon roundabout ways of production, whether these be in the form of finished stocks of goods ready for consumption, or in the transition form of intermediate products”(1891, 94, his emphasis)

Here Böhm-Bawerk clearly considers consumption goods as inputs, as factors of production. Two important things about consumption goods as inputs to the economic process can be emphasized.

First, Böhm-Bawerk in fact makes a very physiocratic point in arguing that the possibility of conducting roundabout production is subject to the availability of means of subsistence. Making tools (roundabout production) has the opportunity cost of foregoing to produce consumption goods directly. Hence sufficient means of subsistence must be available before initiating (more) indirect stages of production, as the indirect production will diminish the output of consumption goods in the short-run. In chapter IV, Böhm-Bawerk argues that if a Crusoe wants to build a bow and arrows, he needs first some ‘means of subsistence’ to survive the time-consuming process of making tools (such as bows). When Crusoe is constructing his bow, he cannot be picking berries or be gathering other ‘means of subsistence’. Saving precedes the production roundabout, but both the saving of consumption goods and the production of tools are elements of the ‘formation of capital’.

Second, it should be emphasized that from chapter III of Book II, contrary to the previous two chapters, Böhm-Bawerk not only uses the term ‘capital’ to designate tools. He also uses ‘capital’ in the sense of raw materials (which can become tools or consumption goods) and consumption goods. This is the conception of capital that Böhm-Bawerk sees as “not intermediate products only, but the entire national subsistence fund, which would therefore include the labourers’ subsistence” as he wrote just a few pages earlier (*ibidem*, 92). The size of the ‘national subsistence fund’ that is in the possession of a nation, or for that matter the amount of ‘means of subsistence’ in the possession of a Crusoe, is a pre-condition for the formation of capital.

To Böhm-Bawerk, the capitalist production process thus *subsides* on what is *previously* produced, rather than that it subsides on its own output. In distinction to many other economists, Böhm-Bawerk does not imagine or treat the production process as if it were living in a ‘closed circular-flow’, as if each element is in *complete* interdependence with each other element. Only if one disregards the lapse of time one could say that the production process begins and ends with a stack of consumption goods – *as if* that stack of consumption goods is the same thing. But Böhm-Bawerk does not disregard the lapse of time. With Böhm-Bawerk the production process begins with a *previously* produced stack of consumption goods (which is taken as a datum or independent variable) and ends with a stack of

production goods that has a different ‘time-stamp’ (which is the dependent variable of the production process) (cf. Rothbard [1962] 2009, 479; Kurz & Salvadori, 1995, 468-469)<sup>57</sup>.

#### 4. The Ring-Scheme as a Model of the Economic Period

In chapter V of the *Positive Theory*, on the ‘Formation of Capital in a Community’, Böhm-Bawerk divides the lapse of time, by which the whole economy moves forward, in yearly periods. He once uses the term *economic period* (*Wirtschaftsperiode*) for each year. Within each year, Böhm-Bawerk argues, there will be several *parallel* stages-of-production of different maturations performed, each taking one year. Each stage of production has taken-over intermediate products – i.e. tools or raw materials – from a preceding stage in a previous year. Furthermore, Böhm-Bawerk assumes that each such year the economy receives an annual endowment of man-years of labour-power (the *Jahresdotation*)<sup>58</sup>. The endowment of man-years is allocated among the different stages of production.

This parallel performance of stages-of-production of different maturation, during a year, is pictured by Böhm-Bawerk through his ‘scheme of concentric rings’ or ‘ring-scheme’ (see the figure below). The outer-most ring pictures the most immature stage of production, while rings closer to the centre ring each picture progressively more mature stages. The centre-ring is the most mature stage of production, and pictures the final work that result in consumer goods during the current year. The ring is therefore not only a picture of what happens during a year, but also a ‘cross-section’ (*Querschnitt*) of the economy at a moment in time (Wicksell, 1934, 236; Hayek, 1935, 43).

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<sup>57</sup> In a distribution-theoretic sense, Böhm-Bawerk’s position is that wages are paid out of capital (i.e. advances out of a previously saved ‘subsistence fund’ or ‘wage fund’). The opposite position is that wages ‘are paid out of product’ (Taussig, 1898, 15). The latter position implies a mutual dependence between consumption and production in a timeless vacuum: Wages are paid out of ‘product’ (i.e. output or revenue), but at the same time the payment of wages ensures that there is output or revenues. With Böhm-Bawerk this mutual dependence between production and consumption in a timeless vacuum does not exist: Current wages (the workers’ consumption) are paid out of previous product; future product is provided for by paying wages now (by identifying wages as advances). The distribution-theoretic thesis that wages are prior to revenues is paralleled in production theory in the thesis that input is prior to output.

<sup>58</sup> This endowment or ‘dotation’ is thus a datum taken from outside the thought-construction; it does not follow from the system itself.

Fig.1.

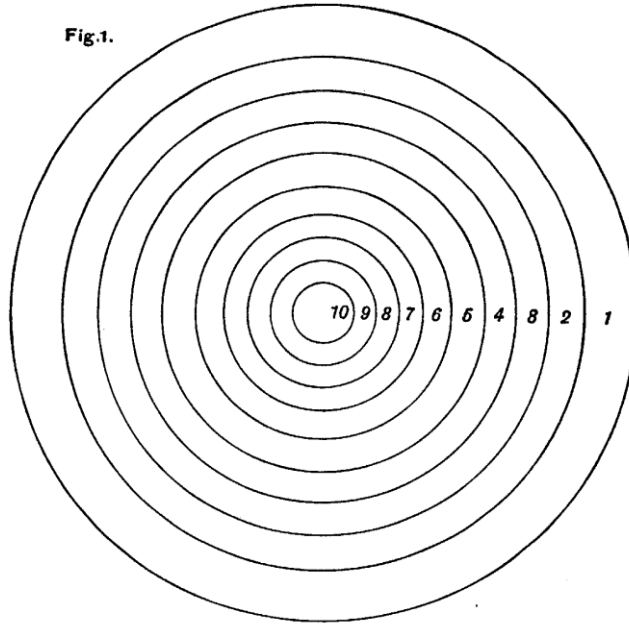
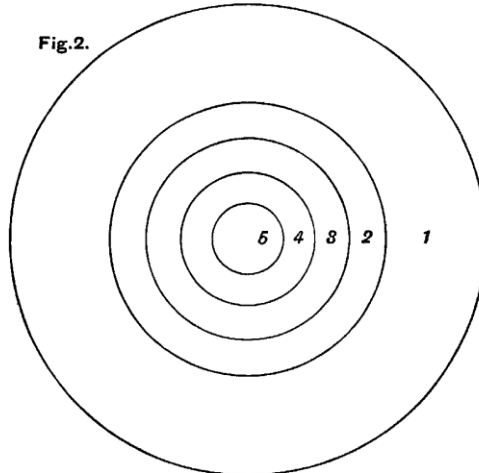


Fig.2.



Böhm-Bawerk's explains the ring-scheme as follows:

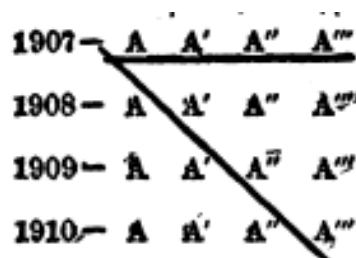
“Now the inventory of capital lays a kind of cross-section through the production processes, thus unlike in length and unlike in stage of progress, and intersects them, of course, at the most different points, just as a national census lays a section through the paths of life, and encounters and registers the individual members of the nation at the most different stages of life.

Considered with reference to the varying distances at which intermediate products lie from the goal of consumption, the total mass of capital divides itself into a number of annual classes or stages of maturity, which may be very appropriately pictured by a diagram of concentric annual circles. The outmost circle (Fig. 1) embraces those goods which will be transformed into goods ready for consumption within the coming year; the second circle represents those goods which will ripen into consumption goods in the year after; the third circle, those which will be ready the year after that, and so on. In a community where production is not yet strongly capitalistic, the inner circles will rapidly contract (Fig. 2), because, in such a community, very lengthy roundabout ways of production, such as turn out their finished goods only after many years, will be rare. In rich and well-developed communities, again, there will be a considerable number of comprehensive circles, and of these the inner ones will have a content that, although relatively smaller, is not inconsiderable.” (1891, 108)

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Clearly, the ring-scheme is meant as a ‘cross-section’ of time, as a momentary picture of different production stages going on at the same time as time goes by. However, the question that Böhm-Bawerk does not clearly answer is how to use this cross-section. Should it be used as a *stand-alone* schema, or should we think of a *sequence* of schemes of the stages-of-production, each ‘cross-section’ representing a further ‘economic period’ of a year in which an ‘annual endowment’ or original productive powers is received?

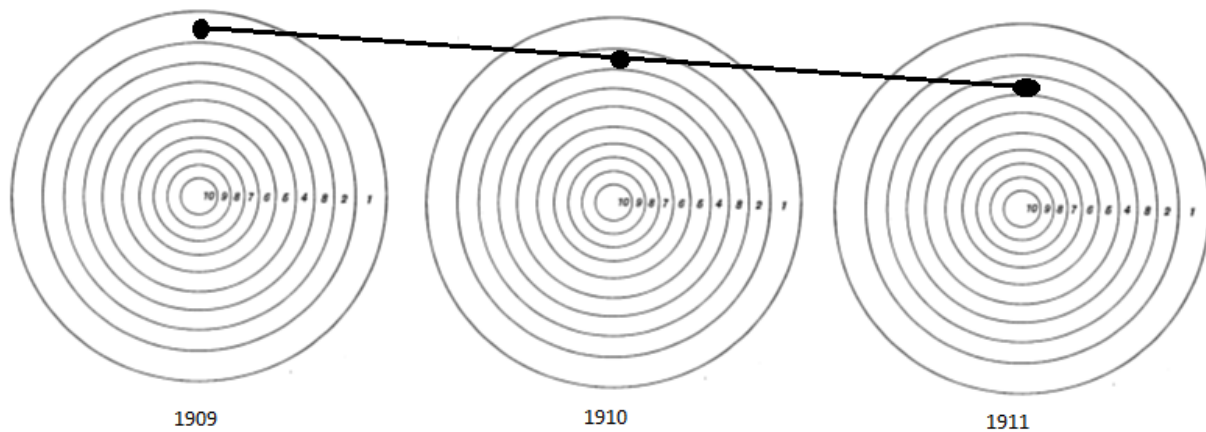
One of Böhm-Bawerk’s contemporary admirers, F.W. Taussig, interpreted and defended Böhm-Bawerk’s position by depicting a sequence of ‘economic periods’ (years) in which in each ‘economic period’ four stages-of-production are pictured (the stages are designated as A; A’; A” and A’’’):



Taussig explained his scheme as follows:

“During any one period (say in 1907) all four A’s are working simultaneously (say growing wool, erecting spindles and looms, manufacturing cloth, making garments). But the material on which A has worked in 1907 is passed on to A’ in 1908. That which A’ has partly fashioned is passed on to A” in 1909. A”” finally gives the finishing touches in 1910. It is not the horizontal line running through 1907 that represents the course of production, but the oblique line that runs through all four periods” (1908, 338)

There is ample reason to believe that Taussig’s interpretation is in line with Böhm-Bawerk’s<sup>59</sup>. Translated to the ring-scheme, Taussig’s interpretation could be explained by this example:



Suppose the product of the outermost-ring of year 1909 (ring number 1) matures into ‘intermediate goods’ used in ring n° 2 of year 1910. Ring n° 2 of year 1910 turns out the product that become the ‘intermediate goods’ of ring number 3 of year 1911, etcetera (Taussig, 1908, 338). So, the ‘period of production’ – understood as the time it takes to manufacture a consumption good from the time it is

<sup>59</sup> Taussig’s interpretation is that Böhm-Bawerk’s employs a *chronological* imaginary construction. The particular years that Taussig uses (1907; 1908; 1909; 1910) are clearly not used to explain an economic historical event that occurred between 1907 and 1910, but are simply used to illustrate the passage of time. However, a number of author’s, among them Kraus (1961, 22-23) and Bortis (1990, 70), have followed Burchardt’s interpretation that the ring-scheme (and Böhm-Bawerk’s theory of the formation of capital) is a historical-genetical construction, i.e. that it portrays an historical event. Bortis even goes so far as arguing that: “Böhm-Bawerk describes the *production* of final (consumption) goods and the reproduction of the means of production used up in the production process in terms of a *historical process* [...] Böhm-Bawerk’s view of the production process is, in fact, *not a theory* but a *historical description* of production” (1990, 70, his italics). That seems to me a serious misrepresentation of Böhm-Bawerk’s theory.

planned to be produced until it is actually put out – is something that spans (in Böhm-Bawerk’s analysis) several year-long ‘economic periods’.

The ring-scheme can thus be seen as a part of a bigger scheme, of a *chronological thought-construction* in which one imagines several ‘economic periods’ – each represented by a ring-scheme – in sequence.

### **5. The Conditions of Stationarity, Growth and Decline**

Böhm-Bawerk furthermore briefly explains under what conditions the capital stock is steady, grows or declines. In order to use it so, one simply has to consider again that the economy receives each year (1) an endowment of man-years of labour and it also receives, out of the *former* economic period, and (2) an amount of ‘intermediate goods’ of different maturities, *also* out of the *former* economic period. How both man-years and intermediate goods are *re-allocated*, in the current year, determines the output of consumers goods and the change in the capital stock for both the current year and for future years.

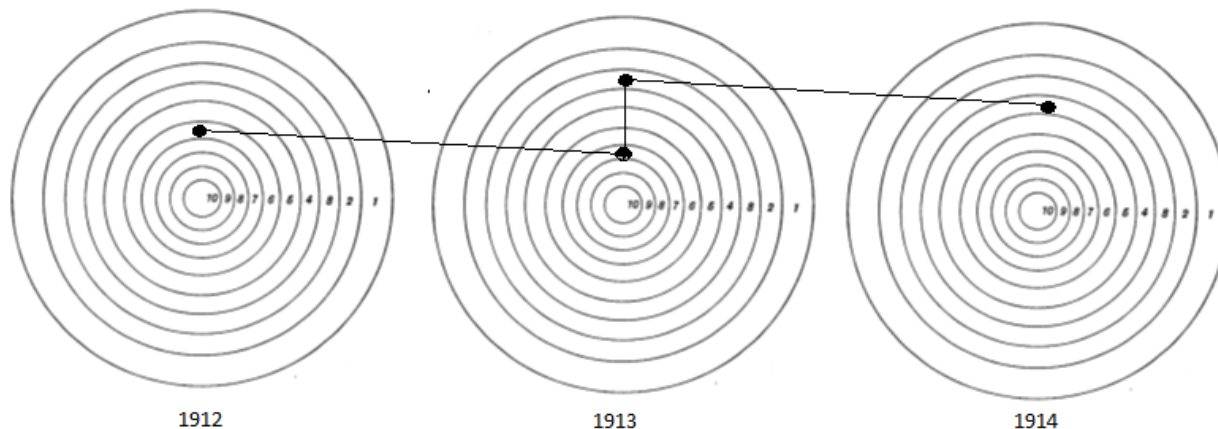
The first way of re-allocation that Böhm-Bawerk thinks of is varying the amount of manpower employed in the last stage of production. When lowering the number of workers in the final stage of production, there will be the disadvantage that in the current year less consumer goods will become available. However, the advantage will be that these workers can now be allocated to higher stages of production, augmenting the output of consumer goods in later years.

The second way of re-allocating is to make sure that less intermediate goods pass into the stage of full maturity, by re-allocating these intermediate products back to less-mature stages of production.

“It is a familiar fact that there are many goods which admit of being employed in a variety of ways. This often makes it possible to put back goods which have already attained full maturity, or which stand quite near to maturity, by several stages. Grain, for instance, instead of being ground for food purposes, may be stored for seed, or used in distilling; coal may heat the blast furnace instead of the domestic oven; iron may build machinery instead of park railings; and so on.” (1891, 112).

Böhm-Bawerk does not *depict* this ‘putting back’ in his ring scheme (Burchardt, 1931; Eucken, 1940). Hence, there is a discrepancy between Böhm-Bawerk’s textual theory and his schematic theory,

although he does not explore this phenomenon any further either. However, in a chronologic sequence of ring-scheme's, Böhm-Bawerk's 'putting back' of intermediate goods would look something like the following example:



The scheme above may depict that iron is produced in 1912 in stage 6 and moved to stage 7 in the year 1913 to be used as an 'intermediate good' (with the aim of eventually turning out park railings). However, instead of proceeding with the production of park railings, in that same year, this iron is 'put back' to stage 3. In other words, the iron is *re-allocated* to a higher stage of production. The production-aim is now to produce machinery in stage 3, machinery which will be used in a following stage of production (stage 4) in the year 1913<sup>60</sup>.

## 6. Conclusion

When Böhm-Bawerk studies the production process, or 'reproduction process', his time-perspective is that of a timeline, i.e. a chronological sequence of unit-periods. The unit-period is called either the 'economic period' or simply the 'year'. From the observation of a time-line one can descent to the perspective of a 'current period'. Then the capital goods, consumption goods and 'original productive powers' are the *data* ('annual dotation'), because these resources are delivered by the previous period

<sup>60</sup> The fact that Böhm-Bawerk's theory around the ring-scheme contains this concept of 'putting back' is very often overlooked by German and Austrian economists since Burchardt (1931). Professor Klausinger writes that "Böhm-Bawerk took refuge in a vertical structure of staggered stages of production. The output of each stages results from combining labour with the products of each previous stage, except for the first stages which uses solely labour as an input. The economy thus exhibits a linear structure of production, no product of a later stage being required as an input in the production process of an earlier stage." (2012, 26) Other examples in which Böhm-Bawerk's schematization of production is portrayed as something entirely 'linear' are Helmstädter (1962, 258); Bortis (1990, 70); Hagemann (1994, 112) and Kurz, (2000, 268). A non-German economist even speaks of the "linear imperialism of the Austrians" (D. Clark, 1984).



to the doorsteps – so to speak – of the current period. Machinery, raw materials, consumption goods (or ‘means of subsistence’), labour and land (original productive powers) can all be considered as inputs. But saving consumption goods is prior to capital goods formation. Capital goods formation takes time and prevents direct production of consumption goods, hence a stock of consumption goods is necessary to commence production roundabouts.

With the help of the ring-scheme, each combination of capital goods and ‘original productive powers’ can be ordered according to the *prospected* duration of that combination to bear fruit, to be ‘matured’ into consumption goods. However, whether the stock of capital, and the amount of goods consumable, will grow, remain stationary or decline, all depends on how choices are made with respect to the allocation of both man-years and capital goods during the current year. Re-allocation towards higher stages of production means a growing capital stock, but it also implies more saving (i.e. more foregone consumption) in the current year, and *vice versa*. Böhm-Bawerk’s conclusions on what will grow or shrink an economy are very similar to the concepts of productive consumption and unproductive consumption in classical economics. What was known as *productive consumption* in classical economics means to say that consumption goods of a former period can be considered as inputs in a next period when such consumption goods help sustain the livelihood of workers employed in producing further output of consumption goods. But if consumption goods do not sustain further production, there is unproductive consumption (cf. Corry, 1962, 18-19).

However, Böhm-Bawerk’s theory of reproduction lacks a deeper investigation into the connection between periods. An aspect that Böhm-Bawerk does not consider is that tools made in a first plan may not be fully worn out once that first plan is completed, and thus may very well be used to produce in subsequent plans. Gadolin (1939) would argue in the 1930’s that Wicksell’s concept of the *Rentengüter* (i.e. rent-goods) refers to fixed capital goods which are very durable and outlive the original production plans in which they are formed. Van Dorp (1937) has also pointed out that Böhm-Bawerk’s theory of distribution lacks the ability to transcend the focus on the current period.

Another critique of Böhm-Bawerk’s theory of reproduction is that the ring-scheme is an inadequate model of the connections and interdependence between sectors or functions of the economy. It is criticised as flawed or lacking with respect to the ‘circular-flow’ (in the sense of interdependence) of the economy (e.g. Burchardt, 1931). This is indeed an interesting point for further investigation. We

have seen that there is a discrepancy between the text of Böhm-Bawerk's reproduction theory and its schematics. Furthermore, it is quite clear that the ring-scheme emphasises the duration of production processes until their maturation into consumption goods, while it highlights little else about the production process.

However, the modelling of a 'structure of production' can be considered as a topic in itself. Böhm-Bawerk's main concern must have been with a rudimentary *period analysis* (which focusses on the chronology of economic development) rather than functional connections and interdependencies of the 'circular-flow' or interdependence of economic phenomena. We will deal extensively with the schematics of the 'structure of production' or the 'circular-flow' in the next chapter.

# 3. The Schematic Representation of the ‘Structure of Production’ in Economic Thought

## 1. Introduction

### 1.1 The research question involved the Schematic Representation of the ‘Structure of Production’

Are there circumstances and constraints – relating to investing in productive capacity and capacity utilization – that are *peculiar* to different types of industries, such as the consumption goods industries (‘manufacturing’); the machine producing industries (or ‘investment goods industries’); and the raw materials industries (the ‘primary sector’ and the ‘heavy industries’)? In other words, are the constraints and incentives of entrepreneurs in one industry *representative* of another industry or not? Is there such a thing as a *representative firm*? Is what is true for one entrepreneur also true for others?

Marshall’s concept of the *representative firm* seems to deny the existence of a structure of production, That is, it seems to deny the existence of sectors in the economy performing functions which are different – and therefore not representative – of others sectors within the economy. Wassily Leontief’s thesis, underlying his *input-output matrix*, was similar: Every industry supplies every other industry, so there is no question of a ‘hierarchy of production’. Yet if we simply look at the great variety of enterprises and capital goods, in an empirical sense it does not seem plausible at all to argue that one firm is representative of another. Hence there is plenty of reason to revisit the history of economic thought on the topic of the structure of production and of the way in which to convey the structure of production – its schematization.

### 1.2 The general problem

The problem of the *schematics of the structure of production* may be introduced by one of the more famous passages in Adam Smith’s *An Inquiry into the Nature and Causes of the Wealth of Nations* ([1776] 1904, 13). Smith writes:

“Observe the accommodation of the most common artificer or day- labourer in a civilized and thriving country, and you will perceive that the number of people of whose industry a part, though but a small part, has been employed in procuring him this accommodation, exceeds all computation. The woollen coat, for example, which covers the day-labourer, as coarse and rough as it may appear, is the produce of the

joint labour of a great multitude of workmen. The shepherd, the sorter of the wool, the wool-comber or carder, the dyer, the scribbler, the spinner, the weaver, the fuller, the dresser, with many others, must all join their different arts in order to complete even this homely production. How many merchants and carriers, besides, must have been employed in transporting the materials from some of those workmen to others who often live in a very distant part of the country ! how much commerce and navigation in particular, how many shipbuilders, sailors, sail-makers, rope-makers, must have been employed in order to bring together the different drugs made use of by the dyer, which often come from the remotest corners of the world! What a variety of labour too is necessary in order to produce the tools of the meanest of those workmen! To say nothing of such complicated machines as the ship of the sailor, the mill of the fuller, or even the loom of the weaver, let us consider only what a variety of labour is requisite in order to form that very simple machine, the shears with which the shepherd clips the wool. The miner, the builder of the furnace for smelting the ore, the feller of the timber, the burner of the charcoal to be made use of in the smelting-house, the brick-maker, the brick-layer, the workmen who attend the furnace, the mill-wright, the forger, the smith, must all of them join their different arts in order to produce them.”

In summary: One consumption good, such as a coat, has behind it a vast number of tasks and processes that have led up to the final realization of this particular consumption good. Smith says that all these tasks and processes “exceeds all computation”. Indeed this is so, because the *description* of all the tasks that are involved in manufacturing a coat may go on virtually endlessly.

However, there is some structure visible in all these production-activities. At least there seems to be a structure. The coat, after all, is at the *end* of a process. Smith traces back a number of ‘stages of production’ in various degrees of proximity behind the final realization of the coat. Some production-activities seem closer behind the realization of the coat, such as weaving and spinning. Others seem more distant, such as the activity of machine-making. In the theories of the Austrians Menger (1871) and Böhm-Bawerk (1891) we find use of the ‘earlier’ (more distant) and the ‘later’ (closer) activities as a basis of a rudimentary theory of a ‘structure of production’.

Now the task of the *schematics* of the structure of production is to provide a schema or model of the ‘structure of production’ or ‘hierarchy of production’. It must be a scheme or model, a simplified and

abstract account of the type of economic reality that Smith described. We must avoid a description of tasks that degenerates into an endless regression, that ends up being an account of the historical-genetic production processes<sup>61</sup>. It must also be as complete as possible, the *scheme* of the structure of production must be a survey of the typical ways in which the natural environment constraints production, as well as a scheme of that incorporates the tool-making and tool-using aspects of production.

A scheme of the economy or of production should not have to compete with the textual theory, it is rather that the scheme supports verbally or textually conveyed theory, as it should summarize lengthy verbal or textual considerations at one glance<sup>62</sup> (Gerritsen, 1941; Higgs, 1897).

### **1.3 The ‘goods-side’ or ‘real-side’ of the economy versus the ‘money-side’:**

Most economists are familiar with the conceptual break-up of the economy into a money-side and a goods-side or ‘real-side’. ‘Lifting the veil of money’<sup>63</sup> means to penetrate deeper into the workings of the economy (Hayek, 1941). It is not just to leave money-phenomena out of the picture; not just to consider direct exchange (‘barter economy’) instead of indirect exchange (‘money economy’)(cf. Keynes, 1933) .The study of the ‘real-side’ of the economy means to abstract from the market (or exchange-phenomena) altogether.

In our opinion, this point was typically better perceived by German economists than by Anglo-American economists. A good example is the German economist E. Wagemann’s description of (what he called) the “removal of the money veil”. Wagemann writes:

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<sup>61</sup> For example, if we take any consumption good, we could find that this goods was produced with produced factors of production, and for that produced factor of production we could find that it as produced by an earlier produced factor of production, etcetera. In such a line of thought, the production process can be described historically and it would begin in the Stone Age, or with Adam & Eve.

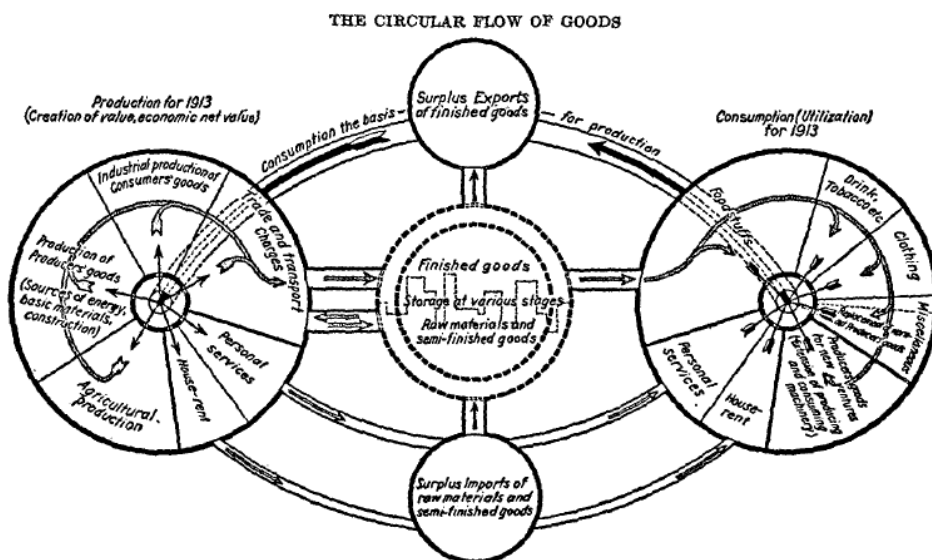
<sup>62</sup> One might compare the rationale of schematization in economics with drawing roadmaps: The roadmap can be an alternative to textual descriptions of driving from one place to another. For example, to describe how to get from every town in France to every other town would undoubtedly take up far more space than the collection of roadmaps contained in Michelin’s *Atlas Routier & Touristique* of France. Many drivers would therefore much prefer the map and its abstract model of the actual roads above a verbal description of these roads. But the map and route-descriptions do not exclude each other, they can complement each other. In fact, today’s navigation equipment often combines the two modes directing a driver towards his destination.

<sup>63</sup> Boianovsky (1993) traces the origin of the phrase ‘veil of money’ to no other than Böhm-Bawerk.

“How this can be effected can best be made clear if one supposes oneself in the position of an inhabitant of Mars, looking down at the earth through a powerful telescope. One would then be able to observe how coal is extracted from the bowels of the earth, how iron is produced by the blast furnaces, how the harvest is gathered in the fields. One would note how man transports these and a thousand other products in carts, ships, and railway trains for further transformation, how he redespaches the finished goods and stores them in warehouses, up to the point where (frequently through many roundabout channels) they reach the consumer. Thus viewed, the earth would give the impression of a vast ant heap, busily engaged in production, transport, storage of supplies, foreign trade, and consumption- the sum total of which processes constitutes the circular flow of goods.” (1930, 29-31)

In the midst of Wagemann’s description there appears a scheme which depicts this “circular flow of goods” (figure 1):

Figure 1



A few pages onwards Wagemann provides his readers with a second scheme, but now of the ‘circular flow of money’. This is a typical example of putting the major division of economics into a production-theoretic part and an exchange-theoretic part. The topic of the ‘goods-side’, ‘real-side’ or ‘circular-flow of goods’ is how men work to transform what is taken from natural resources into consumption goods. The topic of the ‘money-side’ or the ‘circular flow of money’ is about the exchange - between men -

of goods and services. Money, after all, is the medium of exchange and as such the centrepiece of exchange<sup>64</sup>.

We will continue our discussion of the schematics of the structure of production by delimitating the *problem* to the goods-side, or real-side of the economy. We will be dealing with the ‘structure of production’. However, that does not mean that we cannot draw inspiration from schema’s of the economy that also address the money-side.

## 2. The Physiocrats’ *Tableau Économique*

### 2.1 Quesnay’s *Tableau Économique*

The first serious schematic model of the structure of production in economic theory is widely regarded as Quesnay’s *tableau économique*. There are a few different versions of this tableau, below are depicted two of those (figures 2 and 3):

Figure 2

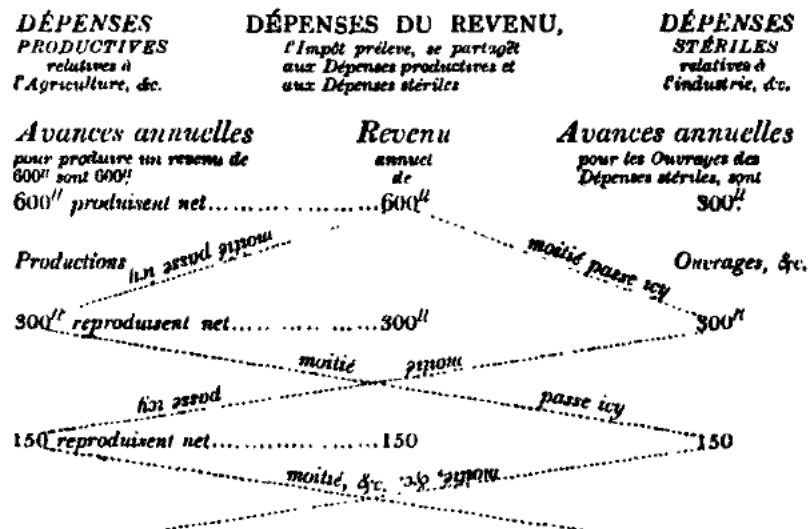


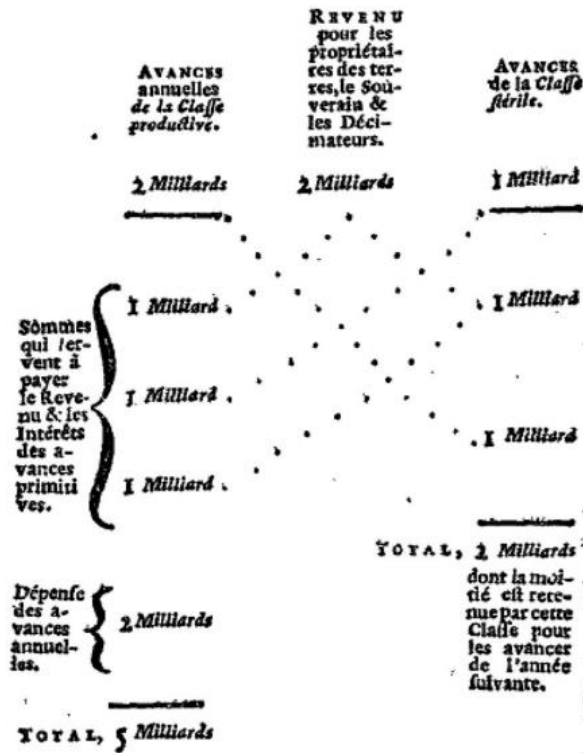
Figure 3

<sup>64</sup> The thought-construction of a barter-economy – the ‘real-exchange economy’ – is in this sense *not* the study of the ‘real-side’ or ‘goods-side’ of the economy. The barter-economy belongs to the theory of exchange – the *theory of direct exchange* to be precise – just as much as the monetary economy belongs to the closely related *theory of indirect exchange* (cf. Mises, [1935] 1953, 462).

# FORMULE

## Du Tableau économique.

**RÉPRODUCTION totale. Cinq Milliards.**



The *tableau économique*, it seems, is supposed to convey how three classes (or sectors) of the economy are supposed to interact with respect to the annual reproduction of goods. These sectors are the *classe productive* (farmers); the *propriétaires* (landowners) and the *classe sterile* (artisans). But it is not easy to quickly understand what the tableau exactly describes, that is, how it operates as a model of the economy or the structure of production.

What was the purpose of the tableau? According to Higgs in his *The Physiocrats*:

“The practical economic problem of contemporary France, as it presented itself to the mind of Quesnay, was of this character. Here is a country, abounding in natural resources, but production is starved in its infancy for lack of capital. Yet capital is only to be obtained



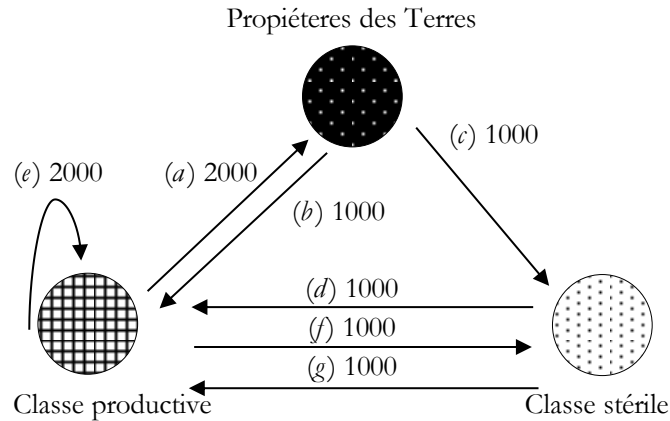
by setting it aside out of the fund created by production. If this fund be turned into channels where it is not available for utilisation as producer's capital, the nation is doomed to sterility. How then is wealth distributed throughout the different classes of the nation, and how is a larger portion of it to be diverted from immediate consumption to the benefit of future production? It was clear to him that luxury and extravagance had reached a pitch at which the nation was rapidly impoverishing itself, living above its means and consuming not only its revenue but its capital. To make this intelligible at a glance he designed a chart or table [i.e. the *tableau économique*] which, so far as rapid intelligibility is concerned, is a ludicrous failure" (1897, 23).

The *tableau* thus requires some of interpretation and studying of its accompanying text in order to make it intelligible. Fortunately there is an extensive literature of interpreting the Physiocrats. According to one historian of economic thought, the *tableau* conveys the following description of an economy:

"The *classe productive* produces 5,000 livres worth of products annually; 2,000 of these are pure surplus (produit net), which is ceded to the owning class [*propriétaires*] [a]. The latter uses half of the money to buy food from the peasants [b] and half to buy industrial products from the *classe sterile* [c]. The latter also buys food from the farmers for its share [d]. Thus the 2000 initially paid to the landowners are returned to the farmers; of the remaining 3000 of the net product, 2000 do not enter the circular-flow, but remain with the peasants themselves for their own sustenance [e]. The third thousand serves them to buy commercial products [f], but is in turn used by the *classe sterile* to buy agricultural products [g]; This means that the entire annual product has once again reached agriculture and the cycle is closed." (Schmölders, 1961, 26)

Based on Schmölders explanation, we can make the following redrawing of the *tableau économique*. In this redrawing, each money-flow is indicated by a letter that refers to the flows mentioned by Schmölders and indicated by letters in the brackets:

Figure 4:



One reason to make this redrawing is that, from the original *tableau* itself, it is not immediately clear that of the 5 milliards of output, 2 milliards goes to the proprietors and 3 milliards are initially retained by the *classe productive* (which is now indicated by the arrow *e*).

## 2.2. Circular-Flow Analysis

The literature on the Physiocrats and the *tableau économique* is quite extensive, and we are not here concerned with revisiting the original texts of the Physiocrats or a review of that literature on the Physiocrats. However, we need to highlight just two very important aspects of the *tableau économique* (and its surrounding theory) that are not always very balanced in the literature on the Physiocrats, especially when one compares some of the German literature related to the Physiocratic School with some of the English sources. These are the topics of ‘circular-flow analysis’ and ‘period analysis’. We will deal with ‘circular-flow’ analysis first.

Undoubtedly due to the influence of both Marx and Schumpeter – probably the two biggest names in German-language economics – the word *Kreislaufanalyse* (i.e. ‘analysis of the circular-flow’) is used quite a lot in German literature<sup>65</sup>. This analysis of the circular-flow is often connected historically to the

<sup>65</sup> A large part of the German economic literature seems to have been obsessed with the *Kreislauf* as the pinnacle of economics. Many German contributions to economic thought herald the concept of the *Kreislauf*: Schumpeter, writes not only on the circular-flow in his *Theory of Economic Development*, but also in a chapter on “The Discovery of the Circular Flow of Economic Life” in his *Economic Doctrine and Method* (1954): Further notable contributions in the German literature on the circular-flow are Leontief: „Die Wirtschaft als Kreislauf“ (1929); Burchardt, „Die Schemata des stationären Kreislaufs bei Böhm-Bawerk und Marx“ (1931); Peltzer, *Der Physiokratismus und die Entdeckung des wirtschaftlichen Kreislaufes* (1932); Ferdinand Grünig: *Der Wirtschaftskreislauf: Die Grundlegung einer Wirtschafts-Mechanik ihre Erprobung an einem Wirtschafts-Modell ihre Auswertung beim Wiederaufbau der deutschen Wirtschaft* (1933); Carl Föhl, *Geldschöpfung und Wirtschaftskreislauf* ([1937]

physiocrats. Marx theorized on the ‘circular-flow of productive capital’ in the second volume of *Das Kapital* ([1893] 1969, 394) by taking the *tableau économique* of the Physiocrats as the major inspiration. Schumpeter saw Quesnay’s thought on interdependence as a forerunner of Walras’ model of general equilibrium, and Schumpeter certainly described static equilibrium as a static circular-flow (Schumpeter, 1954, 918). Mises also credits the birth of economics in the “discovery of the inescapable interdependence of market phenomena”, for which he very probably had the Physiocrats in mind (1949, pages 2 & 9). This aspect of the circular-flow, or the interdependence of economic phenomena, is certainly something that the *tableau économique* was supposed to convey and it is of the utmost importance. There is no doubt about this.

In the German literature on the ‘circular-flow’ we also find a methodological imperative to ‘close’ each scheme of a circular-flow that is drawn (Burchardt, 1931; Schmölders, 1961). All expenditures *must* be somebody’s receipts within the circular-flow. All output produced by one sector *must* become an input in another sector. This idea is perhaps best exemplified by the class of goods called ‘means of subsistence’, which is both input and output of the agricultural sector (or *classe productive*). In other words, ‘closing’ the circular-flow means that when drawing the circular-flow we need to show how everything is interconnected, and in what ways.

### 2.3 Period Analysis

But there is another aspect of the *tableau économique* which is perhaps just as important, and which perhaps also nuances a *total* interdependency of economic phenomena that the emphasis on the ‘analysis of the circular-flow’ tends to bring about. This aspect can be distinguished from the ‘analysis of the circular-flow’ and is called *period analysis*, and sometimes *sequence analysis*. It is a phrase one will find more easily in the English than in the German literature (Baumol & Turvey, 1959, 127; Schumpeter, 1959, 471, 538, 1126; Eagly, 1974, 43-45; Skinner, 1967, 154; 1996, 164; Sowell, 2006; Tieben, 2012, 4). The phrase ‘period analysis’ refers to the fact that the *tableau économique* was a model

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1955); A. Bilimovič; „Das Allgemeine Schema des Wirtschaftlichen Kreislaufes“ (1942); Erich Schneider, in a chapter called “Das Kreislaufbild von Eugen v. Böhm-Bawerk“ in *Einführung in die Wirtschaftstheorie* (1962, 61-62); Ernst Helmstädter, „Linearität und Zirkularität des Volkswirtschaftlichen Kreislaufs“ (1965); Helmut Reichardt, *Kreislaufaspekte in der Ökonomik* (1967). These writings on the circular-flow are hardly ever combined with a period analysis.

of *annual reproduction*. The *year* is, after all, a period, and one period is followed by another period *in sequence*<sup>66</sup>.

The sequential aspect of the *tableau économique* is born-out particularly well by the phrase ‘*avances*’ (advances), by which previously accumulated stocks of money, raw materials or means of subsistence were meant. The physiocratic school and (especially its main fellow-traveller, Turgot) upheld the *thesis* of the necessity of having accumulated stocks (savings, advances) on hand in order to be able to produce<sup>67</sup>. The reasoning behind this thesis is that the farmworkers must be fed with the corn from a previous harvest, they cannot not be fed with the corn that still has to be harvested.

In order to study the effects of this necessity of having accumulated stocks at hand, i.e. the necessity of making advances, the Physiocrats laid the basis of a *working hypothesis* that is difficult to distinguish from the thesis of the necessity of making advances. This working hypothesis of classical economics is that production in an economy is characterized by a *discontinuous* type of production-activity, meaning that all production processes commence at the beginning of a period (such as preparing and sowing agricultural land) and concludes at the end of that period (such as harvesting the land). The ‘discontinuous’ aspect of such a working hypothesis – called ‘period analysis’, ‘sequence analysis’ or the ‘annual harvest assumption’ – means we assume that there are no overlapping production-activities. For example, under the ‘annual harvest assumption’ it is *not* the case that while one field is being sown-in, *at the same time* another field is harvested<sup>68</sup>. Of course this working hypothesis is not in line with reality, since in reality production-activity is often characterized by being ‘continuous’ or ‘synchronized’ in the sense that many production processes are commenced, continued and concluded at the same moments in time (Taussig, 1898, 24). In actual agriculture, we can see that while one field is being tilled, or sown-in, another field is harvested.

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<sup>66</sup> Zeuthen seems to define sequence analysis in the following way: “[i]f we take the course of time into consideration, it may be appropriate to follow the events in their chronological sequence and see how the events in the first period form the basis of those in the following” (1957).

<sup>67</sup> Especially in the *Philosophie Rurale* [1763], see the translation by Meek (1962, 57); Turgot stresses this point in his *Reflections*.

<sup>68</sup> Negishi uses the phrase “annual harvest assumption” and defines as such: “The annual harvest assumption in the simplest version implies point input-point output in the sense that the time interval between an input and the resultant output is a technologically given constant and identical to the time elapsed between an input and the subsequent input, or between an output and the next output” (1985, 59-60).

However, pointing out this unrealistic aspect of the working hypothesis that has been called the “annual harvest assumption” (Negishi, 1985, 69) does not disprove the thesis that the farmworkers cannot be fed from the output of the harvest that is yet to come, that their subsistence must be an advance out of a previous harvest. It is precisely the fact, that in reality production is often continuous, which obscures a clear view on the consequences of the necessity of having accumulated stocks before one can produce<sup>69</sup>.

#### **2.4 Combining Circular-Flow Analysis and Period Analysis**

In a *functional sense*, output becomes input. Harvested corn becomes seed-corn. Harvested corn is the means of subsistence of the farmworkers that prepare the land for a corn-harvest. Hence there is a certain ‘circularity’ of economic life and one is justified in calling this discovery a ‘circular-flow’. Uncovering or ‘mapping’ connections and interdependencies between actors in the economy (be they classes, sectors, firms, households, etc.) is the fundamental task of ‘circular-flow analysis’. Circular-flow analysis is to study the functional aspects of the economy or ‘structure of production’.

However, in a *chronological sense*, the corn that is harvested (the output) is not exactly the same corn as that was used as the seed-corn (the input). A period analysis must accompany circular-flow analysis since only in a functional sense things ‘can move in a circle’. The corn produced by today’s harvest cannot actually move back into a circle towards feeding the farmworkers that were tilling the land in the months before today’s harvest. Period analysis must trace the effects of the lapse of time on the structure of production.

The simplest way to achieve the combination of circular-flow analysis and period analysis seems to be to simply put a number of circular-flow-schemes (each representing a given period) in a sequence. We will touch upon this point further on this chapter.

### **3. Marx’ Departmental Scheme**

Karl Marx is well known for dividing the capitalist economy into two ‘departments’. One department that produces the means of production; the other department produces the consumer goods (Marx, [1893] 1969, 394). Marx has put his division of the economy into two departments into a *numerical*

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<sup>69</sup> In his *Wages and Capital, An Examination of the Wages Fund Doctrine* (1898, 1-25) Taussig defends the advances-thesis and provides a crude and simple type of period analysis at the end of its first chapter (although he does not call it period analysis).

*scheme* (ibid. 396). In that scheme, each department is represented by an equation in which the left-hand side represents the kinds of capital put in ('constant capital' designated by  $c$  and 'variable capital' designated by  $v$ ) as well as the *Mehrwert* (profit or 'surplus-value', designated by  $m$ ) of that department. The right-hand side then represents the exchange value of the product of that industry:

I.  $4000_c + 1000_v + 1000_m = 6000$  means of production

II.  $2000_c + 500_v + 500_m = 3000$  consumption goods

Marx' numerical scheme has been used by plenty of economists that would describe themselves either as Marxist or not as a Marxist. The reason is perhaps precisely that mankind is generally recognized as a tool-making and tool-using species, two activities that Marx' departmental scheme portrays rather simply and effectively.

Marx' explicit classification of these two industries also appears with economists that do not seem to be inspired directly by Marx. Especially in the business cycle literature, the distinction of between consumer goods industries and capital goods industries has been often made. The reason is that there is wide agreement in that literature that 'capital goods industries' show a wilder swing in activity during the business cycle compared to the consumer goods industries. As W. Röpke argued:

“it should also be quite clear at this point that this rise appears first and foremost in those industries which produce the capital goods necessary for the expansion of the productive equipment (machines, iron and steel, building materials, &c.) and are thus known as *capital goods industries* in contrast to the *consumption goods industries*. Modern trade-cycle theory is indeed unanimous concerning the *fundamental principle* that *the alternation of boom and depression is first and foremost an alternation in the volume of long-term investments and thus in the activity in the industries producing capital goods*. All economic phases, and especially the boom, are wont to attain their maximum effect in these industries: hence the striking increase in the consumption of iron and coal.” (Röpke, [1932] 1936, 25, emphasis in original; cf. Mitchell, 1913, 471-72 and 483-84; Aftalion, 1913, 30; Hayek, 1931, 29<sup>70</sup>; [1929] 1933, 59-60).

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<sup>70</sup> Hayek's second lecture of his *Prices and Production* (1931 & 1935) is called "The conditions of equilibrium between the production of consumer goods and the production of producers' goods".

Hence, from the point of business cycle theory also, if any schematics on the ‘structure of production’ is undertaken, there is reason enough to distinguish in such schematics between consumer’ goods industries and capital goods industries.

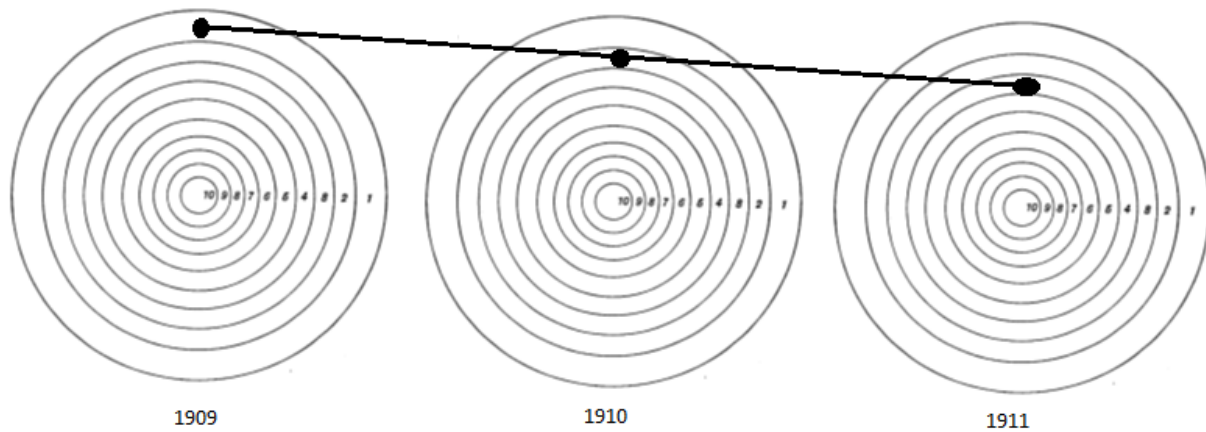
#### 4. Böhm-Bawerk’s ring-scheme

Before discussing Hayek’s triangular scheme in the next section, we should first briefly recall Böhm-Bawerk’s ring-scheme and its place in Böhm-Bawerk’s production theory.

In his theory of roundabout production, Böhm-Bawerk employs what can be called a *plan analysis*. That means that Böhm-Bawerk considers an actor and his production plan, but not what lies beyond that plan. Every plan has an end; a production goal; a plan-horizon. With Böhm-Bawerk the plan has clearly defined inputs (man’s labour and nature). Within the plan tools are manufactured, and these tools serve as a means towards producing the production goal, namely consumer goods. Böhm-Bawerk calls the inputs (labour and nature) the ‘original factors of production’ and he calls the tools ‘intermediate products’. Since in this ‘roundabout’ production process we go (1) from land and labour to (2) intermediate products and then finally to (3) consumption goods, Böhm-Bawerk is said to have provided a “linear view of production” by a number of scholars (Helmstädter, 1962, 258; Bortis, 1990, 70; Hagemann, 1994, 112; Kurz, 2000, 168). This *linear view of production* of Böhm-Bawerk is characterized by the inputs (original factors of production) being dissimilar to the outputs (consumption goods). It is contrasted with a *circular view of production* which is characterized by the inputs being similar with the outputs.

However, it is often not clearly seen that *after* Böhm-Bawerk expounded his plan analysis with his theory of roundabout production, he in fact commences a *period analysis* that is entirely in the tradition of the Turgot and Smith. It has been dubbed Böhm-Bawerk’s “theory of reproduction processes” (Stavenhagen, 1969, 658). Where Böhm-Bawerk uses the term *period of production* to indicate the *variable* length of the production plan, he now employs the term *economic period* to refer to the annual round of production of *standard* length. In order to grasp the full importance of the ring-scheme, we must transcend the perspective on one period and look at a sequence of periods. We should portray a ‘ring-scheme’ for each economic period in a sequence:

*Figure 5:*



Once we put several ring-scheme's in sequence in such a way, we can see the following 'circular' aspects of Böhm-Bawerk's theory of production better:

1. The output of the latest stage (1) becomes an input to all other stages in the *next* economic period. After all, the latest stage will put out consumption goods (ready means of subsistence) which are to be consumed by all workers of all stages.
2. Böhm-Bawerk argues that the output of any intermediate stage can be "put back" to a higher or earlier stage (Smart-edition, p.112). This cannot be taken literally. In a chronological sense, the output is not 'put back', only in a functional sense can one 'put back' intermediate products<sup>71</sup>.

The ring-scheme emphasizes the time-to-maturity of production processes. However, it does little or nothing to illustrate the interdependence of sectors of the economy.

## 5. Hayek's Triangle

### 5.1 The 'Real Structure of Production'

We can now turn to what is regarded as a refinement of Böhm-Bawerk's ring-scheme. This is Hayek's triangular scheme – often called the 'Hayekian triangle' – and which appeared in Hayek's *Prices and Production* (1931, revised edition 1935). In the preface of *Monetary Theory and the Trade Cycle* ([1929] 1933), which to Hayek is in fact the preliminary companion volume to *Prices and Production*, Hayek states that in that in the former book he mainly discusses "the monetary causes which start the cyclical fluctuations" and that in the latter book he has "concentrated on the *successive changes in the real structure*

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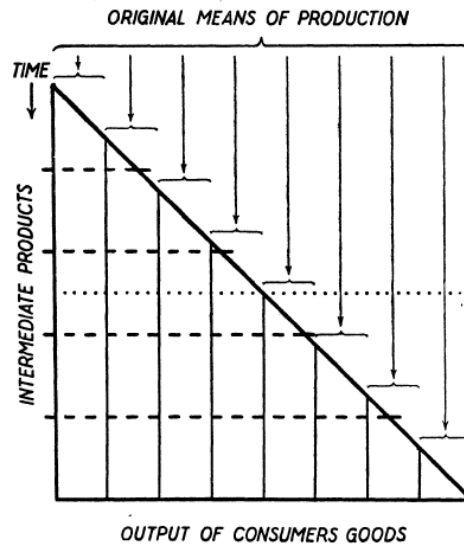
<sup>71</sup> Because the ring-scheme does not depict the 'putting back' of intermediate products, it is lacking as an analysis of the circular-flow, i.e. as an analysis of functional relations in the economy.



of production, which constitute those fluctuations” ([1929] 1933, 17, his italics). As the title of *Prices and Production* indicates, Hayek was joining elements of a theory of prices and money on the one hand, with a theory of production on the other hand.

Hayek employs a schematic representation of this ‘real’ structure of production in order to elaborate what he means by the ‘successive changes in the real structure of production’. Hayek provides such a scheme which depicts “the successive applications of the original means of production which are needed to bring forth the output of consumers’ goods accruing at any moment of time” (figure 6):

Figure 6



The triangular shaped scheme shows a *time-axis* which represents from top to bottom the time-consuming “successive stages through which the several units of original means of production pass before they become ripe for consumption” (1931, 36-37). (For the moment Hayek does not think of these stages as distinct steps in the production process, but as a “continuous flow”). For example, if the bottom horizontal line at the time axis is to represent the output of consumers’ goods accruing on the ‘moment’ of December 31<sup>st</sup>, and a ‘period’ represents a month, then the first of the successive stages of production begins on August 1<sup>st</sup>, as the horizontal broken lines may here be seen as separating months on the time-axis.

The principle way in which Hayek conceives of his scheme is that the bottom horizontal line represents the “output of consumers’ goods” at given moment (such as December 31<sup>st</sup>), and that everything above that horizontal line represent all that is needed to be done *before* that given moment in order to provide the particular output at that given moment. An alternative way of interpretation, that Hayek says is possible, is to conceive of the triangle as “representing the processes of production going on simultaneously in a stationary society” (37). In this alternative interpretation the triangle no longer represent all what must be done *at different moments before a given moment* in order to arrive at the output of consumers’ goods *at that given moment*, but it represents all that is done *at one moment* in order to help provide parts of the output of consumers’ goods *at different moments in the future*.

## 5.2 The Cross-Section of Production

Hayek subsequently argues that his initial schematic representation is still not adequate for what he wants to discuss. Hayek’s discussion that follows, appears in light of other literature as a rudimentary *period analysis*, albeit one that is more developed than Böhm-Bawerk’s. In his preface Hayek used the phrase “the ‘time-structure’ of production” (1931, ix) to give a name to his topic (he never used the phrase ‘period analysis’)<sup>72</sup>. This part of *Prices and Production* is really the core contribution of the lectures contained therein, and it is useful to look at Hayek’s ‘period analysis’ in detail.

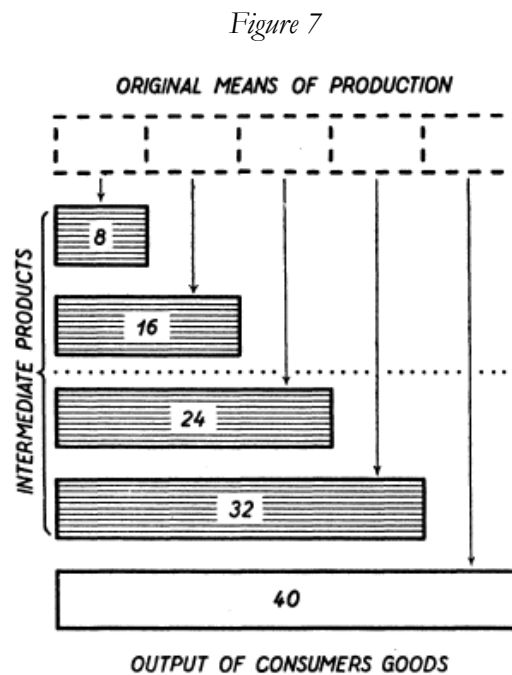
Hayek drops the idea of a “continuous flow” of not very distinct successive stages of production for “the assumption that goods move intermittently in equal intervals from one stage of production to the next” (39). This simplification can be achieved by making “cross sections through our first figure at intervals corresponding to the periods chosen, and to imagine observers being posted at each of these cross cuts who watch and note down the amount of goods flowing by” (39). These intervals are “indicated by the broken lines” that Hayek had already drawn horizontally (*ibid.* ; see figure 1).

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<sup>72</sup> The preface is the only place where Hayek uses the term “the ‘time-structure’ of production”, in the rest of *Prices and Production* Hayek simply uses ‘structure of production’. In *Monetary Theory and the Trade Cycle* he once uses the phrase “*real structure of production*”, but for the rest simply ‘structure of production’. It seems to me that Hayek had insufficiently pursued the distinction between a structure of production in a functional sense (what his contemporaries called a ‘circular-flow’); and the structure of production in a chronological sense (what he more or less seemed to call a ‘time-structure’ of production. The sequence of Hayekian triangles pictured in this section is meant as an interpretation of Hayek’s triangle in order to make it useful as a period analysis.

“I, personally, prefer to make it amenable to a simpler method by dividing the continuous process into distinct periods, and by substituting for the concept of a continuous flow the assumption that goods move intermittently in equal intervals from one stage of production to the next. In this way, in my view, the loss in precision is more than compensated by the gain in lucidity. Probably the simplest method of transforming the picture of the continuous process into a picture of what happens in a given period is to make cross sections through our first figure at intervals corresponding to the periods chosen, and to imagine observers being posted at each of these cross cuts who watch and note down the amount of goods flowing by.” (1931, 39)

Hayek then provides a new illustration, also of triangular shape, of such cross-sections (figure 7). In this second scheme the “goods flowing by” are classified into distinct “stages of production” illustrated by shaded blocks:



The second scheme (figure 7) is thus akin to the alternative interpretation on the first scheme (figure 6). It represents all that is done at one period in time in order to help provide parts of the output of consumers’ goods at different periods in the future. The top stage of production helps to provide for the “output of consumers’ goods” in the most distant period in the future, while each successive stage

down until the bottom stage of production helps to provide output in successively nearer periods in the future.

Hayek emphasizes that the “relative magnitudes” of the shaded blocks, in the two triangles he compares, refer to money values and not to physical quantities (51). Nonetheless the triangular scheme does indicate “relative magnitudes” of “physical quantities” to a certain extent. One is that the difference in length between each shaded block and the one preceding it signifies the amount of “original factors” used by that stage (ibid.)<sup>73</sup>. The other is that the number of stages is a simple indication of how many “original factors” are proportioned between cooperation for near future output and for distant future output. In comparing two cross-sections of two different stationary economies, the one with the greater (physical) capital stock also has more stages.

For defining the ‘capital intensity’ of the structure of production in a stationary state, Hayek uses Böhm-Bawerk’s “average production period” as a parallel measure – besides the actual number of stages. In the triangular scheme this ‘average period of production’ is indicated with a dotted line through the middle of the stages.

### 5.3 The ‘Stationary State’

Hayek uses his triangular shaped ‘cross-section’ as descriptive of a ‘period’<sup>74</sup> within a “stationary state” (1931, 40). The quantity indicated in each stage (8, 16, 24, 32, 40) describes the value of output in a period<sup>75</sup>. This “stationary state” simply means that the economy is repeating itself after the passage of a certain “production period” (cf. Machlup, 1935, 581-583). As the illustration of one cross-section of a period in a stationary state is identical in shape to all others in a stationary state, there is in principle no need for Hayek to depict a sequence of identical cross-sections in discussing a given stationary economy (cf. Taussig, 1908, 338). However, by depicting a chronological order of cross-sections (in figure 3 below) we will clear up the difference between Hayek’s “stationary state” of

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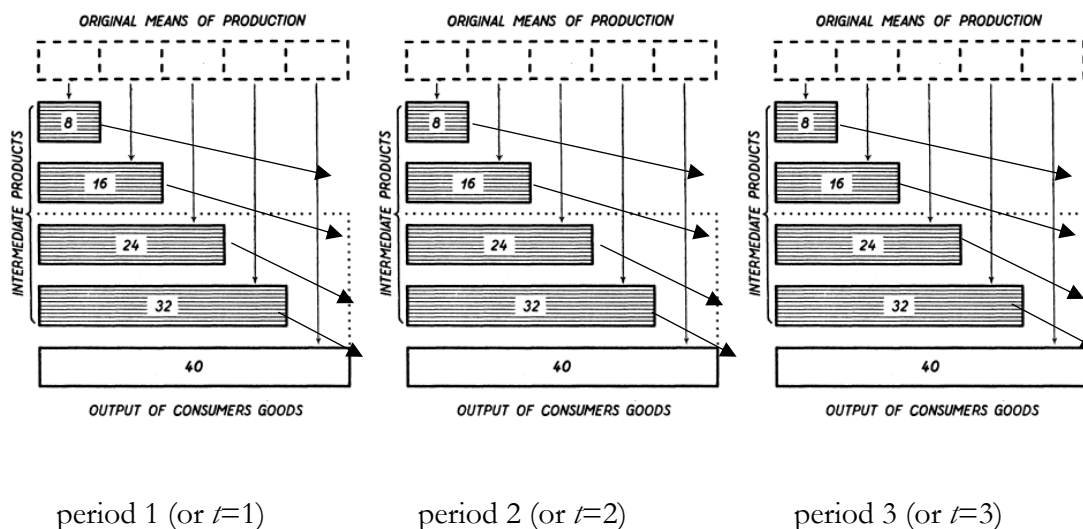
<sup>73</sup> For example, the third stage of production, counting from the top, has an output of 32 units, 24 of which are inputs which are the intermediate products of the previous stage, the rest, 8 units, are original means of production.

<sup>74</sup> This “amount of goods flowing by” at a cross-section can be either understood as an amount of ‘flow’ in a unit period of time, but also as an amount of ‘stock’ at a moment of time.

<sup>75</sup> This feature of the triangle could be extended to indicate both the *potential* output in a value and the actual output (or capacity utilization) with another value.

“distinct periods” and the non-chronological point of view that was at the time sometimes called a “circular-flow” (cf. Machlup, 1935, 581-583).

Figure 8



A cross-section of Hayek’s stationary economy combines the “intermediate products” - which are produced by the “earlier stage” or “higher stage” of the cross-section of one period *earlier* - with “original means of production” available within the *current* period. For example, the “intermediate products” produced by the highest stage of a cross-section at period 1 will be used as inputs in the second highest stage at period 2, etcetera (see figure 3). The one exception is the highest stage of production, which is the stage of production which produces without “intermediate products”, but only with “original factors” (labor and land)<sup>76</sup>.

Hayek does not argue his cross-section of a stationary economy to be in a ‘circular-flow’ (*Kreislauf*)<sup>77</sup> in the sense in which either Schumpeter or Leontief defined a ‘circular flow’. To Leontief, to postulate

<sup>76</sup> Hayek switches from the terms “earlier stages” and “later stages” of production to “higher stages” of production and “lower stages” well after he has switched from his first triangular scheme (with a time-axis) towards his triangular shaped cross-section. In the second edition of *Prices and Production* he mentions that this is done on purpose.

<sup>77</sup> Hayek does not use the word ‘circular-flow’ (*Kreislauf*) in *Prices and Production*. He did use it in his article “The ‘Paradox’ of saving” ([1930] 1931), but there he uses that term in the sense of the ‘circular-flow’ (circulation) of money.

a ‘circular-flow’ is to “imagine the economic process as a closed causal chain”, where “[b]etween any two neighbouring elements [...] there lies a distinct, if infinitely small time interval” ([1928] 1991, 184; cf. Schumpeter [1926] 1934). Hayek’s cross-section of production is not used by him as a closed and interdependent system, as a ‘static equilibrium’ which is *imagined* to be in movement at a moment of time (Löwe, [1926] 1997; Van Dorp, 1937, 108; Machlup, *ibid.*). Rather, his triangular shaped cross-section is simply meant to be an accounting device for an economy that moves forward in time, which is characterized by having no growth nor a decline in its stock of intermediate products. The ‘stationary state’ is simply an initial benchmark against which Hayek will formulate his time-based study of a changing structure of production in the rest of his book.

#### **5.4 The transition from one stationary state to another**

After the initial explanation of his triangular scheme, Hayek proceeds to a treatment of his main problem, which is “the problem of how a transition from less to more capitalistic methods of production, or vice versa, is actually brought about” (1935, 49). As becomes clear, Hayek asks with this question how a stationary economy with a certain capital stock (and an output of consumers’ goods correlated with it) can be transitioned to a stationary economy with a greater capital stock (and the larger output of consumers’ goods correlated with it). Hayek’s answer to this question is basically twofold, as he considers both the monetary side and the real side of this transition. He firstly mentions the monetary side, arguing that this change “will take place if the total demand for producers’ goods (expressed in money) increases (or decreases) relatively to the demand for consumers’ goods” (50).

Rather than subsequently explaining how the transition will look from the real side, Hayek first shows how the shape of the cross-section is *after* the transition, rather than *during* the transition. In order to do so he considers his initial cross-section (the left part of figure 9) as the stationary economy before the transition. He pictures then subsequently an altered cross-section (the right part of figure 9) that he considers as the stationary economy after the transition to “more capitalistic methods of production”:

*Figure 9*

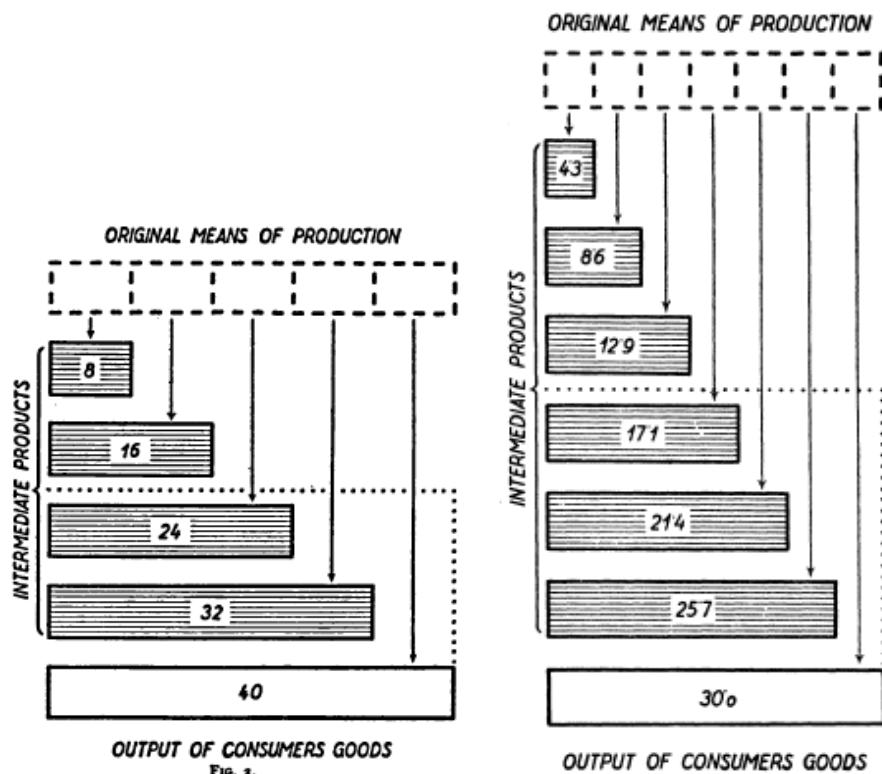


FIG. 2.

This situation *after* the transition shows how Hayek’s triangular scheme illustrates Böhm-Bawerk’s law of an “increase of productivity by roundabout methods of production” (1935, 38). According to Böhm-Bawerk, the earlier one starts with preparatory work, the higher will be the final output of consumers’ goods in the future. Hayek argues that if more money is *permanently* spent on capital goods, the number of stages will also increase, as the “original means of production” are reallocated to do earlier preparatory work (1935, 53) This means that the cross-sections of a stationary economy with the greater capital stock have more stages than the cross-sections of a stationary economy with smaller capital stocks. The reason is that the economy with the greater capital stock starts, at each cross-section of its productive process, with preparatory work for a more distant future.

Only when Hayek considers the case of “forced saving” (an expansion of credit through the creation of additional money by banks) he points at the real side of affairs *during* the transition from one stationary state to another. The main consideration here is that: “the use of a larger proportion of the original means of production for the manufacture of intermediate products can only be brought about by a retrenchment of consumption” (57). Strangely, however, Hayek does not use his triangular

scheme to illustrate this temporary effect – which is also a condition – of a change to more capitalist methods of production (cf. Lowe, 1976, 110).

### **5.5 The non-distinction between durable and non-durable goods in the triangle**

Hayek's triangle is sometimes described as a model for the production of circulating capital only or as a way to treat both fixed- and circulating capital goods for convenience only as circulating capital goods (Lowe, 1976, 48)<sup>78</sup>.

In terms of the representation of 'circulating capital' (or 'goods-in-process') the triangle is indeed very straightforward. For example, out of four stages, the first stage may be seen as the mining of iron ore, the second stage as the smelting of iron ore, the third stage as the casting of iron into iron parts, and the fourth stage as the assembly of iron parts into finished consumer's goods.

Indeed, the triangle's representation of 'durable goods' (i.e. fixed capital) is less straightforward. In the first edition of *Price and Production* (1931) Hayek recognizes this difficulty in a footnote, in which he offers a way to understand the role of durable goods in his triangular scheme:

“There is some difficulty in regard to the way in which durable goods, particularly instrumental goods rendering services continuously throughout their working life, are to be taken account of in our schematic representation. While, for purposes of general theory, their period of life is to be considered equivalent to a roundabout production of corresponding length, for our purpose, it is more convenient to regard only that part of these durable goods which is currently used up and renewed as entering into the total of intermediate products existing at any moment.”(1931, 37; German edition [1931] 2016, 139).

Hayek thus seems to simply disregard in his scheme both the original production, as well as the replacement production, of durable goods. He simply assumes durable goods to be there as far as they are needed in the production process. In the preface to the second edition he admits that he “had

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<sup>78</sup> Hayek seems to heed to this view when he write in *The Pure Theory of Capital* (1941, 47): “Stress is laid on the role of circulating capital which arises out of the duration of the process of production, because this brings out particularly clearly some of the characteristics of all capital.”



to leave durable goods simply out of account”, but laments that he had not sufficiently explained why he did so in the footnote cited above (1935, xii). The reason Hayek left ‘durable goods’ out of account in his triangle is that he found it unrealistic that ‘durable goods’ regularly change hands between entrepreneurs in his scheme of a downflowing stream of “intermediate goods” and an upwards “money stream” (ibid, xi-xii).

In the second edition, however, Hayek offers a way of incorporating ‘durable goods’ into his scheme, which he explains in a footnote that replaces the one of the first edition cited above. He argues:

“the triangular figures may be taken to represent not only the stock of goods in process but also the stock of durable instruments existing at any moment of time. The different instalments of future services which such goods are expected to render will in that case have to be imagined to belong to different ‘stages’ of production corresponding to the time interval which will elapse before these services mature.”  
(1935, 40)

This way of treating ‘durable goods’ is rather complicated: Half-built machines will provide little to none “output of consumers’ goods in the near future, but more so in the distant future. The “instalments of future services” of such half-built machines then belong to the higher (earlier) stages of production. Almost worn-out machines will provide quite some “output of consumers’ goods” in the near future, but probably none in the distant future. The “instalments of future services” of almost worn-out machines thus belong to the lower (later) stages. Brand new machines will help to increase the “output of consumers’ goods” in the near future, but will also contribute in the distant future. Their ‘instalments’ belong to both higher and lower stages.

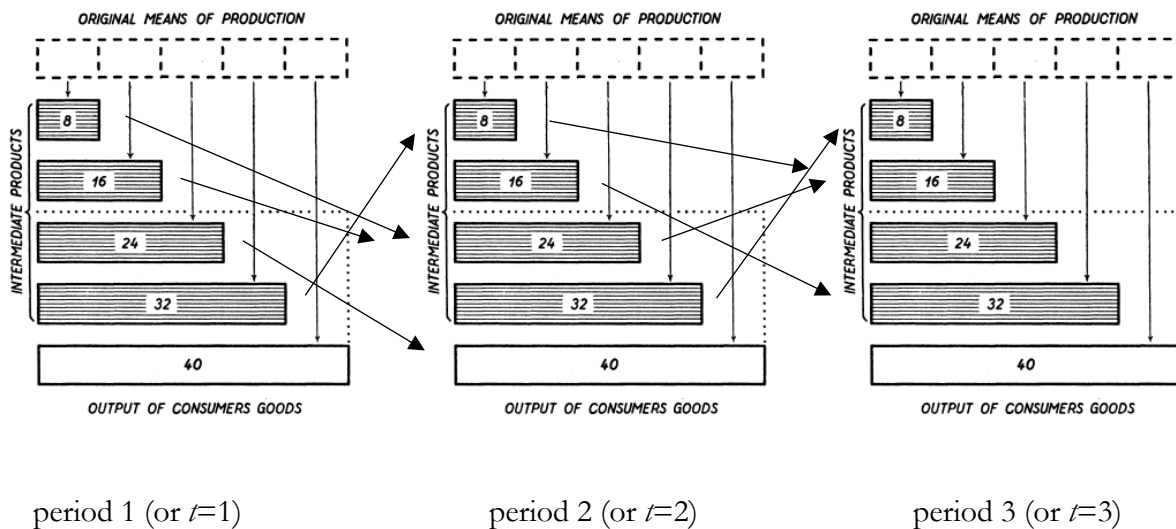
In Hayek’s way of treating durable goods one cannot distinguish between machines that are unfinished, and machines that are finished and employed in production. Furthermore, under this way of incorporating ‘durable goods’ into the triangular scheme, ‘durable goods’ will remain indistinguishable from ‘non-durable goods’.

## 5.6 The distinction between ‘specific goods’ and ‘non-specific goods’

Only in the third lecture, after the second lecture in which Hayek introduces and utilizes his triangular scheme, he delves into the distinction between “producers’ goods of a specific character” and “producers’ goods of a more general applicability” (1931, 66-67; 1935, 71-72). He argues that during the course of the business cycle the “producers’ goods of a more general applicability” can and will be shifted by entrepreneurs to the stages in which their utilization will be the most profitable. To this class of “non-specific goods”, as he also calls them, “belong not only almost all original means of production, but also most raw materials and even a great many implements of a not very specialised kind—knives, hammers, tongs, and so on” (ibid.).

These considerations in the third lecture imply that “intermediate goods” which are non-specific can ‘flow’ from a lower stage of production in a cross-section at  $t=1$  to a higher stage of production of a cross-section at  $t=2$ . Or alternatively that non-specific “intermediate goods” may skip a stage. However, Hayek did not *illustrate* these considerations. If he would have illustrated subsequent cross-sections of an economy moving in time, then his verbal considerations on non-specific intermediate goods could have been illustrated in a manner as depicted in figure 10. Here, intermediate products of lower stages sometimes do not flow downwards but are “put back” to higher stages.

Figure 10



This consideration of the shifting of these intermediate products somewhat contradicts the ‘downflowing’ or ‘unidirectional’ *appearance* of the triangular scheme which he had presented in the second lecture. Hayek’s triangular scheme, if regarded on its own, obviously *suggests* that intermediate goods can only flow downwards to lower stages (in later cross-sections) and only “original factors of production” can be shifted from higher to lower stages and vice versa. In this respect Hayek follows Böhm-Bawerk, who after he had *schematically* pictured the ‘downflowing’ aspect of intermediate goods in his ring-scheme, discussed *verbally* the ‘upflowing’ possibility of intermediate goods which are ‘put back’ to earlier stages of production (Böhm-Bawerk, 1891, 112).

The important thing here is that the *impression* that Hayek’s schematic view of the cross-section of production may leave - when one considers only a single cross-section - is one of a unidirectional flow of goods from earlier (higher) to later (lower) stages (cf. Hayek, 1939, 21-23). However, when the reader of *Prices and Production* separates the unidirectional earlier-to-later (by imagining or depicting subsequent cross-sections) from the multi-directional applicability of non-specific intermediate goods from higher to lower stages or *vice versa*, Hayek certainly recognizes that the process of production of consumer’s goods may involve zig-zag patterns of its inputs through higher and lower stages (cf. Hagemann, 1994, 112; cf. Kurz, 2000, 168; cf. Klausinger, 2012, 26)<sup>79</sup>. A shortcoming of the schematic representation of the production process in *Prices and Production* is that too little is done to clarify that the concept of ‘stages of production’ can be interpreted both temporally and functionally.

### 5.8 The ‘level of abstraction’

According to professor Garisson, probably the best-known contemporary user of Hayek’s triangle,

“[Hayek] right triangle depicts the macroeconomy as having a value dimension and a time dimension. It represents at the highest level of abstraction the economy's production process and the consumer goods that flow from it” (1994).

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<sup>79</sup> My personal point of view of *Prices and Production* is that Hayek’s exposition would have benefited by simply illustrating subsequent cross-sections of both stationary states and of the re-allocation of intermediate goods from one period to another.

The supposed advantage of treating fixed capital as circulating capital as the same thing is that it brings out the time-element. But it does so at the expense of being able to differentiate between functions. As Professor Garrison notes:

“Hayek’s triangle can be more misleading than enlightening. The entrepreneur is not supplied with – and cannot create for himself – a Hayekian triangle complete with a clearly marked sign that reads: YOU ARE HERE. Designed to emphasize the essential time element in the production process, the triangle abstracts from the actual complexities of the economy’s capital structure. Feedback loops, multiple alternatives for inputs, and multiple uses of outputs, all of which destroy the strict linearity implied by the triangle, are not the exceptions but the rule.” (2001, 82)

Where should we place the entrepreneur that owns a mine and who brings iron ore to the market? Iron ore can relatively swiftly be put into iron, which in turn can be relatively swiftly be put into consumption goods, such as bicycles. But iron is also a material for much machinery, machinery which takes a relatively long time to produce. Since machinery is often quite durable, it will help to put out products for years to come. Where to place this entrepreneur in the triangle? As it is, it is too ‘abstract’ to do so.

What remains to be seen, however, is whether the distinction between fixed- and circulating capital is an irreparable flaw of the triangle, or whether it can be amended.

## **6. Burchardt’s Critique of Böhm-Bawerk’s “Scheme of the Stationary Circular- Flow”**

The most important critique of Böhm-Bawerk’s schematic representation of the structure of production – the ‘stages-of-production’ concept as pictured by the ring-scheme – one finds in Burchardt’s two articles on “Die Schemata des stationären Kreislaufs bei Böhm-Bawerk und Marx” (1931 & 1932). The first of these two papers deal mostly with Böhm-Bawerk’s ring-scheme. Besides a general introductory discussion as to the purpose and use of the *schematics* of production and a critique of Böhm-Bawerk’s ring-scheme in particular, this paper also touches upon the way in which

Böhm-Bawerk incorporates the notion of *time* into his production theory. We will here concentrate upon Burchardt's contribution to the schematics of the structure of production<sup>80</sup>.

### 6.1 The primacy of the “technological facts”

Burchardt did not hide in the introductory section of his review of Böhm-Bawerk's “stationary scheme of the circular-flow” that it was embedded in his research into business cycles. As an adherent of the ‘non-monetary business cycle theory’, Burchardt also states that he believes that the business cycle must be explainable “from the goods-side”. In order to elaborate such a non-monetary business cycle theory, he thinks to be in need of a theory of economic growth, since “as critical point of departure the stationary circular-flow does not suffice anymore and must be replaced by a theory of the growing economy” (1931, 526). The problem with this is, however, that “[i]n contrast to the clean foundation of static theory, which is a closed and universally accepted system, the theory of the growing economy is relatively unfinished and controversial” (ibid.). This realization brings him to study the “analysis of the circular-flow”, since “dynamic theory” initially builds upon that analysis<sup>81</sup> (ibid, 527).

Burchardt puts this “analysis of the circular-flow” into a field of study that deals with the “pre- or meta-economical preconditions” (531). According to Burchardt, both Marx and Böhm-Bawerk provided verbal or schematic ‘models’ of simply-reproducing or ‘stationary’ circular-flows. These schemes deal with labor, capital, and the division of labour into partial tasks (*arbeitsteilige Staffellung*) of the production process (531). By focusing on these “pre- or meta-economical preconditions”, Burchardt argues that he will be able to compare the “antipodes” Böhm-Bawerk and Marx (1931, 526). As Burchardt explains:

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<sup>80</sup> Burchardt's paper is important because there are a number of interesting and original points in them in relation to Böhm-Bawerk's production theory. However, it also contains a number of lesser original points of critique against Böhm-Bawerk. Many economists had already preceded Burchardt in criticizing Böhm-Bawerk, and Burchardt does seem to copy some of these criticisms. About the *interbellum* period in German economics, it has been rightly observed by professor Köster “dass die Autoren kaum Fußnoten setzen [...] und zudem unbedingt den Eindruck vermeiden, sie seien intellektuell von irgendjemand abhängig“ (2011, 205).

<sup>81</sup> Burchardt uses “dynamic theory” as synonymous with the “theory of the growing economy”. However, with “static theory” it seems that Burchardt means Walrasian static *price* theory, not the production-theoretic ‘schemes of the stationary circular-flow’ or ‘schemes of simple reproduction’ on which (according to Burchardt) “dynamic theory” builds and which Burchardt investigates in his papers of 1931 on Böhm-Bawerk (discussed here) and of 1932 on Marx (cf. Löwe, [1926] 1997).

“For the construction of the circular-flow it is indifferent, whether value- and price formation is explained with the help of the Marxian labor theory of value or with the Böhm-Bawerkian marginal utility theory, because with simple reproduction the value of goods stays constant” (ibid. 531, cf. Burchardt, 1932, 119).

With respect to Böhm-Bawerk’s work in particular, Burchardt points out that:

“Eugen von Böhm-Bawerk’s *Positive Theory of Capital* begins with a discussion of the concept of capital and the function of capital and, before all the strictly economic theory (value-, price- and distribution theory), explains a series of technological facts that *in nuce* contain the basic conceptions determining the further systematic construction. In almost insoluble interweaving, typical of well-thought-out theoretical constructions, the concepts of the period of production, the subsistence fund, maturity classes and production roundabouts are here defined. But precisely the economic-ontological character of this introductory clarification, which provides the terminological and technological foundation for the economic theory to be constructed on this foundation, allows comparison with the analogous problematic layer in Marx without going even further into the divergences of the economic-theoretical superstructure.” (532, Latin in original)

Burchardt thus takes note of the structure of Böhm-Bawerk’s theoretical system, in which a “theory of production” – the term that Böhm-Bawerk himself used for it – precedes Böhm-Bawerk’s theories of value- and price. These theories of value- and price in their turn precede Böhm-Bawerk’s theory of distribution<sup>82</sup>. It seems that this sequence and structuring of economic theory was entirely *unobjectionable* to Burchardt. *That* is the most interesting methodical agreement that underpins the

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<sup>82</sup> In Löwe’s later writings, especially in *On Economic Knowledge: Toward a Science of Political Economics* ([1965] 2017) under the Anglicised name Lowe, Lowe argues that economics is built-up from a theory on the “relationship between Man and Matter” on the one hand, and on the other hand the “relationship between Man and Man”. Furthermore, there is the combination of these theories. With different words a similar construction of economics is encountered in Lowe’s *The Path of Economic Growth* (1976). This way of construction economic knowledge is precisely the system that Böhm-Bawerk works out by starting with the most fundamental theory of ‘Man and Nature’ (what Lowe calls ‘Man and Matter’).

business cycle research of both Hayek (on the one hand) and Burchardt and Löwe (on the other hand)<sup>83</sup>.

## 6.2 The Ring-scheme and the Period of Production

The first element of Böhm-Bawerk's theory of production itself, that Burchardt takes note of, is Böhm-Bawerk's ring-scheme. Burchardt summarizes this element of Böhm-Bawerk's theory as follows:

“The total capital stock [of intermediate goods] is divided [...] by the temporal distance of the individual capital services from being ripe for consumption. This creates a temporal order of the production load. In every class, or, as Böhm says, in every ring, those intermediate goods belong which at the same time become ripe for consumption. So, in the first ring are those intermediate goods that mature in the current period to consumer goods. The second ring contains the goods needed to replace the goods that wear the first ring, such as machinery and semi-finished goods. The third ring produces the intermediate goods for the second ring. In the staged-order of ‘raw material-to-finished product’ another maturity-order is set up, which again subdivides the successive partial services of the durable capital stock according to ripeness for consumption. A machine of the third order of goods is thus only present in the third ring with its utilizable mass of wear and tear [*Verschleißmasse*] of the current year, with the unutilized remainder of amortization in the next higher class of maturity.” (532-533)

Then Burchardt argues that “the ring-construction [i.e. ring-scheme] finds its parallel in (but is not identical to) the formation of the concept of the average production period” (533). This parallel concept of the “production period of a consumer good”, according to Burchardt's reading of Böhm-Bawerk, “is found by tracing its creational processes” (533). Furthermore, the production period serves as a “measure of the capital intensity to describe the technical improvements that Böhm

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<sup>83</sup> Professor R. Köster has argued that Löwe and Hayek held methodologically “sharply diverging positions” (2011, 232-233). The sharp divergence lies more, it seems to me, on the level of their respective theses on what ultimately causes the business cycle: The decentralized steering of the market economy (Löwe) versus the credit-expansive nature of the banking sector (Hayek). No other schools in business cycle theory have seen such a great importance in a preliminary study of the structure of production as the Kiel School (Löwe & Burchardt) and the Austrian School (Mises, Hayek, etc).

characteristically calls prolonged production roundabouts” (534). With that ‘production roundabout’ itself is meant the opposite of production which does not involve the “time-consuming production of intermediary goods (tools, devices, etc)”: “The use of means of production whose production requires time, so that the consumers’ good only accrues later (but with whose help - which is indifferent here - a larger output is achieved), implies a production roundabout” (534-535)<sup>84</sup>.

### 6.3 The Indistinction of Fixed- and Circulating Capital in the Ring Scheme

The focal point of Burchardt’s evaluation of Böhm-Bawerk’s theory is the *ring-scheme*, of which Burchardt says that its “fundamental projection” is that “[a]ll goods ripen into consumers’ goods (535)”. To give more clarity to this fundamental projection, there comes an important interpretive step in Burchardt’s treatment of the Böhm-Bawerkian “circular-flow”. Burchardt finds it advisable;

“to make a distinction between the parts of capital which also in the technical sense go into consumers’ goods, and those that only in value terms help define the costs [of consumers’ goods], thus *cum grano salis* between ‘investment’ and ‘raw materials’ or between fixed- and circulating capital. The circulating capital of the ring closest to consumption goes into the value of consumers’ goods with its full product-value. The fixed capital only carries over the value on the consumers’ goods of the service-capacity that is the worn out during the economic period” (535-536, Latin in original).

What Burchardt suggests is to think of *two* ring-schemes side by side. In such an “unfolded scheme” one ring-scheme utilizes fixed capital to process circulating capital (raw materials) into consumers’ goods. Another ring-scheme then depicts how the former ring-scheme is supplied with the fixed capital it utilizes (536). In other words, it is to think of an economy with two departments: A consumers’ goods industry on the one hand, and a machine producing industry on the other. Thus, Burchardt undoubtedly used Marx’ *departmental scheme* to interpret and ameliorate Böhm-Bawerk’s ring-scheme.

However, Burchardt does not picture two rings-schemes side-by-side, he prefers to schematize his interpretation of an ‘unfolded scheme’ in a more mathematical fashion (figure 11):

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<sup>84</sup> It seems to me that time serves as a measure of the labor-saving efficiency of the tool that is produced in the time-consuming production roundabout, that is, the more efficient the tool, the more time will have to be put in to produce it. For discussions on this ‘law of roundabout production’ see Weiss (1921) and Eucken (1934).



Figure 11

- F..... = fixes Kapital der Produktionsmittelsphäre  
 f ..... = fixes Kapital der Konsumgütersphäre  
 I, II, III, IV.... = Indizes für die genetische Stufe  
 1, 2, 3, 4 ..... = Indizes für die Konsumferne der Amortisationsmassen  
 Z ..... = zirkulierendes Kapital der Produktionsmittelsphäre  
 z ..... = zirkulierendes Kapital der Konsumgütersphäre  
 (...). .... = bestimmt zur Reproduktion von...  
 — ..... = bezeichnet die Größen, die effektiv in der jeweiligen Wirtschaftsperiode vernutzt werden und wertbildend in das Produkt eingehen.

Nach dem Gesagten sieht das entfaltete Schema dann zunächst so aus:

Schema A

$$\begin{aligned}
 \underline{fI_1 + zI} + v & \dots\dots\dots = \text{Konsumfertiggüter} \\
 \underline{fI_2 + fII_1 + zII} + v & \dots\dots\dots = \text{Konsumhalbfabrikate} \\
 \underline{fI_3 + fII_2 + fIII_1 + zIII} + v & \dots\dots\dots = \text{Konsumguthalbzeug} \\
 \underline{fI_4 + fII_3 + fIII_2 + fIV_1 + zIV} + v & \dots\dots\dots = \text{Konsumgutrohstoffe} \\
 & \quad \underline{fII_4 + fIII_3 + fIV_2} \\
 & \quad \quad \underline{+ fIII_4 + fIV_3} \\
 & \quad \quad \quad \underline{+ fIV_4}
 \end{aligned}$$

Schema B

$$\begin{aligned}
 \underline{FI_1 + ZI} + v (fI-IV) & \dots\dots\dots = \text{Produktionsmittel-} \\
 & \quad \text{Fertiggüter} \\
 \underline{FI_2 + FII_1 + ZII} + v (fI-IV) & \dots\dots\dots = \text{Produktionsmittel-} \\
 & \quad \text{Halbfabrikate} \\
 \underline{FI_3 + FII_2 + FIII_1 + ZIII} + v (fI-IV) & \dots\dots\dots = \text{Produktionsmittel-} \\
 & \quad \text{Halbzeug} \\
 \underline{FI_4 + FII_3 + FIII_2 + FIV_1 + ZIV} + v (fI-IV) & \dots\dots\dots = \text{Produktionsmittel-} \\
 & \quad \text{Rohstoffe} \\
 & \quad \underline{FII_4 + FIII_3 + FIV_2} \\
 & \quad \quad \underline{+ FIII_4 + FIV_3} \\
 & \quad \quad \quad \underline{+ FIV_4}
 \end{aligned}$$

### 6.4 The Partial Self-Reproduction of Real Capital

The interpretive step of thinking of two parallel ring-schemes helps Burchardt to point out what to him, it seems, is the most important problem in the Böhm-Bawerkian model of the (stationary) circular-flow. This problem lies on the part of the machines producing industries, were the “last ring, most distant to consumption, is produced by naked labor without the cooperation of capital” (538).

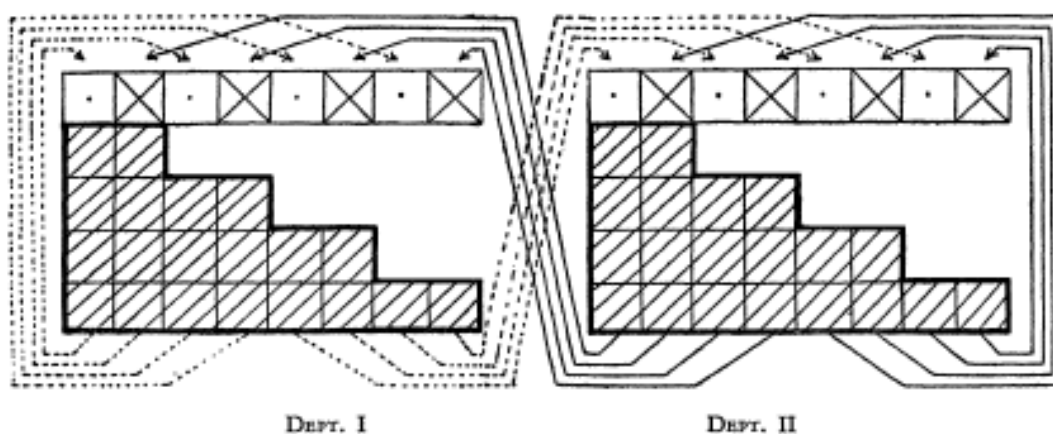
Burchardt points out that this last ring<sup>85</sup>, as a stage of production that uses only labor, is problematic, because: “The ring-scheme wants to give a structure of the existing capital stock of an economy, and show the conditions of its maintenance, but by no means wants to make understandable the once-only creation of the current capital stock (540)”. In a distant past production must have gone on without the help of capital (capital goods), and the capital stock must have initially been created without the help of capital, but this consideration in no way relates to a modern economy of which one needs a model of its circular flow (539-541). Burchardt looks to solve this “problem of the last ring” (541) by pointing to the *fact* that the machine building industries, “next to machines for the consumer goods industries also build the machines, that are applied for reproduction of themselves” (546), which he also calls the “partial self-reproduction of capital goods” (547). One gets the impression that capital goods should not only be viewed as “intermediate goods”, but also as the initial inputs in the scheme of the concentric rings.

## 7. Further Developments from Burchardt’s Paper

### 7.1 Nurkse

Burchardt’s suggestion to depict two ring-schemes side-by-side was picked-up by Ragnar Nurkse. Nurkse, however, applied it to Hayek’s triangle, as this triangle was clearly an adaption of the ring-scheme (figure 12):

Figure 12



<sup>85</sup> The inner-most ring of Böhm-Bawerk, nr. 10, is the ‘highest’ or ‘earliest’ stage of production, and Burchardt refers to it as the ‘last ring’.

Nurkse's scheme is perhaps best described as a 'double Hayekian triangle', or as a hybrid of the Marxian departmental scheme and the Hayekian triangle. One triangle represents "department I" or "industries producing instruments of production" and the other triangle represents "department II" or the consumer goods industries (1935, 235). Nurkse also drew this schema as a model of a 'closed system' in which the products of both departments are partly consumed by the industry itself and partly traded with the other industry: The consumer goods department provides one part of its output of consumer goods to feed its own workers, another part is traded with the machines producing departments: Consumer goods are traded against machinery. The machine producing department in turn also consumes some of its own output as it produces its own machinery.

Nurkse was thus able to maintain Hayek's need for portraying that fixed capital is in varying stages of completion towards becoming complete machines, but he was also able to distinguish this construction of fixed capital (by machine producing industries) from the turnover of raw material into finished consumers' goods (by consumer goods industries). Hence the objection against Hayek's triangle, that it does not distinguish fixed- from circulating capital goods, can indeed be easily overcome by doubling that triangle<sup>86</sup>. Furthermore, the problem identified by Professor Garrison, that the stages of Hayek's triangle do not easily refer to industries or production processes in reality, can be remedied a great deal. One triangle can be interpreted as varying stages of machine-production (research & development; toolmaking; parts-manufacturing; assembly) while the other triangle can be

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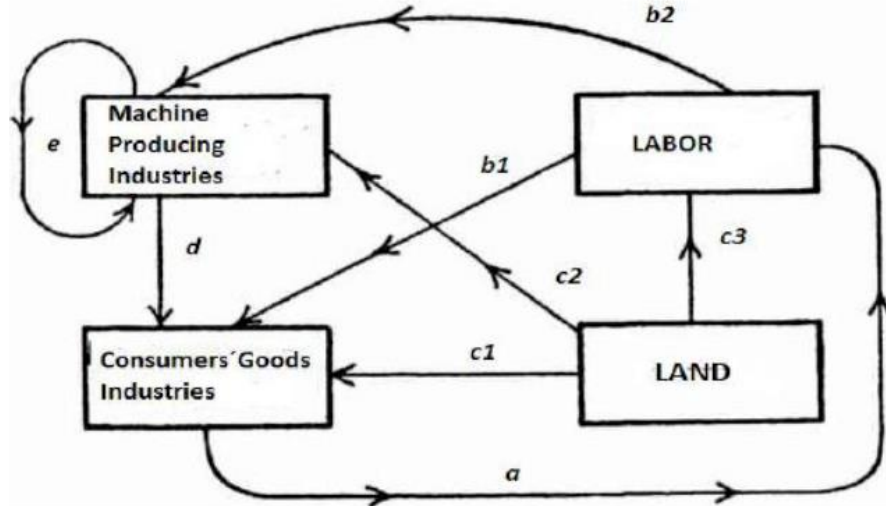
<sup>86</sup> In Professor Skousen's *The Structure of Production* (1990, 153) the "problem of circularity" is identified as a "major critique of the concept of the stages of production concept". Interestingly, a page before Skousen points to this major problem, he has already offered a solution to this problem by stating that: "heavy machinery involved in iron ore production as well as all other higher-order tools also have their own sequential process of manufacturing apart from the iron ore operation, but we must make a sharp distinction between *current* production of these higher-order capital goods and *past* production of these machines which are now being used to extract iron ore"(p152). Skousen adds a footnote citing Tryge Haavelmo that: "[i]t is really not necessary that we go back to a point in history where there was no capital" (Skousen, *ibidem*, 176). I believe I may interpret this as in fact (1) an argument for *two* orders of production, one for circular capital, one for machines or tools and (2) as an argument for recognizing that the highest order of production must be that order that reproduces the same or better versions of the tools and equipment. Professor Skousen's position comes down to the same point as Professor Hagemann's summarization of Burchard's paper (1990, 149). I believe it is not farfetched to assume that Haavelmo had picked up his insights from Adolph Lowe when he was at the New School for Social Research in New York during the 1940's. Also, professor Skousen has included Nurkse's 1935 paper "The Schematic Representation of the Structure of Production" in the literature section of his *The Structure of Production* (1990), but oddly enough he does nowhere refer to this paper in his book, although the titles of Skousen's book and Nurkse' paper overlap to a great deal!

seen as stages representing the turnover of raw materials into consumers goods (e.g. smelting of iron ore; iron bar production; bicycle production).

## 7.2 Schneider

Burchardt's message regarding the 'partial self-reproduction of fixed capital' was also received well. The actual scheme that most clearly pictures this notion of the "partial self-reproduction of capital goods" (which is also called the "partial self-reproduction of real capital") we find with Erich Schneider (1935). He depicted the following 'departmental scheme'<sup>87</sup> (figure 13):

Figure 13



It can be noted that Schneider only uses his depiction of the circular-flow as a way of dismissing the Böhm-Bawerkian theory of production. Schneider followed Burchardt only in this negative aspect, for even though Schneider drew a simply and useful depiction of Burchardt's discovery (so to speak) of the 'partial self-reproduction of real capital', no further development out of this discovery can be found with Schneider. For a development of this point, we will have to go to A. Lowe (Burchardt's dissertation supervisor).

<sup>87</sup> I have translated the words in the four rectangular shapes and added designations to the arrows or "flows" between the rectangles.

### 7.3 Lowe

The importance of the fact that “next to machines for the consumer goods industries [the machine producing industries] also build the machines, that are applied for reproduction of themselves” was not really pointed out by Burchardt. However, Burchardt’ thesis supervisor, Löwe, did point out why this fact is so important for understanding the industrial system and why it is important in the schematics of the structure of production.

In order to do so, Lowe draws an analogy with the production of wheat. Wheat is not only an output of wheat production, it is also an input. Lowe states what must be done if one wants a constant yield of wheat:

“How can the output of, say, wheat be maintained? Disregarding tools altogether, we require for this purpose labor, land, and seed wheat. A constant yield is assured only if part of the final product, wheat, is allotted every year not to consumption but, in the form of seed wheat, to the production of the next crop. And if the next crop is to be increased over the present one, the ratio of the productive use to the consumptive use of wheat has to be raised” (1952, 148)

Lowe argues that it is similar with machine-tools, that is, with the type of machinery that the machine producing industries use:

“Only if we succeed in discovering the realm of fixed-capital goods certain instruments which share with wheat the capacity for physical self-reproduction can our problem be solved. In other words, we have to look for a type of equipment which is technically suited to produce other equipment as well as its own kind. What we find, as a matter of fact, is not one single instrument, but the comprehensive group of instruments which are classified as machine tools. They are for industrial production what seed wheat or the reproductive system in animals represents for agricultural production. They form an indispensable part of input whenever an equipment good, including machine tools themselves, is to be produced. And in the industrial sphere, as is the case in the agricultural sphere, saving and investing rest on a technical foundation: the fact that the existing stock of machine tools can be used for the production new machine tools.” (ibidem, 149).

In other words, some of the machines that the machine producing industries put out must be machine-tools, since they are the ‘seed’ to produce new machinery. It is from this consideration that one can draw the conclusion that there exists a *near future-distant future trade-off* in the production of machinery. One could allocate all the machinery of the machine producing industries towards only producing specialized equipment for the consumer goods industries. That would increase output of consumer goods in the near-future. But since the equipment of the machine producing industries themselves is not replaced as it is wearing out, such an allocation would be detrimental to the output of consumer goods in the more distant future. To re-allocate machine-tools towards producing more machine-tools is what Lowe would eventually call a “backward switch” – a term very similar to ‘putting back’ (1976, 160). The “backward switch” has as its result that, since less resources are devoted to producing machinery for the consumer goods industries, the output-capacity of the consumer goods industries declines (or at least does not grow as much as it could). However, since the number of machine-tools is now increasing more than before, the capacity to produce machinery is increasing, which is beneficial for the distant-future output of consumption goods<sup>88</sup>.

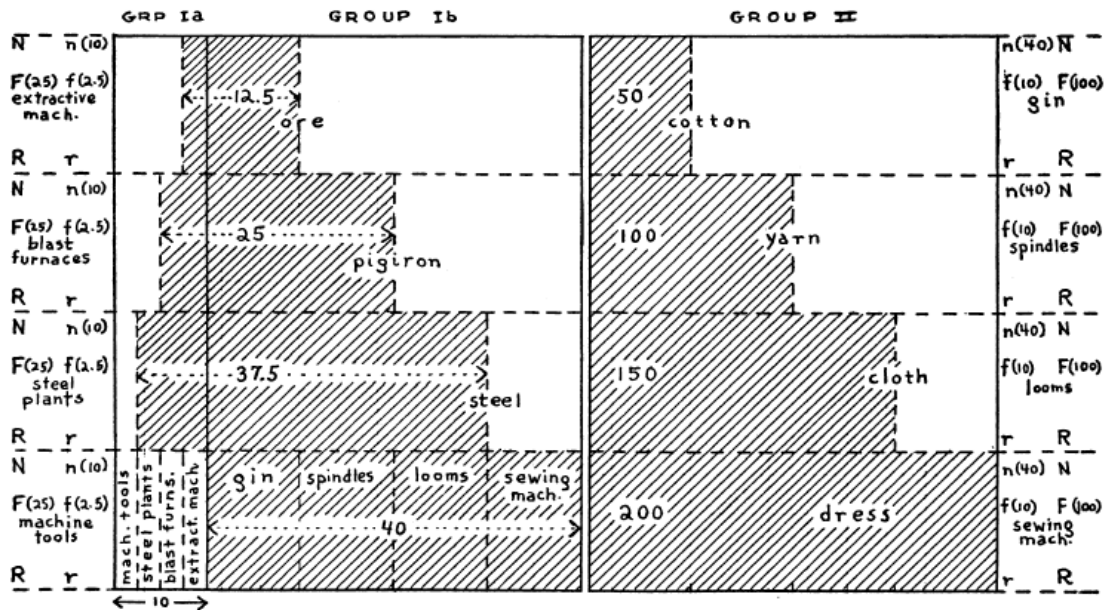
Lowe would incorporate his considerations about the self-reproducing characteristic of the machine producing industries in an actual “schema of production” (figure 14 below, 1952, 1950; cf. 1976, 32). This schema which was in a sense a development of Marx’ departmental scheme since in which ‘department I’ was divided into two sub-departments. Sub-department ‘group 1a’ is responsible for producing machine-tools for the machine producing industries themselves (partial self-reproduction); ‘group 1b’ produces the machinery for the consumer goods industries:

*Figure 14*

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<sup>88</sup> The same argument was made, probably independently of Lowe, by Soviet economist G.A. Fe’ldman. See his “On the theory of growth rates of national income” in Nicolas Spulber, ed., *Foundations of Soviet Strategy for Economic Growth* (1964).

## SCHEMA OF PRODUCTION



An important aspect of Lowe's scheme, and its division of the machine producing department into a subgroup 1a and a subgroup 1b is that they can easily be tied to industries in reality. By first dividing all industries into 'capital goods industries' (groups Ia and Ib) and 'consumption goods industries' (group II). Subsequently it becomes possible to order sub-industries according to the level of completion of either machines or consumption goods.

The Lowe's scheme conforms well to reality is evidenced nicely by professor Floud's *The British Machine Tool Industry 1850-1914* (1976). Professor Floud writes of machine-tool firms and engineering firms, who both use machine-tools. The machine-tools firms are normally producing machine-tools using machine-tools, while the engineering firms are those that normally use machine-tools to produce equipment (though not machine-tools) for other industries. Now 'machine tool firms' and 'engineering firms' are perfect real-world counterparts of the subgroup 1a and subgroup 1b (respectively) in Lowe's departmental scheme. Also, Professor Floud points out that (in the history of machine-tool making) indeed engineering firms have entered the machine-tool business and *vice versa*. The engineering firms could, after all, use their ownership of machine-tools, and experience with machine-tools, to start making machine-tools themselves. Machine tool firms could move in the opposite direction, by

starting to make specialized (non-machine tool) equipment for other industries, thus becoming ‘engineering firms’ (1976, 42).

Besides it being obvious that Lowe’s schema was a development of Marx’ departmental scheme, we also see a resemblance with Hayek’s triangular scheme, since Lowe designates the value-added in stages-of-production in an obvious triangular style<sup>89</sup>. The benefit of Lowe’s projection over Schneider’s is that, at least in principle, we have here a way of depicting the allocation of resources *within* the machine producing department. In Lowe’s schema, ‘group 1a’ of the machine producing industries produces the smaller proportion of the ‘value-added’, while ‘group 1b’ produces the larger part of that ‘value-added’. It is at least conceivable that this proportion can be made to vary in a chronological sequence of schemata.

### **8. Three-Sector Schemes versus the Two-Sector ‘Departmental Scheme’**

To distinguish between consumer goods industries and machine producing industries (‘capital goods industries; ‘investment goods industries’; ‘production means industries’) in either schematic or verbal form, is a widely accepted practice. This is not only the case for those basing themselves on Marx’ departmental scheme. Even many adherents of ‘Austrian’ or Hayekian stages-of-production schemes will argue that the lower stages consist of the ‘consumer goods industries’ while the higher stages consist of ‘machine producing industries’ or ‘capital goods industries’.

What can be seen in the literature, however, is that the dichotomy of consumer goods industries and machine producing industries still obfuscates an important element of production: The origin of raw materials. Lowe noted that “industries, like coal mining or chemical production, belong to both categories [i.e. both ‘departments’], and it is again only the concrete situation which, revealing the purpose, can tell us where to draw the exact divided” (1952, 45). Lowe seemed to have simply accepted

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<sup>89</sup> The modern Austrian School has, oddly enough, not noticed Lowe’s scheme. Professor Hagemann has noticed an ‘Austrian flavor in Lowe’s scheme’: “A characteristic feature of Lowe’s model is that a group of fixed capital goods classified as machine tools are capable of physical self-reproduction and therefore hold a strategic position in any industrial system analogous to that of seed corn in agricultural production. Moreover, the hierarchical order of the sectors implies a unique intertemporal complementarity which accommodates the analysis of traverse processes in time. This intertemporal complementarity was reinforced by the Austrian flavor of Lowe’s schema of industrial production (consisting of three sectors and four successive stages within each sector), which was based on the seminal synthesis of the sector model and the stage model of his colleague Frank Burchardt.” (1997, 407-408)



that raw materials can be produced by either the consumer goods industries or the machine producing industries.

### **8.1 The Allocation of Raw Materials between Consumer Goods Production and Machine Production**

Hayek was well aware of Burchardt's critique of the 'Austrian' stages-of-production schematics, including, of course, its indistinction between the production of fixed capital goods and circulating capital. In *Profits, Interest and Investment* (1939), he admits that his stages-of-productions schematics would have to be amended by better distinguishing the production of machinery from the production of consumer goods with machinery. He admits as well that his stages-of-productions schematics does not adequately depict the 'circularities' of the machine producing industries. The interesting thing is not really that Hayek somewhat reluctantly seems to accept these two points of Burchardt's critique against the stages-of-production schematics. The interesting thing is that he actually takes the discussion of the schematics of the structure of production a step further by now pointing out a shortcoming of the simple dichotomy of consumer goods industries and machine producing industries.

While discussing the rising prices of raw materials during the upswing, Hayek sketches textually a three-sector economy model containing a consumer goods industry, a machine producing industry and a raw materials producing industry (cf. Lachmann, 1940). Hayek does so by distinguishing the capital goods industries into two sectors: On the one hand the "industries [...] which specialise in the production of [...] durable equipment" (Hayek, 1939, 25) or "producers of machinery" (ibidem, 30) and on the other hand and the "raw material industries" (ibidem, 31). Hayek addresses to reasons that seem to warrant a three-sector scheme: One reason is the issue of 'derived demand' between the consumer goods industries and raw materials producers on the one hand, and 'derived demand' between consumer goods industries and machine producers on the other hand. The principle of derived demand is fully applicable to the relation between the consumer goods industries and their suppliers of raw materials. The reason is that: "raw materials are required in practically fixed amounts per unit of output of any particular commodity" (ibidem). But this is not so between the consumer goods industries and the machine producing industries. Hayek points out that an increase in demand for consumer goods may or may not increase the demand for machines, because increases in demand can often be met by a higher degree of capacity utilization: "labour, so far as provision for an

expansion of output is concerned, is to a large extent a possible substitute for machinery” (ibidem). In other words, factory owners can often have their personnel do “over-time and double shifts” or hire additional workers for extra shifts on existing machinery, rather expanding production by purchasing additional machinery. It follows that the level of demand for consumer goods and the level of ‘derived demand for machines’ cannot be as correlated as the level of demand for consumer goods and the ‘derived demand for raw materials’. Another reason for distinguishing between three sectors has to do with the allocation of raw materials. Hayek notices what should be obvious: that raw materials are not only used in consumption goods, but also used to make machinery.

Hayek did not pursue this three-sector consideration any further. However, M. Weitzman (1971) did raise a similar reason as Hayek’s:

“because most intermediate commodities are used, directly or indirectly, for both consumption and investment, plant and equipment engaged in producing these raw materials is easily transferable in the sense that a change in the intermediate product's final destination is tantamount to shifting capital from one department to the other.”

Weitzman’s solution was indeed to distinguish the raw materials producers from both machine producers and consumer goods industries, and arrive at a three-sector classification of all industries one can find in an actual economy:

*Figure 15*

Symbol	Sector	Definition	Examples
<i>I</i>	Investment	All final and intermediate goods and services used directly or indirectly to produce <i>investment only</i>	construction, cement, machine tools, metal working
<i>C</i>	Consumption	All final and intermediate goods and services used directly or indirectly to produce <i>consumption only</i>	bread, flour, clothing textiles
<i>R</i>	Raw materials	All intermediate goods and services used indirectly in producing <i>both investment and consumption</i>	freight transportation, fuels, chemicals, electricity.

Of course, a further consideration here is that the producers of machinery (or ‘investment goods’) are not only competing for the use of raw materials with the consumer goods industries. It is obviously also the case that machinery must be allocated to three different sectors: The consumer goods industries; the machine producing industries (self-reproduction of real capital) and to the raw materials industries.

## **8.2 The (Re)Production of Natural Resources.**

The traditional exploiters of a two-sector scheme of consumer goods industries and capital goods industries are the Marxists, or at least the Marx-inspired economists. We can put the question here why they did not move towards a scheme with three sectors, by adding a ‘raw materials industries’ to the original two sectors.

We can first observe that a number of German economists have used Marx’ departmental scheme to find evidence for the thesis that business cycles are due to some sort of periodical ‘overproduction’ of consumer goods. R. Luxemburg ([1913] 2003), assumed that such a periodical ‘overproduction’ of consumer goods indeed took place. The more formidable task was, however, to explain why the capitalist system had not yet collapsed, despite the prediction of Marx that it would collapse (Luxemburg was of course writing a number of decades after the publication in 1867 of Marx’ *Capital*). She attempted to answer this challenge by using the departmental scheme. That scheme was used on the one hand as a model for the production structure on the internal market (home-market) of a capitalist state. On the other hand, she also postulated the colonies of the capitalist state as producer of raw materials and as an external market (export-market) for the machine producing industries and consumer goods industries residing in the capitalist state itself. According to Luxemburg, the surplus of cheap consumer goods, which cannot be sold in the home-market of a capitalist state, will be exported to its colonies. The colonies, in exchange for the received consumer goods, export raw materials to the home-market of the capitalist-imperialist state. In this way, the capitalist state – which according to Marxism was bound to collapse through a proletarian revolution – was thought to be able to lengthen its life.

Two things are here of interest. The first is that one could say that Luxemburg’s theory employs a textual three-sector model in disguise, as the machine producing department and the consumers goods department are in fact supplemented with a raw material producing department (disguised as the

‘colonies’). The second thing that is of interest is how Luxemburg (and her followers) deal with the question how – *given* that raw materials are a requirement to produce – the sector producing raw materials constraints the rest of the industrial system (machines- and consumer’ good production).

However, the striking fact is that with these Marxians there is hardly any recognition that the sector producing raw materials constraints the industrial system. This non-realisation may have already begun with Marx. Luxemburg quotes Marx in an approving manner:

“In the extractive industries, mines, etc., the raw materials form no part of the capital advanced. The subject of labour is in this case not a product of previous labour, but is furnished by Nature *gratis*, as in the case of metals, minerals, coal, stone, etc.” (quoted in R. Luxemburg, [1913] 2003, 336).

Nature furnishes raw materials *gratis*, says Marx. Then Luxemburg makes a similar point:

“The process of accumulation, elastic and spasmodic as it is, requires inevitably free access to ever new areas of raw materials in case of need, both when imports from old sources fail or when social demand suddenly increases” (338)

She further dwells predominately on the point that both slaves and wage-workers in the colonies are needed for raw materials production, but she writes nothing on possible constraints on (and of) raw materials production itself. We see similar points raised by the followers of Luxemburg. F. Sternberg, for example, argued that “modern Imperialism [...] guarantees a cheap sourcing of raw materials” (1929, 254). Another discussant of the departmental scheme, A. Caspary, seems to even go a bit further, as he argued that “the collective capitalist [*Gesamtkapitalist*] has the materials itself - nature, so to speak - for free. After all, he never paid them, but occupied them by force. Only labour is paid for - and not in full either.” (1929, 135)<sup>90</sup>.

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<sup>90</sup> I could add A. Lowe to the list, as he argues that “[i]f at any point of time we were to undertake a census of an industrial community’s wealth in physical terms, we would find altogether four different stocks: a stock of labor; a stock of natural resources; a stock of equipment, such as plants, machinery, residential buildings; and a stock of other commodities, which shall presently be discussed specifically” (1952, 143). It seems that we mostly do not ‘find’ stocks of natural resources, but rather that these stocks of natural resources are stocks of *extracted* natural resources (iron ore, crude oil, harvested grains, etcetera).

The Marxians, being busy with the alleged exploitation of workers by capitalists (through the thesis that workers are not fully paid), lose sight of the relation between man and nature, that is, how man ‘exploits’ nature. It is true that one man can obtain raw materials from nature without paying another man for it. The land from under which the raw material is mined may indeed be unowned and as such it is simply occupied and unpaid for. Also, one man can indeed enslave another man to have this other man do the work of digging up raw materials. But the interhuman relations – in which, for example, a landowner can demand royalties for mining under his land – form not the only set of possible constraints in human action. The Marxians seem to have missed this point entirely with respect to raw materials production. Nature itself does not guarantee any cheap sourcing of raw materials. There is no ‘cheap sourcing’ in the sense that nature has put all the mineral ore that mankind needs on top of the surface of the earth. Nature constrains mankind, in this sense the sourcing of raw materials is not a cheap thing at all.

### **8.3 Operable Natural Resource in Schemata of the Structure of Production**

The *toil* that it takes, to get raw materials into the supply chain in the first place, is therefore another good reason to separately consider the raw materials producers from both the consumer goods industries and machine producing industries. The fact is that raw materials are very often *not* lying around to be simply taken. One often needs to mine such raw materials out of the ground. That mining is at least a two-stage process: The *first step* is that tunnels and shafts must be dug, or - in the case of strip mining - considerable amounts of earth must be moved. Only once some preparatory work has been done can the actual *second step* of the actual extraction of mineral ore begin. The preparatory work is also often a very resource-consuming work.

This is also true for many agricultural raw materials. For example, land must often be prepared first (trees and weeds must be removed) in order for it to become useful agriculturally. One must therefore distinguish between *natural resources in the geological sense* and *operable natural resources*. The former are those places on earth of which we know that there are, or likely are, deposits of minerals (and other ‘natural resources’) beneath the earth’s surface. The latter are those places on earth which have been *prepared* in a certain way through tooling and infrastructure (machines, lifts, shafts, drilling-pipes, etc.) so that those ‘natural resources’ can be exploitable in the first place; i.e. so that the ‘natural resources’ can actually be extracted more or less directly.

That mining and other forms of raw materials production is a two-stage process is an important constraint upon the industrial system, because the amount of *operable* natural resources is limited even though the amount of natural resources *in the geological sense* may be practically unlimited. For example, there is such a great number of known places on earth where bauxite can be found that nature's supply of bauxite itself is practically unlimited for generations to come. However, that does not mean that what can be produced currently and in the nearer future is unlimited. What can be produced currently and in the nearer future is constraint by the amount of bauxite which the operable bauxite mines can put out, and furthermore, by the capacity the aluminium smelters have to turn bauxite into aluminium.

What above all should be realized is that also in the sphere of raw materials production there exists a *near future-distant future trade-off*. The reason is that mines that are depleted through extraction must be replaced with new mines<sup>91</sup>. There must be a reproduction of operable natural resources. Hence, *before* a mine is depleted, some resources must have already been allocated to the exploration for, and development of, replacement mines. The second consideration is that mines can be extracted at various speeds of depletion. It is therefore possible that factors of production in the mining industry are re-allocated *towards* realizing a higher depletion pace in existing mines, while being re-allocated *away from* the exploration and development of new mines. Such a re-allocation will increase near future mining output, but will diminish distant future mining output<sup>92</sup>.

## 9. Conclusion

Having reviewed the main body of contributions on the schematics of the structure of production, we may conclude with a list of requirements that we would want to have in a scheme of the structure of production, as well as arguments why we want these requirements.

**First.** The distinction, between tool-making and merely tool-using, is of fundamental importance. Böhm-Bawerk's theory of roundabout production recognizes this. But Böhm-Bawerk's ring-scheme blurs the distinction between the turnover of raw materials into consumers goods (in which tools are

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<sup>91</sup> Bradley (2007, 82) is the most vocal up to date about the reproducibility of operable natural resources. He writes: "today's *supply* of a "fixed" mineral is just as reproducible as it would be if we could synthetically create the substance. *Resource-ship*, the positive act of mineral creation, is thus *praxeologically* akin to manufacturing in a factory" (his emphasis).

<sup>92</sup> I will expand on this point in the next chapter.

used) with the making of the tools themselves. It does not distinguish between intermediate products which are ‘circulating capital goods’ from intermediate products which are ‘fixed capital goods’. Judged from the point of departure of his own production theory - the theory of roundabout productivity – this is problematic: Roundabout productivity refers to the increased productivity of *tools* (of ‘fixed capital goods’) of various gradations of ‘mechanization’. The so-called ‘circulating capital goods’ (raw materials, goods-in-process) are not helping to make production go faster. They provide no ‘degree of mechanization’, ‘degree of automation’ or ‘capital-intensity’. Hence the blurring of the production of ‘fixed capital goods’ with the turnover of ‘circulating capital goods’ is not helpful at all. Burchardt’s suggestions to ‘unfold’ the ring-scheme into two schemes is thus very helpful. The scheme of the structure of production should distinguish tool-making from mere tool-using.

**Second.** The ‘partial self-reproduction of real capital’ is something that must surely be included, as it forms the essential industrial bottleneck.

**Third.** The distinction of the departmental scheme, in a consumer’ goods industries and a machine producing industries, is based on the type of fixed capital goods in use. It still leaves in the middle which of the two departments produces the raw materials. In reality, machines production and consumer goods production do not have separate supply chains for raw materials. Iron can be used for machines (fixed capital goods) or for bicycles (consumer goods). What we see with a number of economists (Hayek, Lachmann, Raj & Sen, Weitzman) is that one can improve the schematics of the structure of production by developing the dichotomy of consumer’ goods industries machine producing industries into a trichotomy that also includes a raw materials industries.

**Fourth.** It is useful to be able to depict the amount of *capacity* (the capital stock) of a sector or industry of the economy, and to be able to depict how this capacity can change from one period to another (whether productive capacity is stationary, declining or growing). Preferably, it should be specified what the *degree of mechanization* or *degree of automation* of this capacity is, because we do not only want to know what the maximum is that a factory can put out - what it’s (maximum) capacity is - but also how many workers would be needed to reach this capacity – what the degree of mechanization is.

**Fifth.** It is useful to be able to depict the amount of activity or capacity utilization in a 'stage', 'industry' or 'department', and especially to depict how this capacity utilization can change from one cross-section (period) to another. This is especially important with respect to understanding business cycles.

**Sixth.** The scheme of the structure of production must be able to integrate into a timeline in order to make it helpful in understanding the growth, stationary or decline of an economy that progresses into the future.

A new scheme based on these criteria will be discussed in the following chapter with a distinction of consumer goods industries, machine producing industries and raw materials industries as well as the flows of goods and services between these industries; the amount of capacity utilization in these industries; the development through time of the configuration of capacity utilization in different industries.



## 4. The Theory of Capacity Utilisation

### 1. Introduction

So far we have not delved much into the question of capital utilisation or capacity utilisation. The economists that have so far been of the greatest help in developing criteria for a model of the structure of production, provide little help, however, on this topic. Böhm-Bawerk did not seem to have written anything substantial on capacity utilisation, although Hayek wrote just a few very interesting things about it. Lowe seems to avoid a systematic survey of the topic of capacity utilisation altogether since he argues that already “iron and steel and chemical production operate under a three-shift system” (1976, 121). He seems to imply, in other words, that because critical industries (such as steel- and chemical production) already operate under full capacity utilisation (three-shifts), a further neglect of the topic of capacity utilisation is warranted. Nonetheless we are not convinced about this minimisation of the importance of capacity utilisation.

The term *capital utilisation*<sup>93</sup> refers simply to the *use* of tools, machinery, buildings and other fixed assets or ‘fixed capital goods’<sup>94</sup>. In economics, there is a small subfield specifically dealing with the topic of capital utilisation (Betancourt & Clague, 1981; Betancourt, 2018, 1360). In the field of *supply chain management* the topic is also discussed, but it is then called *capacity utilisation*, which is a preferable term because it avoids the ambiguity between financial- and real capital. The *theory of capital utilisation* deals with the question why and how intensely machinery is utilized, with the *rate of capacity utilisation*. In a way, one can say that the theory of capital utilisation deals with the topic of the relation between ‘fixed capital’ (i.e. capacity) and working capital or circulating capital (the means used to utilize capacity).

The research question we are dealing with is: What type of circumstances constrain and induce entrepreneurs towards a higher rate of capacity utilization? Obviously enterprises need *financial* working capital in order to pay for workers and raw materials so that capacity can be utilized. The utilization of capacity must be limited to the financial working capital available. However, when we stop looking at individual firms, but observe mankind in its entirety, the problem cannot be one of

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<sup>93</sup> “Capital utilization” is the usual term in economics, while “capacity utilization” seems to be the more usual phrase in fields such as management science and supply chain management.

<sup>94</sup> One of the earliest definitions of the term ‘capacity’ we find with Rae: “All instruments [...] either produce, or contribute to the production, of events supplying some of our wants. Their power to produce such events, or the amount of them that they produce, may be termed their *capacity*.” ([1834] 1964, 92, his emphasis).

financial working capital. By looking at mankind as whole, we are able to peel off a layer of the aforementioned research question. We then arrive at what likely is the core of that problem: *What constrains does mankind face in increasing capacity utilisation?*

The approach of this chapter is to look at capacity utilization from a macroeconomic perspective, rather than the microeconomic approach that is dominant in the existing literature on the theory of capacity utilisation. We will also build further on our conclusions from the previous chapter on the schematization of the structure of production. We will inquire into the rates of capacity utilisation of different sectors in the structure of production and the interrelations between them. This will all lead, by the end of this chapter, to a new schema of the structure of production based on pie-charts that each display the amount of capacity utilization per sector. Hence we will build on the list of requirements we have compiled in the end of the preceding chapter.

The aim of this chapter is twofold: On the one hand to incorporate the phenomenon of capacity utilization into a scheme of the structure of production. This scheme should also fulfil a requirement we have reached in the previous chapter: It should ‘disaggregate’ the equipment in the economy by making three sectors and their interconnectedness visible: The consumer goods industries; the machine producing industries and the raw materials industries. This scheme will illustrate one important thesis: That capacity utilization can best be understood from a macro-economic perspective in which the allocation of workers and raw materials are the essential determinants of capacity utilization at each point in time. On the other hand, the aim is more ‘dynamic’ and preparatory to business cycle theory. It is to make plausible that the high level of capacity utilization in the business cycle’s upswing may be the cause of an unsustainable depletion rate of the raw materials (‘commodities’) which feed the industrial system. In other words, we want to show the possibility that an *overconsumption* of raw materials causes the high capacity utilization of the upswing, but also explains the low capacity utilization of the downswing.

## **2. Two Types of Capacity Utilisation**

Economists that have dealt with capital utilization usually distinguish two forms of capital utilization. The one is what professor Scazzieri calls “[t]he number of tasks performed by a given tool at the same time” (1993, 85). A task may be to transport a certain good from place  $A$  to place  $B$ . A truck may be the machine that performs this task of transporting goods from place  $A$  to place  $B$ . The more the

truck is loaded with goods, the more tasks it is handling, the more it is utilized. Hence, a higher truck-load is a higher capital utilization.

The other mode of capacity utilization is designated by Professor Scazzieri calls as the “the fraction of the working day during which a tool is active” (ibid.). It is usually associated with ‘shift-work’ (the number of shifts performed during a working day) and with the ‘average workweek’ (the amount of time worked on average by workers in a plant during a week)<sup>95</sup>.

Besides these *forms* of capacity utilization, there are two clearly visible *requirements* of capacity utilizations: Men and materials. A ‘capacity’ is *utilized* if it is operated by workers. But besides the need for labour-services (to utilize machinery) almost always it is also the case that one needs materials and (or) energy sources. Some tools, such as a bicycle or a hand cranked dynamo, do not need fuel or materials in order to bring about a product. But in most of the relevant cases, machinery needs some non-human energy sources (e.g. fuel for vehicles or electricity for many processing machinery)<sup>96</sup>. In many other cases, some material needs to be literally ‘put in’ to machinery to get some ‘output’ (e.g. empty cans and soup as inputs to manufacture canned soup as an output). *Obviously*, a higher degree of capacity utilization (in both forms) requires a higher amount labour and (or) materials and energy inputs. Also, it is obvious that a higher capacity utilization (in both forms) implies a higher rate of output of products (although not necessarily consumer products).

### **3. The Relative Scarcities of Fixed Capital and of ‘Working Capital’**

Every tool or machine – every ‘fixed capital good’ – can in some way be used, by literally taking control of handles, steels, wheels, buttons and other sorts of ways. Some machines allow only for one person to handle or control it, others allow for more. One could say that each tool or machine allows for a maximum number of simultaneous human *operators* – by which we mean the employees actually handling the tool or machinery – and a certain number of supervisors or managers who are needed to instruct and coordinate these employees. If we assume that there can only be one ‘shift’ per 24 hours, then we can say that the sum of operators and supervisors needed for each machine gives us a total number of *possible* occupations. If we assume two 12-hour shifts of three 8-hour shifts are possible,

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<sup>95</sup> The average workweek is a metric that the National Bureau of Economic Research of the U.S.A. compiles.

<sup>96</sup> One could also argue that humans need means of subsistence in order to work. In fact, many classical economics saw ‘circulating capital’ not only as the raw materials from which products were made, but also as the foodstuffs needed to feed the workers.

then the total amount of possible occupations in the economy is doubled or tripled. If all occupations were occupied by workers, the machinery of the economy would run at ‘full capacity’. In other words, the *level of capacity utilization* in the aggregate would be 100%.

Now, we never see such a 100% level of capacity utilization in the economy. That is, we do not see that every single factory is operating 24 hours a day and seven days a week. Especially in manufacturing, ‘plant and equipment’ is not utilized around the clock, for it is often not used during evenings, nights and in weekends. We also do not see that every train is moving on the rails 24 hours a day and seven days a week; we do not see all construction machinery used 24 hours a day and seven days a week to build new buildings, bridges, roads; etcetera, etcetera. Why is this? If we do not discriminate between the different sorts of occupations the various sorts of tools and machinery in existence provide for, we can make the following general historical-empirical observation: *labour factors have practically always been relatively scarcer than tools and machinery*<sup>97</sup>. In other words, the number of possible occupations is greater than the number of occupants. Or to put it very briefly: *Labour is generally scarcer than tools*. There is therefore, in principle, nothing mysterious about the non-utilization of capacity<sup>98</sup>.

Besides workers, the other requirement of capacity utilization remains that one must have raw materials or other ‘commodities’ as inputs. So, we can make the historical-empirical observation about labour being relatively scarcer than fixed capital somewhat wider: *‘Real working capital’ - by which we mean*

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<sup>97</sup> I am paraphrasing M. Rothbard, who in *Man, Economy, and State: A treatise on Economic Principles*, argued: “It has simply been an historical-empirical truth *that labor factors have always been relatively scarcer than land factors*. Land and labor factors can be ranged in order of their marginal value productivity. The result of a relative superfluity of land factors is that not all the land factors will be put to use, i.e., the poorest land factors will be left idle, so that labor will be free to work the most productive land (e.g., the most productive agricultural land, urban sites, fish hatcheries, “natural resources,” etc.). Laborers will tend to use the most value-productive land first, the next most productive second, etc. At any given time, then, there will be some land— the most value-productive—under cultivation and use, and some not in use” ([1962] 2009, 559).

<sup>98</sup> If all capacity (all tools and machinery) would be utilized a 100%, and we would at the same time see people working with their bare hands (using no tools) since there are not enough tools, then we could not claim that the statement, that mankind is a tool-making and tool-using being, had a *general* anthropological validity. However, nowhere in the modern economy we see ‘stages of production’ engaged in bare-handed production – as some clever German economists pointed out in the 1930’s. In fact, if we look not only at production activities (activities which are a means to an end) but also to consumption activities (activities which are an end in themselves) we see that also in that regard mankind very often uses tools. A lot of sports use ‘tools’ (such as rackets and clubs); people watch television; drive bicycles for fun, etc. Certainly consumption-tools (durable consumer goods) are not used around the clock (utilized a 100% of the time). Nothing is mysterious about this either.

*workers (or foodstuffs for workers) plus raw materials and energy supplies – is generally scarcer than the aggregate of ‘real fixed capital’.* What has to be explained in the theory of capital utilization is therefore not so much why not all fixed capital goods are underutilized.

#### **4. The Main Problem of the Theory of Capacity Utilization**

In this chapter, we will concern ourselves mainly with the problem of the level of capacity utilization throughout the business cycle: Capacity utilization increases in the boom-phase, when more people are employed, and when employed people are also performing ‘overtime’ and ‘double-shifts’ on their existing jobs (Hayek, 1939; Lawrence & Fitzgerald, [1998] 2002; Beaudry et al., 2020)<sup>99</sup>. At the same time, the throughput of raw materials increases. After the ‘upper turning point’ of the business cycle, this trend reverts: Capacity utilization decreases in the bust-phase: More people get unemployed; employers are demanding less overtime and double-shifts from their employees; the rate of throughput of raw materials declines. This fluctuating level of capacity utilization is thus a *defining* characteristic of the business cycle. That capacity utilization goes up and down is a typical pattern of the real economy in the business cycle.

The level or ‘intensity’ of capacity utilization is to a great deal indicated by the statistical measure of the ‘average workweek’, which is the average number of hours worked by employees in companies. The ‘average workweek’ has been regarded as one of the defining characteristics, and also as a ‘leading indicator, of the phenomenon of the business cycle (Bry, 1959, 1-5; Moore, 1983, 65-92). Capacity utilization, indicated by the ‘average workweek’, increases in the cyclical upswing and it decreases in the cyclical downswing<sup>100</sup>.

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<sup>99</sup> That “hours worked” (which *is* another way of describing ‘capacity utilization’) is a crucial aspect of business cycles, is something that recurs in business cycle literature. For example, Lucas writes: “Why, in the face of moderately fluctuating nominal wages and prices, should households choose to supply labor at sharply irregular rates through time? Most business cycle theorists had avoided this crucial problem. and those who addressed it had not resolved it, Keynes saw that by simply sidestepping this problem with the unexplained postulate of rigid nominal prices, an otherwise classical model could be transformed into a model which did a fair job of accounting for observed time series.” (1977, 12)

<sup>100</sup> In mainstream economics, the decline in capacity utilization during a recession has been dubbed the ‘output gap’. This ‘output gap’ is assessed by comparing actual GDP with an estimate of a ‘potential GDP’ that could be reached – it is assumed – if employment (and thus capacity utilization) were higher. The actual question is whether capacity utilization and output can potentially be higher during a recession. But in any case, the proponents of the ‘output gap’ theory do not deny that, in fact, capacity utilization is higher during the upswing and lower during the downswing. There are two big problems with this theory of the output gap. The first is that it omits that besides workers one also needs raw materials to increase output. A ‘reserve army of

In relation to the changing capacity utilization during the cycle, the main question from a production-theoretic perspective seems to be this: What makes the increased capacity utilization (more work hours performed with given plant & equipment) possible in the first place; what is (or should be) caused by this increased capacity utilization; and what are there ‘real factors’ that will constrain the higher capacity utilization in the upswing and in the downswing?

### 5. The Overconsumption Thesis

The main thesis of this chapter is that the cyclical phenomenon of capacity utilization – the rate of capacity utilization as going up and down in all industries through the business cycle – must be studied in close connection with the *depletion* of the deposits in mines and wells and with the depletion of stocks (inventories) of raw materials and other ‘commodities’. The subfield called the *theory of capital utilization* must look at the other subfields of *mining economics* or *mineral economics* (e.g. W. Gocht et al., 1988); at the *theory of inventory cycles* (Lachmann & Snapper, 1938; Abramovitz, 1950; Nurkse, 1952) and the *theory of forward markets* that traditionally deals with forward prices on commodity markets (e.g. Eastham, 1939)<sup>101</sup>. The (theory of) the schematic representation of the ‘structure of production’ aids in connecting the sometimes too independent and specialized subfields of economic thinking.

The reason to connect these subfields is simple: Obviously, there cannot be any utilization of the industrial system (‘structure of production’) without it ‘feeding’ itself with raw materials. Naturally, a higher level of capacity utilization requires a higher input of raw materials. The thesis of the overconsumption theorists of the business cycle presents itself here as an explanation for the declining capacity utilization *after* the upper turning point of the business cycle: There must be a relative scarcity of raw materials at the peak of the business cycle compared to other phases in the business cycle. Because of an increasing relative scarcity of raw materials, capacity utilization must decline.

Statistics of business cycles in fact confirm that, over the course of the business cycle, stocks (inventories, staples) of commodities are *not* at their highest point when the business cycle hits the

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unemployed’ is not enough to increase capacity utilization. Inventories of raw materials or ‘commodities’ are also needed. The second is that the theory of the output gap ignores the temporal aspects of production. If capacity utilization goes up in the ‘early stages’ of production, such as in exploration and development of new mines, or the research and development of new electronics and machinery, then this will have no immediate consequences upon the output of consumer goods. Increased capacity utilization does not necessitate an immediate increase in the output of consumer goods.

<sup>101</sup> Betancourt & Clague (1981) have completely neglected the depletion of stocks or deposits of raw materials as a reason for fluctuating capacity utilization.

‘upper turning point’. For example, Lachman & Snapper concluded the following after an empirical study on “Commodity Stocks in the Trade Cycle”:

“The main conclusion emerging from the statistics we have presented appears to be that our stocks are inversely correlated with the [business] cycle. As a rule, they reach their lowest level very shortly before the outbreak of the crisis, while their peak level is to be found towards the end of the depression. If this reading of the facts is correct, it is difficult to accept Mr. Keynes’ theory according to which surplus stocks must be exhausted before recovery can start. On the contrary, the conclusion that seems to suggest itself is that raw material stocks must have reached a certain size if they are to support a lasting recovery” (1938, 445)

A little more than 10 years later, M. Abramovitz’ extensive study on *Inventories and Business cycles, with special reference to manufacturers’ inventories* (1950) confirmed this finding of Lachmann & Snapper that commodity stocks are generally low at the peak or upper turning point of the business cycle, while they are relatively high at the ‘through’ of business cycles. In the cases of some commodities Abramovitz found their stock to be moving counter-cyclical (cf. Nurkse, 1952, 391)<sup>102 103</sup>.

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<sup>102</sup> Abramovitz, a researcher at the American *National Bureau of Economic Research* (NBER) was certainly not biased in the sense of an adherent of the overconsumption theory of business cycles who may have went looking for (cherry-picking) empirical evidence to support his theory. It seems he was rather best acquainted with the accelerationist theories held by earlier researchers at the NBER, such as J.M. Clark and Simon Kuznets. Abramovitz assumed, basing himself on the acceleration principle theory, that “manufacturers and merchants are both desirous and able to maintain inventories in constant ratio to their output or sales. Inventories would vary directly and proportionately with sales or output” (1950, 20). His research by and large disconfirmed this predictions.

<sup>103</sup> These findings of Lachmann & Snapper and Abramovitz contradict also what Mises writes of the upper turning point in *Human Action*: “It is no less erroneous to believe that the events which resulted in the crisis amounted to an undue conversion of ‘circulating’ capital into ‘fixed’ capital. The individual entrepreneur, when faced with the credit stringency of the crisis, is right in regretting that he has expended too much for an expansion of his plant and for the purchase of durable equipment; he would have been in a better situation if the funds used for these purposes were still at his disposal for the current conduct of business. However, raw materials, primary commodities, half-finished manufactures and foodstuffs are not lacking at the turning point at which the upswing turns into the depression. On the contrary, the crisis is precisely characterized by the fact that these goods are offered in such quantities as to make their prices drop sharply.” (1949, 557) But it seems to me that this observation contradicts Mises’ definition of certain ‘malinvestments’ which appear after the crisis: “Some of the investments made in the boom period appear, when appraised with the sober judgment of the readjustment period, no longer dimmed by the illusions of the upswing, as absolutely hopeless failures. They must simply be abandoned because the current means required for their further exploitation cannot be recovered in selling their products; this ‘circulating’ capital is more urgently needed in other branches of want-satisfaction; the proof is that it can be employed in a more profitable way in other fields (ibidem, p.561).

## 6. Capacity Utilization and the Workforce

We will now proceed with a step-by-step reasoning towards a scheme of the whole structure of production in which the concept of capacity utilization is fully incorporated. Our first step is the recognition that capacity utilization means the proportion of working capital (or circulating capital) to fixed capital, and that ‘investment in working capital’ can be subdivided into two subcategories. On the one hand working capital consists in the factor of production called ‘labour’<sup>104</sup>. On the other hand, the non-human factors, which are materials and fuels (‘circulating capital’ in the narrow sense).

The total availability of labour we will call the *workforce*. We shall first pick up the relation of the workforce to capacity. The first thing to point out under this header is that there must be some allocation of the workforce among sectors in the structure of production, and that each allocation has certain consequences. After treating the relation of the workforce to capacity, we will discuss the relation of raw materials to capacity utilization in section 5.

### 6.1 The Allocation of the Workforce Among Sectors with Respect to Current Output

The way in which a workforce is allocated among various sectors may very well impact current output. In order to show this, we should divide the economy into at least two sectors. Furthermore, we should recognize that each sector has its own *rate of employment at full capacity*, which is the maximum amount of workers it could technically employ in cooperation with its machinery under the condition that there are no negative marginal physical returns<sup>105</sup>. This *rate of employment at full capacity* of a sector does not necessarily mean that such employment would be profitable, merely that it is technically feasible if energy, materials and personnel was abundantly available. For example, all toothbrush factories in existence may be operated at full capacity, meaning that tooth-brush machines are turning out toothbrushes 24 hours a day and seven days a week. This is all conceivable in a technical sense of course. But it might also mean such a flooding of the market that the price of a toothbrush declines so drastically that this full capacity utilization is completely loss-giving from an accounting perspective. The point is that the *aggregate of jobs*, which can be computed by summing the number of jobs for each

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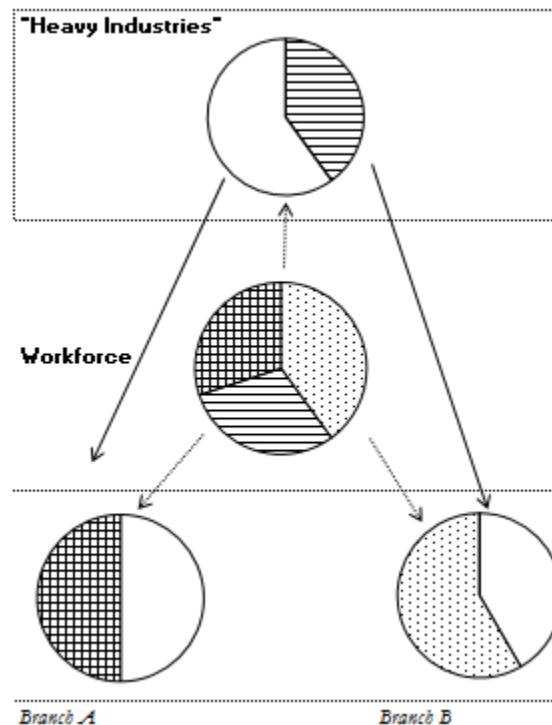
<sup>104</sup> Some would argue that it is the ‘food of the labourer’ rather than the labourer’s money wages which is the actual ‘working capital’. A do not disagree with this point of view, but for now it is irrelevant.

<sup>105</sup> Of course, any enterprise or sector can employ people by letting them produce barehandedly. But such employment would, besides being hardly relevant in terms of output, have nothing to do with the way in which we have defined a sector, namely as producing with a certain set of equipment.



sector operating at full capacity, may very often far exceed the aggregate of available workers (the *workforce*).

To illustrate this point, we suppose that a sector called 'heavy industries' supplies two different branches of the consumer goods industries with raw materials (branch A and branch B). The raw materials are turned into consumer goods by the two branches of the consumer goods industries. Now we have three sectors which we each portray in a scheme with a pie chart: These are branch A (down left) and branch B (down right) of the consumer goods industries, plus the 'heavy industries' (on the top). Apart from these branches we portray the allocation of the workforce also with a pie chart (in the center of the scheme).



The capacity utilization of each sector, which also gives a rate of employment in that sector, is shown by the slice in the pie chart. For example, branch A has a 50% capacity utilization (illustrated by the slice with horizontally and vertically crossing lines which make up 50% of the total pie). This level of capital utilization also implies that a certain number of workers must be employed in branch A. In this case, the 50% capacity utilization implies that 30% of the workforce must be allocated to branch A in order to reach that 50% capacity utilization (this 30% of the workforce is mirrored in the pie-chart for the workforce, which is the slice with the same pattern of horizontally and vertically crossing

lines). Branch B, on the other hand, has a 60% capacity utilization, and needs 40% of the workforce to achieve this level of capacity utilization (both illustrated by the slices with a dotted pattern). It follows that only the remaining 30% of the workforce can be employed in the heavy industries (indicated by the slice with the horizontal lines). It may be that this 30% of the workforce is not enough to reach full capacity in the heavy industries, but, for example, only a 40% capacity utilization.

It is obvious that the *aggregate of jobs*, which can be computed by summing the number of jobs for each sector operating at full capacity, far exceeds the available workforce. We maintain that, in general, the total workforce is not large enough to supply each sector with men so that *all* machinery can be operated full-time. However, we do suppose (in this scheme) that the workforce is large enough to supply one sector with enough men to operate the machinery to ‘full capacity’. However, it may not be economically wise to do so. If the raw materials industry is provided with enough workers to full capacity, it will turn out a relative high amount of raw materials which can be fed to both branches of the consumer goods industries. However, since most workers are allocated to the raw materials industries, too little workers may be employed in the consumer goods industries to be able to process all available raw materials into consumer goods. Another case could be that one of the two branches of the consumer goods industries is provided with enough labour to reach full capacity. But the consequence may be that not enough workers are employed by the heavy industries. This means that, for a lack of raw materials, the workers in branches A and B stand idle to a certain extent, as there are too little materials to produce with. Hence by using such pie-charts for different sectors of the economy, one can illustrate the trade-offs of capacity utilization with respect to the economy as a whole.

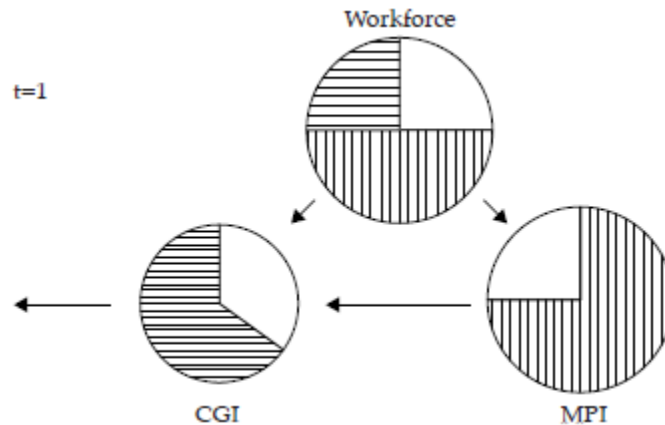
## **6.2 The allocation of the workforce among sectors with respect to economic growth**

A typical ‘Austrian’ approach to explaining how economic growth occurs, is that more ‘originary factors of production’ (especially labour), are re-allocated to ‘higher stages of production’ (Hayek, *Prices and Production*, 1935). The scheme that is used to portray this is Hayek’s triangular ‘stages of production’ scheme. This scheme of multiple stages can, however, be very much simplified by condensing all stages in just two stages: A *consumer goods industry* (the last or latest stage), and a *capital goods industry* (the first or highest stage)<sup>106</sup>.

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<sup>106</sup> Once Hayek’s ‘stages of production’ scheme is simplified to such an extent – something that Hayek sometimes did - then there is no essential difference between his scheme and the Marxian ‘departmental scheme’.

If we would schematize this line of thought, we could represent each industry by a pie chart (see graph below). The pie chart helps us to illustrate the capacity utilization of either the machine producing industries (i.e. the capital goods industry) or the consumer goods industries.



The horizontally dashed slices in the pie charts for the *consumer goods industries* (left below) and the vertically dashed slices for the *machine producing industries* (on the right below) represent the relative amount of capacity utilization. For example, the vertically slashed slice in the pie of the machine producing industries indicates that capacity utilization is at a level of three-quarters.

The level of capacity utilization in each of these two industries has its counterpart in another pie chart, the pie chart of the *workforce*. This pie chart portrays another type of constraint of the physical world, namely that there is a limited number of workers. Each man in the workforce can be employed (in this model) in two different kinds of sectors, or a man can be unemployed<sup>107</sup> (for whatever reason).

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<sup>107</sup> J.M. Keynes has in his *The General Theory of Employment, Interest and Money* (1936) suggested that there is a ‘special’ theory in economics that deals with the allocation of employed resources (classical theory), while there is a more ‘general’ theory which deals with the more general or prior question of the volume of employment (the ‘new’ economics of Keynes). However, there is no need for a treatment in production theory of the topics of unemployment and unutilized capacity (or ‘idle resources’) which is separate from a treatment of employment and capacity utilization. The very simple reason why is that the unemployment of workers is just as much an allocation of a resource as is its employment (cf. Van Dorp, 1937, 214). One cannot be first employed, and in a second instance be allocated to a specific job. The separation between the topic of allocation on the one hand and the topic of the volume of resources that are employed or utilized on the other hand was a polemical trick of Keynes, in fact one of the great tricks that made his economics to be regarded as a revolutionary economics. In our theory of capacity utilization, one can incorporate the phenomena of unemployment and unutilized capacity, for example, by showing in a pie-chart schema that resources can in fact be allocated into idleness. Unemployment *is* an allocation of ‘human resources’; the fact that welfare states provide financial support to unemployment people explains the existence of persistent unemployment. Keynes’ *General Theory* leaves the

The proportion of men (or woman) employed in the *consumer goods industries* are represented by the slice with horizontally dashed lines. The proportion of men (or woman) employed in the *machine producing industries* are represented by the slice with the vertically dashed lines. Now the fact that (for example) three-quarters of the capacity of the machine producing industries is utilized does not implicate that three-quarters of the workforce is employed there. In this example, a three-quarter utilization of the MPI requires half the workforce.

E.F.M. Durbin, a colleague of Hayek, based himself on the simple dichotomy of the economic into a consumer's goods industry and a capital goods industry. He argued in *Purchasing Power and Trade Depression: a critique of under-consumption theories* (1933) in a very Hayekian fashion:

“It is impossible that the *real* demand for capital should rise at the same time as the demand for consumption is increasing. The two groups of industries, one producing capital and the other producing consumption goods are *competing* for the services of the ultimate factors of production, and it is therefore silly to imagine that the real output of the two types of production can move upwards at the same time. It would be as sensible to assume that with a fixed total of ultimate resources you could increase the output of all types of consumption goods at once. It is abundantly clear in this case that if you have more wheat you must have less barley, and if you have more cinemas you must have less cars, and so forth according to the arithmetical truism lying behind the doctrine of ‘opportunity costs’. But exactly the same reasoning holds true for the output of consumption goods as a whole on the one hand, and the output of capital goods as a whole on the other. You cannot have your cake and eat it too. If the profits on consumption goods rise they will rise relatively to those appearing in the production of capital goods, and if the volume of money is constant the factors of production will move to the production of consumption goods *away* from the production of capital goods. The one type of production must fall as the other rises.” (pp. 149-150, emphasis in original)

Hence there is a trade-off involved. More labour (i.e. more “ultimate factors of production”) allocated to the consumer goods industry means more consumer goods in the short-run; more labour (ultimate

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topic of the influence of tax-funded financial support for unemployment undiscussed. Terms such as ‘unemployment benefits’ or similar terms do not appear in the *General Theory*.

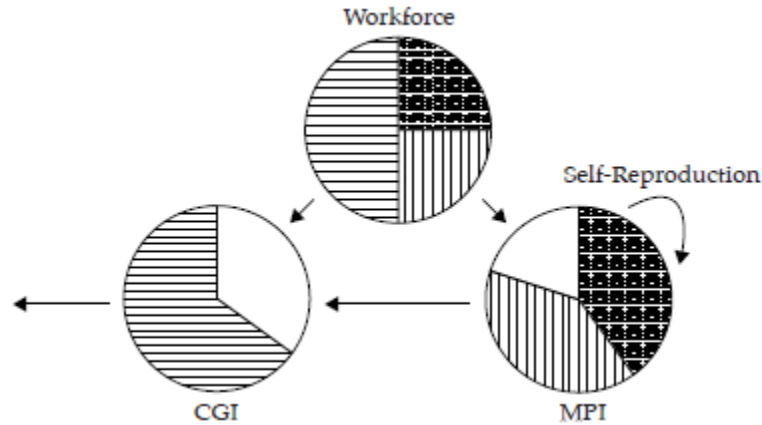
factors of production) allocated to the capital goods industry means more consumer goods in the long-run, since in the short-run more capital goods will be turned out which in the long-run help to increase consumer goods output.

### **6.3 The allocation of the workforce within the machine producing industries**

A topic touched upon in the chapter 3 (on the schematic representation of the structure of production) is the so-called ‘partial self-reproduction of real capital’. The importance of this concept lies in the fact that economic growth has not only to do with the re-allocation of workers from a consumer’s goods industry to a machine producing industry. The concept first points out that the machine producing industries themselves do not only produce the machines of the consumer goods industries, but also its own machines, often called *machine-tools*.

Lowe has pointed to the strategic role of the versatile machinery (machine tools) of the machine producing industries (1976). In Lowe’s thinking the resource that ‘bottlenecks’ economic growth is not the workforce (as Hayek seemed to think) but precisely this versatile equipment of the machine producing industries. He means to say that the output of consumers goods greatly depends on machinery at disposal in the consumer goods industries, and that this machinery in turn can only be increased (or made more efficient) through efforts by the machine producing industries. These machine producing industries, however, have also only a limited capability to increase the machinery of the consumer goods industries. Hence the ability (or capacity) to increase the machinery of the machine producing industries – which can be found *within* the machine producing industries itself - is to Lowe what ultimately constraints economic growth.

We could easily incorporate this ‘partial self-reproduction’ of the machine producing industries in the pie chart scheme we have pictured above. Rather than two slices within the pie for the machine producing industries (one for capacity utilization, one for idleness) the slice for capacity utilization may be further divided into two slices, so we get a total of three slices in this pie.



One slice represents idle capacity, one slice represents capacity utilization with the purpose of providing the consumer goods industries with machinery, another slice represents capacity utilization with the purpose of providing the machine producing industries with machinery (machine-tools).

#### 6.4 The Reproduction of the Workforce itself.

In principle, one could use this scheme to point out that the workforce reproduces itself. Human beings are after all the main ‘factors of production’ in reproducing new human beings, and in raising children towards the ability to work in the economy. There is also a main complementary factor in human reproduction, which is consumption goods: One could draw an arrow from the consumer goods industries to the workforce and as such point out were the workforce gets its foodstuffs and other means of subsistence from. In the pie representing the workforce, a slice could represent a part of workforce which is not employed in either of the three sectors, nor be unemployed, but occupied with raising and educating children which we will eventually become part of the workforce in the future. However, for the purposes of business cycle theory (with +/- 7 year cycles) there is no need to incorporate the effects of the business cycle on the population, as the population is a ‘longer-run’ thing.

#### 7.0 Raw Materials in Relation to Capacity Utilization

Labour is often not enough to operate a machine; a workforce is not enough to get an industry going. To operate a machine to a certain capacity, one needs also an amount of ‘circulating capital’. By *circulating capital* we mean the materials that the machine will help process into a different form (say iron ore into iron bars) and often also the resource that is needed to fuel or electrify the machine. The workforce (‘labour’) together with this ‘circulating capital’ is what one can call the physical- or real

‘working capital’, just as ‘operating expenditure’ consists of wages costs and materials- and energy costs.

We have concluded that, empirically, it seems that the workforce is relatively scarcer than the total number of possible ‘occupations’ that the buttons and handles of all tools and machinery provide. However, even if there were enough men and women to occupy the buttons and handles of all tools and machinery, such a full capacity utilization of all tools and machinery could still not be possible if the raw materials (including energy supplies and goods-in-process) were scarce relative to all workers and machinery.

### **7.1 The allocation of raw materials among industries**

Besides this issue of the *pre-condition* of the capacity utilization in the rest of the system, there is also a topic similar to that of allocating the workforce to different stages or sectors of production. Raw materials must also be allocated to either the consumer goods industries or the machine producing industries. Furthermore, certain raw materials may very well be needed in raw materials production itself: A coal mine may need some coal as a fuel in order to be in operation.

It might seem that the allocation of raw materials is very much the same as the allocation of the workforce to either the consumers goods industries or to the machine producing industries. However, there is an important difference that we should take notice of. The *units* of raw materials, such as a ton of coal or iron, cannot perform “overtime and double-shifts”. There is no flexibility in this respect. Any increase in “overtime and double-shifts” must, however, be accompanied by an increase of consumption of the required raw materials. So even if the workforce is willing and able to increase the capacity utilization of both the consumer goods industries and the machine producing industries – by working overtime or double-shifts or by the unemployed getting back to work – then there may still be a shortage of material- and energy resources to actually realize such an increase in capacity utilization. Hence the availability of raw materials and energies is conceivably a constraint in the growth of output.

Mineral economics shows that the production of raw materials inhibits a certain amount of upward flexibility. A mine can be more intensely exploited by increasing synchronously cooperating labour, or by adding overtime or a further shift to the work-schedule. For example, it is surely possible that

miners can start to work 10 instead of 8 hours a day, or that they will start to work six or seven instead of five days in a week. This type of increase in employment can last for a very long time. The question here is, however, whether the intensified exploitation of *operable* natural resources will not sooner or later run into the border of what is possible. Hence the question of the allocation of raw materials leads back to the question of how they are produced.

## **7.2 The Reproduction of Operable Natural Resources of the Mining Industry, Agriculture, Fishing and Hunting**

The materials used in production are often *originally* taken out of nature, hence economists also speak of ‘natural resources’ when they speak of products we associate directly with ‘nature’, such as wood, coals or metals. More precise would it be to call the forests, and coal and metal-ore deposits – not wood, coals and metals - ‘natural resources’. However, this term of ‘natural resources’ is not really precise enough. For it is not always the case that materials can be picked up from the ground *gratis*, and put into use.

Much like building a machine, *making* natural resources suitable for exploitation, requires some upfront effort – a roundabout – that does not immediately result in a ready supply of the raw materials that these natural resources should provide. The classic example is the mine. A *mine* is often considered to be a natural resource, but to be more precise, we should say it is an *operable* natural resource, as we often consider ‘mines’ to be readily exploitable resources, and as such capable of yielding a more or less direct output of coal, minerals or metal ores. Without the shafts, buildings and (relatively inconvertible) machinery of mines such as its lifts, the ‘natural’ resources in which man can find minerals or metal ores are at best unexplored and unexploited ‘deposits’, they are *non-operable* natural resources.

Almost always it is the case that considerable effort and resources have been put in to get such a mine into that operable condition. There are always deposits and reserves of oil, gold and other types of resources below the surface of the earth. There are plenty of these natural resources, they are relatively abundant. However, such natural resources are literally not in reach of man’s arms, man cannot grab these natural resources unless considerable effort has been put in to transform such resources into operable resources. Hence operable natural resources can be considered as *produced* factors of production, much like machines or buildings.



The same goes to a great extent for agriculture. Here we also have a difference between agricultural land (an operable natural resource) and land in general (a non-operable natural resource). It takes a certain amount of effort to transform non-agricultural land into agricultural land. It may, for example take the effort of removing trees to transform a piece of forest into arable land or grazing land. Furthermore, the productivity of a piece of arable land is often from time to time improved by *fallowing*. Fallow land, or fallowing, is not unproductive. It is simply not productive in the short-run. To leave land fallow means to have its productivity reproduced by nature, which is a time-consuming process<sup>108</sup>. A similar phenomenon of reproduction can be seen in livestock production. For example, a cow can be used to reproduce more cows (and produce milk), while it can also be slaughtered to obtain meat and leather. Hence to reproduce more cows is not productive in terms of meat and leather in the short-run, and expenditure on animal feed must be made to reproduce livestock.

Virtually everywhere in the procurement and supply of raw materials and other products of nature (agricultural produces, fishing and hunting products) we can find that there exists a trade-off between having more of these raw materials in the short-run comes at the opportunity cost of having more of these in the long-run, and vice versa, having more of these raw materials in the long-run comes at the opportunity cost of having less of these in the short-run<sup>109</sup>.

### 7.3 The Level of Capacity Utilization and the Rate of Depletion

We have put the raw materials, as utilized by men and machinery, under the heading of ‘real working capital’. (Real working capital is needed to utilize fixed working capital). In the accounting sense, the acquisition of these raw materials is considered, by most businesses, as an ‘operating expenditure’, an ‘investment in working capital’. It is also often considered a ‘direct cost’ and a ‘variable cost’, as there is a high correlation between the input of raw materials and the output of semi-finished or finished products. However, the raw materials themselves are not entering the *supply chain*<sup>110</sup> through ‘operating expenditure’ alone. In fact, handbooks on mineral economics or mining economics often point out that to put a new mine into operation involves very high capital expenditures. The maintenance of a

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<sup>108</sup> With hunting and fishing we see similar productivity problems. On fishing grounds the phenomenon of *overfishing* (depletion of a fishing ground) which is sometimes reported. Also in hunting, there can be the phenomenon of *overhunting*, that is, that so much of a species is killed that this species is unable to reproduce itself to such an amount that a certain steady output from hunting in a given area can be maintained.

<sup>109</sup> In fact, Lowe has pointed out that the self-reproducing capability of machine-tools is similar to the self-reproducing capability of organic matter, such as weed (1976, 30). It should therefore be no surprise that the intertemporal trade-off involved in the reproduction of the capacity of the machine producing industries is also similar to the intertemporal trade-off involved in the self-reproduction of organic matter.

<sup>110</sup> The ‘chain’ of productive events that raw materials take from being mined to final manufacturing.

certain *mining capacity*, that is, a set of mines or operable natural resources capable of providing a more or less steady stream of materials, requires that depleted mines get replaced by newly installed mines. Hence the maintenance of all mining capacity implies the *recurrence of installation costs* of mines.

A *synchronization* of the production of raw materials means that new mines are put into operation once old mines are depleted (or depleted to such an extent that a former average output-stream is no longer maintainable). Synchronization means that the depletion of operable natural resources must not go faster than the exploration and development for replacement operable natural resources. Hence, synchronization requires that the *depletion pace* (also called ‘rate of depletion’; ‘depletion speed’) of mines and other operable natural resources is restricted in some sense. In other words, it means that certain ‘demands’ of the manufacturing industries must *not* be met. Economic growth requires an increasing amount of raw materials that are fed to the manufacturing industries and to the machine-producing industries. Economic growth requires that the exploration and development will, over time, put more mining capacity into operation than mining capacity is put out of operation through depletion. The ideal of ‘balanced growth’ (Lowe, 1976); ‘sustainable growth’ (Garrison, 2000) or ‘steady growth’ must therefore imply some restriction in the depletion pace of existing mines, it implies a “sustainable depletion path”<sup>111</sup> (Heijman, 2012, 187). It is convenient to name the depletion speed at which either a ‘steady state’ or a ‘steady growth’ is possible the *sustainable depletion pace*. Conversely, a depletion speed at which either a ‘steady state’ or a ‘steady growth’ is impossible may be termed an *unsustainable depletion pace*<sup>112</sup>.

A too high depletion pace – i.e. an *unsustainable depletion pace* - must eventually lead to an *overconsumption crisis*, that is, it must lead to a situation in which current raw materials output is declining

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<sup>111</sup> I do not want to imply it must be aimed at by government policy, what I mean is that it is an interesting question whether market forces incentivise sustainable depletion.

<sup>112</sup> We must stress here that the depletion of the deposits of mines and wells is not the same thing as the depletion of natural resources in the geological sense. A (proven or unproven) deposit of minerals, gas or oil beneath the surface of the earth can be regarded as a ‘natural resource’ in the geological sense. But it is not therefor also an *operable* natural resource. Only once a mine is installed and put in operating condition can we speak of an *operable* mine. *Economically speaking*, the terms ‘depletion’ and ‘exhaustion’ refer to the exhaustion of deposits of mines and oil wells, not to all the deposits of the earth in its entirety. In economics ‘depletion’ or ‘exhaustion’ refers to the limits of humanly engineered factors of production and as such to the problem of (often literally) nearing the *bottom* of such currently accessible deposits. Whether the minerals, gasses and oils that are in the earth’s ‘deposits’ *in the geological sense* are actually ‘exhaustible resources’ or ‘nonrenewable resources’ is also a geological question. Economic theory can assume that mines and wells are ‘reproducible’ in the sense that mankind can install new mines and wells that replace the (almost) depleted ones. So far, this assumption has been in accord with reality

because replacement mining capacity has not yet been made available. An unsustainable depletion pace must eventually lead to a lower capacity utilization in the manufacturing industries. Now this consideration provides us with a possibility that should be studied carefully: The higher rate of capacity utilization during the ‘boom’ or upswing of the business cycle *may* imply an unsustainable depletion pace of raw materials. *If* that is indeed the case, it is explained that the ‘boom’ (*hausse, Hochkonjunktur*) is the *proximate cause* of the upper turning point of the business cycle. The high consumption-demand for consumers’ goods during the boom is correlated with the high capacity utilization in manufacturing. However, this obvious correlation holds only in the short-run and distracts from what is less obvious and more hidden from the surface: That this high consumption-demand and high capacity utilization of the short-run has something to do with the low capacity utilization that follows in the longer-run, *if* the high capacity utilization itself is made possible by an unsustainable depletion pace.

#### **7.4 The Costs of Working Ore and the Cut-Off Grade**

The industries that first take delivery of the product of mines and oil wells are called the *heavy industries*. An important example of heavy industries are the *smelters*, which are industries that extract base metals from metal ores (silver ore, copper ore, iron ore, etc.) that were previously extracted by the mining companies. The amount of extractable metal in a unit of ore is often called the *grade of ore*, or *head grade*. The higher this grade, the relatively more metal is in it. It is also the case that the lower this grade, the higher the physical cost is to extract the base metal. Therefore, not every ton of extracted ore is actually forwarded to smelters. The mining industry works with *cut-off grades*. Only the ores which hold a minimum (expected) amount of metal are smelted, because the costs of smelting each ton of ore must be balanced against the output of metal from each ton of ore. The *cut-off grade* can be defined as the grade of ore below which the costs of smelting are considered too high or as “the boundary between ore that is processed and material that is sent to waste dumps” (Crowson, 2012, 12). In fact, also for ores from which the metal is extracted by a different process than smelting, as is the case with gold, the ore still has a grade. Gold ore also needs to be *worked* (rather than smelted) into gold, and therefore also in gold mining there exists a “grade of ore worked” and a cut-off grade. Another example of heavy industries are the *oil refineries*. The crude oil that is extracted by the drilling and extracting operations of the wells will be forwarded to these refineries. This crude oil also has a certain quality, and here there is also a relation between the quality of the oil and the costs of refining, although the differences in oil quality are often less emphasized than the differences in ore grades.

Furthermore, with respect to capacity utilisation, the grade of ore, as processed by the heavy industries, is very important. The more tons of ore are processed by smelting and other extracting operations, the higher the capacity utilization is. However, if the amount of ore processed is increased, while the grade of ore that is processed is lowered, we encounter a clear example of *diminishing returns* compared to operating costs (both in real terms and in financial terms).

The grade of ore, or head grade, is usually not uniform in a given mining site. An “underlying tendency for [head] grades to decline with depth” is a “a general phenomenon of the mining industry”, writes professor Crowson, an economist specialized in mining (2011, 61). Hence if little to no new mines are put into operation, there is an overall tendency in the mining industry for head grades to decline. Only a substantial opening-up of new mines can withstand the tendency of head grades to decline (*ibidem*, 62). However, the process of putting new mines into operation takes substantial amounts of time and resources. Hence there exists the choice between beginning new mines (with high initial costs, but also with high initial head grades) and the continuation of extraction from existing mines (but with possibly strongly diminishing returns because head grades tend to decline). In order to keep a supply of raw materials forthcoming into the longer-run, there is no other option but to invest resources into the exploration and installation of new mining sites. However, most of those resources can also be allocated towards a more intensive exploitation of existing sites, by extracting more of the lower-grade ores, and a more intensive use of smelting facilities.

### **7.5 Head Grades and Commodity Cycles**

The relation between head grade of ores and the market price of raw materials is one of the more interesting areas in which economists must recon with *technical-physical constraints* (on the one hand) and *market constraints* (on the other hand). Professor Crowson has argued in respect to copper-mining that “Although the evidence about the influence of prices is not clear-cut, it does suggest that prices and cut-off grades may be inversely related” (2011, 59). There is a simple justification for this relationship, because the higher the demand for, and price of, a metal, the higher the operating expenditures can be for extracting and smelting the ores needed to supply the metal in question.

In relation to gold-mining and cyclical fluctuations, South-African economist C.G.W. Schumann observed that a rising gold-price in the 1930's went hand-in-hand with a lowering of the head grade of gold ore being worked into gold. He argued that “the factor ‘grade of ore worked’ [*head grade*] is not

an independent variable [...] The marked reduction in the grade of ore worked after 1932 is due to the rise in the price of gold and the greater payability of low-grade ores” (1938, 324).

The standard viewpoint seems to be that mining and the prices of metals are largely driven by the rest of the economy, and that the cyclicity of the rest of the economy is the reason for the cycles in commodity prices and the cyclical nature of the mining industry. For example, the *SME Handbook for Mining Engineering* (Darling, 2011, 52) says:

“Because the demand for mineral commodities is driven by developments in the broader economy, an assessment of the economic growth environment is typically the starting point for demand analysis. However, because different minerals are used in different sectors of the economy, the structure of economic growth can be important, too. Metals such as steel, copper, and aluminum have a heavy concentration of use in investment goods such as buildings and machinery and in big-ticket consumer items like cars and refrigerators, which tend to be quite cyclical. This explains why demand for these metals tends to be more volatile than economic activity overall.”

However, there is much reason to believe that the mining industry is not so dependent on the cyclicity of the rest of the economy as is commonly suggested. The grade of ore worked or smelted is not an independent variable in the longer-run. This is because the lower (higher) the grade of ore worked, the less (more) mining resources – such as engineers, miners, machinery – can be utilized for putting into operation new mines. If little new mines are put into operation, because resources are used to increase extraction of existing mines, the effect will be that the average head grade decreases. This effect of the declining head grade will be that the operating cost of supplying a metal increases. *Hence a high price of a metal can, for the longer-run, entice away factors of production which would make its supply (and hence its price) decline.* The mining industry is not just a passive respondent to demand-fluctuations. The way in which the mining industry supplies the rest of the economy is not just an effect, but also a cause of price-movements.

In a cyclical upturn, we usually see that the capital expenditure (in money terms) of the mining industry increases. It seems as if much is done to expand capacity. But one should seriously ask whether the ‘veil of money’ is not hiding some ‘underlying real forces’ (cf. Hayek, 1941, 408-410). In the boom,

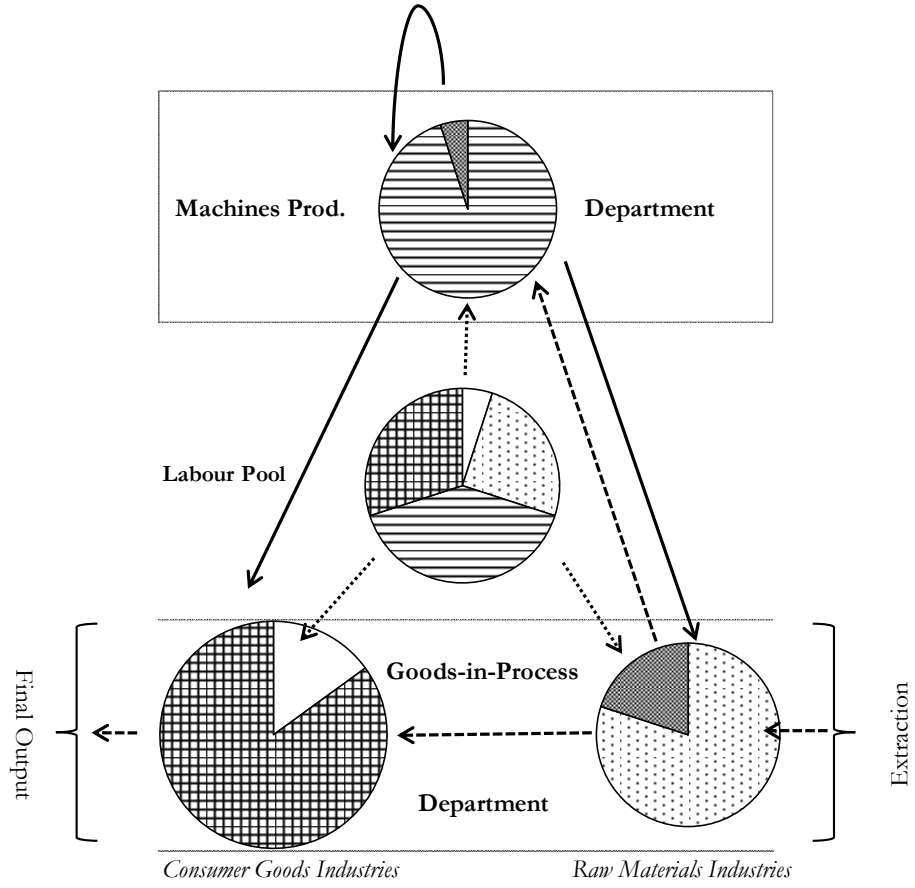
factor prices go up, as well as the ability to obtain financing goes up ('easy money'). All the capital expenditure in the mining industry during a boom occurs upon highly inflated prices for factors of production. But if during this boom the head grades are lowered, this can be taken as an indication that the actual mining capacity to produce is declining in the shorter-run. The average head grades of ores worked or smelted may therefore be used as a way to pierce through the veil of money<sup>113</sup>.

### **8.0 The Three-Sector Scheme that incorporates both types of working capital**

A few theorists have argued that the dichotomy of the 'departmental scheme' can be amended by making it into a trichotomy. Industries such as coal mining or chemical production could better be placed into a separate category, a *raw materials industry* (Hayek, 1939; Lachmann, 1940; Weitzman, 1971, 513). Hence the third step of our modelling of capacity utilization is to arrive at a *three-sector schema*: One pie chart representing the capacity and capacity utilization for consumers goods production; one for machine production; and one for raw materials production. In the middle of these three sectors we have the pie-chart for the workforce. We then arrive at the following schema:

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<sup>113</sup> Crowson (2012) notes a long-term trend for head-grades to decline with respect to copper ore (he uses data from 1905 up until 2010). One explanation for this very long-term trend can be that the degree of automation in the smelting industry is increasing over this very long-run. In such a case there is a long-term trend for smelting costs to come down, justifying a trend in lowering head grades.



The following table provides explanation on the allocation of the various sectors.

<i>Machine Producing Industries</i>	
→	Delivery of Machines %
	Surplus Capacity 0
	Production of Goods-in-Process Machines 95
	Capital Utilization for Self-Reproduction 5

<i>Labour Pool</i>	
.....→	Labor Input %
	Unemployed 5
	To Raw Materials Industries 25
	To Machine Producing Industries 40
	To Consumers' Good Industries 30

<i>Consumers' Goods Industries</i>	
---→	Circular Capital Flow (matured as cons. gds) %
	Surplus Capacity 15
	Capital Utilisation 85

<i>Raw Materials Industries</i>	
---→	Circular Capital Flow %
	Surplus Capacity 0
	Capital Utilisation for Extraction 80
	Capital Utilization for Exploration 20

This three-sector pie-chart model shows certain *interdependencies* of the productive system, such as the ‘partial self-reproduction of real capital’. The importance of these interdependencies will become clear once we use this model for a time-based construction of how the economy moves. It should be remembered, again, that this model itself is a ‘cross-section at a point in time’. It does not show the flow of time in (economic) activity, but by drawing a sequence of such cross-section it would be possible to show the flow of time in the economy<sup>114</sup>.

### 8.1 Economic development through time schematically represented

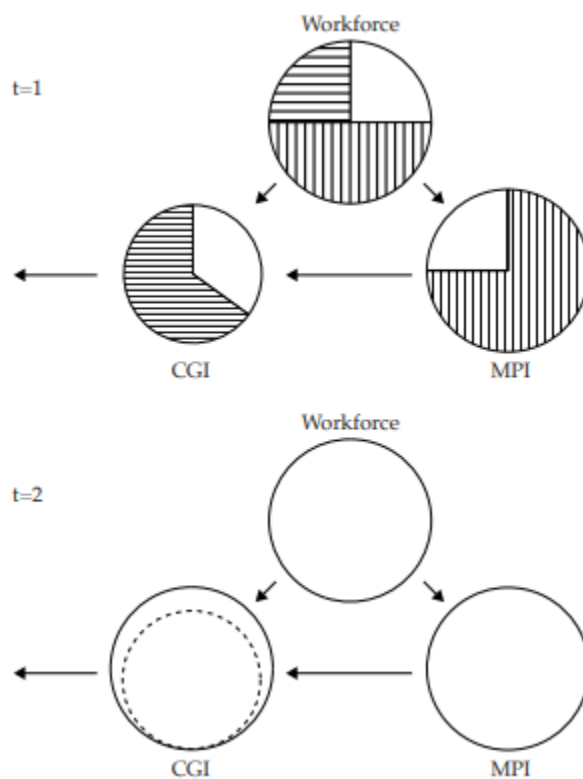
The three-sector pie-chart scheme provided above can be understood as a cross-section of available resources, and the allocation of these resources, at a moment or period in time (say a day or week). A amount of capacity that a sector has can be related to the circumference of each pie-chart. The bigger the pie-chart, the higher the capacity of that sector.

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<sup>114</sup> This ‘three-departments scheme’ is different to the so-called “three-sector” scheme as pioneered by Fisher (1939), in which the primary sector represents the extraction of raw materials, the secondary sector represents manufacturing, and the service industries represents the tertiary sector.



Once we understand the pie-chart scheme as such a cross-section (or a still picture) of what happens in a moment or single period, it also becomes possible to imagine (or portray) a sequence of such still pictures. What we then obtain is a motion picture of the economy developing through time. The output of the machine producing industries at  $t=1$  influences, for example, the productive capacity of the consumer goods industries at  $t=2$ .



In this way, we can make changes in the amounts of resources over time visible and relatable to the changes (or non-changes) in the allocation of resources.

## 8.2. The *rationale* of maintaining ‘working capital goods’ intact

The most important reason for including a separate ‘raw materials industry’ in the scheme of the structure of production is that the nature of its ‘capital’, or better put its *productive capacity*, is different. Productive capacity in the raw material industries does not only consist of the capacity of its machinery used in extraction, but also in the capacity that the *deposits* of the mines and wells form. These deposits form the basic stock of ‘working capital goods’ of the economy, and we must show an important difference between these ‘working capital goods’ and the ‘fixed capital goods’ of the economy with respect to – what Hayek called – ‘the *rationale* of maintaining capital intact’ (Hayek, 1939, 92).

Let us first look at ‘fixed capital goods’. With most equipment, the case is that it technically needs maintenance – i.e. partial reproduction, partial renewal – for it to remain functioning. For example, an airplane needs regular maintenance for it to keep flying. So, in such a case ‘the *rationale* for maintaining capital intact’ is very simple: The *rationale* is to prevent the plane from dropping out of the sky, and as such not to have to write-off an asset which has cost quite a lot of money. This ‘rationale of maintaining capital intact’ seems to work quite well in practice, as very few airplanes do in fact fall out of the sky. The same can be said of many other equipment. Much machinery becomes dysfunctional, and will decline in value, because of ill-maintenance. This is an incentive or *rationale*, which is both technical and financial, to maintain ‘fixed capital goods’ intact. Furthermore, this incentive seems to be working in the relatively short-run, as using machinery without some maintenance can result into malfunctions and damage very soon. With respect to fixed capital goods, the overconsumption thesis seems implausible. In what sense would it be profitable for businessmen to *not* maintain their equipment? This is often only the case when equipment has become obsolete because it is actually being replaced with equipment that is technically more advanced. Maintenance of fixed capital goods must in a certain sense be ‘continuous’ *if* one wants such fixed capital goods to remain operational. Hayek does not give convincing arguments that a decline in the productive capacity of machinery is the reason why the business cycle’s upswing turns into a downswing.

With the *rationale* for maintaining ‘working capital goods’ intact, however, things are different. Take, for example, the deposit for which a mine or well has been installed to extract from. This deposit does not have to be partially replaced on a (more or less) continuous basis. For example, if a 1000 tons of iron ore has been extracted today one can continue mining tomorrow. There is, at least in the shorter-run no technical necessity to explore and develop another mining site with a 1000 tons of iron ore (in proven deposits) in order to continue mining. If one wants to continue with mining, a replacement mine is only required to come into operation once the deposit in a previous mine has been practically depleted. That requirement only comes into effect in a relatively longer-run. Hence, there is no technical necessity in the relatively short-run to perform a measure of maintenance and replacements of the *source* where ‘working capital goods’ come from.

## **Conclusion**

The phenomenon of capital utilization in general, and the up- and down movement of capacity utilization during the business cycle in particular, cannot be adequately studied without at the same

time studying the allocation of the workforce and raw materials to different sectors of the economy. *Obviously*, capacity utilization must in some sense be constrained by the amount of raw materials the mines and other operable natural resources can put out. Since mining economics shows that the rate of extraction for the near future can be raised at the expense of the rate of extraction in the distant future, the increasing ‘scarcity of circulating capital’ (Hayek, 1939, 172) should be considered as one of those “underlying real forces which tend to reassert themselves, although they may be temporarily hidden by the monetary surface” (Hayek, 1941, 33).

From the point of view of the theory of production, and especially from our schematic representation of the structure of production, a cyclical pattern of capacity utilization is necessary *if* an unsustainable rate of extraction is chosen and followed. It furthermore shows that there is no technical necessity which forces capitalists in the mining business to maintain their productive capacity intact, or to even aim for a ‘sustainable depletion pace’. The question *why* an unsustainable rate of extraction is chosen and followed is, however, the task of business cycle theory itself. Production theory simply aids business cycle theory in demonstrating what can possibly ‘constitute’ the business cycle in real terms. Why, for example, monetary factors could ultimately *cause* the business cycle, is beyond the scope of the theory of production.

**PART II: THE THEORIES OF DISTRIBUTION,**  
**SAVING & INVESTMENT AND THE BUSINESS**  
**CYCLE**

# 5. The Neo-Wage Fund Theory Reconsidered

## 1. Introduction

In the first part of this dissertation we have dealt with the technical-physical constraints that mankind faces. A main result of this part was a three-sector pie-chart model of the structure of production. We now want to investigate into the question how the technical-physical constraints affect the interaction of the members of the economy. In the second part of this dissertation - on the theories of distribution; of saving and investment; and of the business cycle - we will thus no longer inquire into the constraints that nature imposes on mankind, but on the constraints of interaction in the capitalist economy (which will be affected, however, by the technical-physical constraints).

Our focal point here is the entrepreneur. Entrepreneurs are not only constrained by the forces of nature, but also by the fact that they will have limited means at their disposal to obtain the cooperation of both workers and other entrepreneurs. How do entrepreneurs in general obtain the cooperation of workers in general, and how are entrepreneurs in general able to derive a profit (income) from their entrepreneurial activity? These questions stand at the beginning of the *theory of distribution* or of *-income*. In extension of these questions we can ask how the means for obtaining the cooperation of the workers are increased and deployed – the *theory of saving and investment*. Extending even further we arrive at questions which have to do with the monetary sphere: What will be the consequences of the creation of credit by the banking system on the real economy? That is question an important question of monetary theory and leads – we will argue – to a *theory of business cycles*.

In the *Wage Fund Doctrine*, which forms the topic of this chapter, we can find an answer to the first of these three sets of questions. This Wage Fund Doctrine is actually a theory of income formation ‘under the veil of money’, i.e. a *real* theory of distribution. The Wage Fund Doctrine embarks from a premise which is still grounded in production theory: Means of subsistence need to be available for any type of production activity that does not immediately, or at least rather quickly, results in consumption goods. “[S]ubsistence [...] is the fundamental force to which is due everything which men cultivate, navigate and build” wrote Quesnay in the *Philosophie Rurale* ([1763] 1962, 57). Turgot argued that means of subsistence are *advanced* to workers. British economists in the 19th century would term all advances together the *wage fund*. It is in making advances available for workers with which entrepreneurs obtain the cooperation of these workers. The fundamental thesis of the Wage Fund Doctrine is that

entrepreneurs provide labourers with a real income *before* what those labourers produce (in the service of the entrepreneurs) results in a gross real income to the entrepreneur themselves. The prime example of this thesis is that the farmers must pay their landworkers some means of subsistence out of the proceeds of a *former* harvest while the landworkers are working on the farmer's land towards a *new* harvest. The method of period analysis is born precisely out of this example of an agricultural cycle, when that example is made the basis for a simple imaginary construction of an annual (i.e. periodical) harvest cycle.

In this chapter we will argue for three theses that should answer the question how entrepreneurs in general obtain the cooperation of workers in general, and how entrepreneurs in general are able to derive a profit (income) from their entrepreneurial activity. First, that entrepreneurs advance consumption goods – a wage fund – to workers in order to gain their cooperation. Second, that this wage fund is the *source of income* of the capitalists in the *subjective* sense (it is what is given up in order to get something else) and that revenues are the source of income of the capitalists in the *objective* sense (from revenues entrepreneurs draw their income). Third, that aggregate dividends are drawn out of aggregate revenues; that what is then left is the wage fund, and that the aggregate wage bill cannot, under stationary conditions, rise to the level of aggregate revenues.

In order to demonstrate the three theses we will look for support not so much in the classical Wage Fund Doctrine, but more in the relatively recent ‘neo-wage fund theory’, as it was developed by Böhm-Bawerk and E.C. van Dorp (1872-1945). The phrase ‘neo-wage fund theory’ derives from a recognition that certain parts and elements of Böhm-Bawerk's ‘Austrian’ capital theory<sup>115</sup> were a continuation of the Wage Fund Doctrine of the classical economists (Pierson, 1889; Wicksell, [1893] 1970; Veblen, 1892; Taussig, [1896] 1935, 312-318; Landry, 1904; Salz, 1905; Åkerman, 1923, 10; Van Dorp, 1931; 1937; Strigl, [1934] 2000; Knight, 1936; 1946; Blaug, 1997; cf. Hülsmann, 2000, xviii).

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<sup>115</sup> Endres (1987) has concluded that “The Austrian theory of capital and interest is now associated with Böhm-Bawerk more than Menger”; Braun (2015) writes that “Menger [...] founded Austrian capital theory”; and in *Austrian Capital Theory: A Modern Survey of the Essentials* (2019) Lewin & Cachanosky write: “In retrospect, Böhm-Bawerk's was a most ‘un-Austrian’ of moves.” Such remarks are completely anachronistic, because ‘*Austrian Capital Theory*’ was understood to be *Böhm-Bawerk's* capital theory from the capital controversies in the 1890's to the capital controversies in the 1930's. In 1941, Hayek equated ‘Austrian’ with ‘Böhm-Bawerk’ with respect to the capital theory he intended to remould in his *The Pure Theory of Capital*. Also, Böhm-Bawerk, not Menger, is the Austrian mentioned a few times in the 1960's ‘Cambridge capital controversies’. Of course, other Austrians, especially Menger and Mises, were more interested in the accounting (economic calculation) notion of ‘capital’. But then, it seems to me, it would be clearer to talk of a *theory of economic calculation* instead of a theory of capital.

The primary reason for this recognition was undoubtedly that Böhm-Bawerk, like the wage fund theorists before him, considered wages to be ‘advances’ instead of being ‘paid out of product’ (Taussig, *ibidem*; Wicksell, 1934, 188-189). Also, Böhm-Bawerk’s concept of the ‘subsistence fund’ is easily affiliated with the ‘wages fund’. The ‘macro-economic’ model of interest, wages and growth, that is contained in a section of the *The Positive Theory of Capital* (1891) entitled ‘The Rate of Interest Under Market Conditions’, had even been dubbed the ‘new wage fund theory’ by Wicksell’s student Åkerman (*ibidem*)<sup>116</sup>. The foremost proponent of considering Böhm-Bawerk’s capital theory as a neo-wage fund theory, and also the most significant developer of Böhm-Bawerk’s ‘capital theory’ along that line, was the Dutch economist E.C. van Dorp (1872-1945)<sup>117</sup>.

We will start this chapter with a short revisit to a terminological topic, namely the two different ways in which the word ‘capital’ is used in economics. After that we will go on to consider the big problem of distribution theory, the *problem of interest* (i.e. the problem to explain profits) along Böhm-Bawerkian lines. Next we will develop Böhm-Bawerk’s distinction between factors of production and sources of income, in order to further understand the (neo-) wage fund theory. After a discussion on the differences between production theory and distribution theory (which should further elucidate the distinction between factors of production and sources of income) we will arrive at the last part in which we discuss how Van Dorp used period analysis in order to tie some loose ends in Böhm-Bawerk’s capital theory together.

## **2. The Dualist Conception of Capital with Böhm-Bawerk**

If we want to understand Böhm-Bawerk’s ‘capital theory’ one must take notice of the way in which he structures the subordinate theories of his ‘capital theory’ (Schumpeter, 1997). The theoretical system of Böhm-Bawerk’s *The Positive Theory of Capital* (1891) begins with two separate pillars. Production theory is the first and most fundamental pillar; value- and price theory is the second pillar. On top of both these pillars Böhm-Bawerk puts a superstructure consisting of a further two parts. In the first part of the superstructure, Böhm-Bawerk offers a theory that contains the so-called ‘three grounds’ for the existence of time-preference. This part of Böhm-Bawerk’s capital theory is known as the ‘time-preference theory’ or ‘Agio theory’. The difference in value between present and future

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<sup>116</sup> In his biography of Böhm-Bawerk, Tomo calls it the ‘neo-Lohnfondstheorie’, i.e. ‘neo-wage fund theory’ in English (1994, 125). Takata has also used the phrase ‘new wage fund theory’ ([1937] 1998, 129). Åkerman, a doctoral student of Wicksell, was probably the first to apply such a phrase to Böhm-Bawerk’s wage fund theory.

<sup>117</sup> Taussig and Strigl are to a certain extent also developers, or at least defenders, of Böhm-Bawerk’s capital theory regarded as a neo-wage fund theory.

goods must help explain the underlying reason for the existence of interest. The second part of the superstructure, also the last part of the *Positive Theory*, is then decidedly broader. First, we find Böhm-Bawerk elaborating on the labour-market as one giant ‘subsistence market’ in which entrepreneurs make advances to labour. This culminates in a theory (or model) of distribution that some writers have termed the ‘new wage fund theory’ (Åkerman, 1923; Tomo, 1994, 125). Some regard it as even broader in scope, as “*a complete macroeconomic theory of equilibrium and growth*” (Fillieule, 2012, 300, his italics)<sup>118</sup>.

Böhm-Bawerk’s production theory deals with the constraints that nature puts on man’s action, and how man can lift such constraints by making and using tools. The first principle and topic of Böhm-Bawerk’s production theory is the general anthropological fact that mankind is a tool-making and tool-using creature. In his production theory the word ‘capital’ – or what he also calls ‘Social Capital’ – stands for tools or ‘instruments of production’. Böhm-Bawerk’s interest- and distribution theories, however, deal foremost with an explanation of the interest-phenomenon. But clearly Böhm-Bawerk offers, towards the end of the *Positive Theory*, an explanation of the ‘height of interest’ *in conjunction with* the height of wages. There he deals with the distribution-theoretic question how the shares of capitalists and workers in aggregate output are determined.

Böhm-Bawerk warns his reader, *right on the very first page of his introduction to the Positive Theory*, that the word ‘capital’ means different things in the respective contexts of production theory and distribution theory. ‘Capital’ means a tool or ‘instrument of production’ in production theory, while it means the capitalists’ ‘source of income’ in distribution theory<sup>119</sup>. Wicksell also remarked that Böhm-Bawerk first uses the modern (neo-classical) concept of capital as tools, but later in his *Positive Theory* returns to the “older concept of a subsistence or wage fund” (the classical notion of ‘capital’ as advances of means of subsistence) ([1928] 1997, 41). This change from one notion of capital (capital as fixed capital goods or tools) to another (capital as a wage fund) is something that is necessitated by the way in which Böhm-Bawerk orders and structures his ‘capital theory’. First, he treats production theory, in the middle value- and price theory, and ending with distribution theory.

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<sup>118</sup> Böhm-Bawerk’s ‘capital theory’, since it contains production-, value-, price- and distribution theories, comes close to a complete ‘economic theory’. The phrase ‘capital theory’ is a collective noun.

<sup>119</sup> The irony of this warning is precisely that Böhm-Bawerk could have used two different terms for what to him are capital-the-factor-of-production and capital-the-source-of-interest; namely *capital goods* and *capital* respectively, and avoid a lot of confusion (Van Dorp, 1937).



Historians of economic thought often seem to want to put economists either in the box of ‘classicals’ or ‘neoclassicals’ (also called ‘marginalist’ or ‘postclassicals’). Böhm-Bawerk is often put into the box of the ‘neoclassicals’, probably because he is a follower of the marginal value theory that supplanted the labour theory of value in the late 19<sup>th</sup> century. However, it is often unnoticed that one can be a ‘marginalist’ or ‘neoclassical’ in value theory but a ‘classical’ with respect to distribution theory. The ‘marginal revolutionary’ W.S. Jevons *did* in fact adhere to the ‘classical’ distribution theory which was called the ‘wage fund doctrine’<sup>120</sup>. He only performed the cosmetic alteration of renaming the ‘wage fund’ into ‘free capital’. Böhm-Bawerk’s reiterates the thesis in his *The Positive Theory of Capital* that wages are advances, in which he surely follows Quesnay, Smith and Ricardo. The ‘capital controversies’ of the 1890’s were essentially a dispute on whether wages must be seen as such ‘advances’ (i.e. paid out of former-period product) or ‘paid out of product’ (Taussig, [1896] 1935; Wicksell, 1934, 108). In other words, the ‘capital controversies’ of the 1890’s were about the question whether the classical wage fund doctrine should survive in a *renewed* form, or that it should be supplanted by a rather different type of distribution theory. Against Böhm-Bawerk’s defense of wages as advances, one finds foremost J.B. Clark (Böhm-Bawerk; ). Clark held the thesis that ‘production and consumption are ‘synchronized’, which is nothing but another way of underpinning the synchronized conceptualization that wages are ‘paid out of product’. Clark’s main follower of the thesis of ‘synchronization’, F.H. Knight, would in the ‘1930’s capital controversies’ continue the fight against (what he called) “the Ricardo-Jevons-Böhm-Bawerk theory” (1936, 453) and the “the classical-Böhm-Bawerk view of Capital” (ibidem, 456)<sup>121</sup>.

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<sup>120</sup> Stigler is an exception. He writes about Jevons: “Jevons, so critical of the classical economists when he dealt with demand theory, was a close follower of the ‘wrong-headed’ Ricardo in distribution” ([1941] 1968, 3). One reason for this mistake may be that the classical ‘wage fund’ concept is often tied to the labour theory of value, even though in such cases it is not made clear what the two have to do with each other (e.g. Valk, 1928, 7).

<sup>121</sup> What is the determining criterion for designating distribution theories as ‘classical’ or ‘neoclassical’? Professor Kurz writes: “While the surplus [i.e. ‘classical’] approach conceived the real wage as determined *prior* to profits (and rent), in the neoclassical approach all kinds of incomes were explained simultaneously and *symmetrically* in terms of the ‘opposing forces’ of supply and demand in regard to the services of the respective ‘factors of production’, labour and ‘capital’ (and land).” (his emphasis, 1990, 81). With Böhm-Bawerk wages are obviously prior and not simultaneous with revenues (and thus profits). But Böhm-Bawerk does indeed attempt to find out how the profit-rate is determined by forces such as the supply of advances and the productivity of extending the production-period. Why should the latter criterion trump the former?

### 3. What is the ‘problem of interest’?

#### 3.1 A First Approximation of the Interest-Problem

With Böhm-Bawerk, the ‘problem of interest’ can be found as a rather straightforward issue: Böhm-Bawerk starts with the observation of a phenomenon generally present in capitalist economy. He finds that entrepreneurs have costs on the one hand, and revenues on the other hand. The costs consist in wages, rents and expenditure on machinery and materials. Usually, revenues are more than costs. The ‘problem of interest’ is simply to explain the spread (Böhm-Bawerk calls it a ‘surplus value’) that exists between those expenditures on the one hand and the revenue on the other hand (1890, 115-117).

In the first approximation of the ‘problem of interest’, Böhm-Bawerk thus holds a broad definition of ‘capital’ when he uses the term *capital* in the distribution-theoretic sense of a *source of income* (not in the production-theoretic sense of capital goods). Capital considered as a source of income is what Böhm-Bawerk also calls ‘Private Capital’ or a *Rentenquelle* (1921, 42). The latter term was translated into English as ‘Rent Fund’, but a ‘source of return’ would be a more literal translation. This Private Capital consist of all the resources (under the ‘veil of money’) that a private capitalist needs to continue his enterprise. It consists of ‘means of subsistence’ needed to pay to workers and landowners (i.e. real wages and real rents) *and* of capital goods. ‘Private Capital’ – the individual capitalists’ source of income – is thus a broader thing than what Böhm-Bawerk called ‘Social Capital’, by which he meant (by and large) capital goods only. With Böhm-Bawerk, the return on capital of the capitalist is thus a return that results from ‘investment in fixed capital’ (capital expenditure) *and* ‘investment in circulating capital’ (operating expenditure).

This broad definition of ‘capital’, when considered as a source of income, can be contrasted with the much narrower definition of ‘capital’ as a source of income that one finds in the ‘post-classical’ or ‘neoclassical’ tradition of J.B. Clark and Walras. Clark and Walras see the *ownership of fixed capital goods* as the source of income of the capitalist, they do not see the capitalists’ other main function of an employer as a source of income to him. To Clark and Walras, the return to capital – which they call ‘interest’ – is only the result of ‘investment in fixed capital’, but *not* of investment in working capital<sup>122</sup>.

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<sup>122</sup> On the narrowing of the concept of capital, see Eagly (1974, 126-138). Interestingly, Eagly seems to apply some censorship by omitting ‘means of subsistence’ as a part of the Austrian concept of capital, by which it seems that the Austrian School stands midway between the Classics and Walras.

### 3.2 A Generalization of the Interest-Problem

The first approximation of the interest problem has a complication. This is the fact that not every entrepreneur makes a 'profit' or a positive return to his expenditure<sup>123</sup>. Some entrepreneurs make losses now and then, and sometimes they even go bankrupt. This phenomenon of losses and bankruptcies accompanies the phenomenon of profit. To deal with this complication, we can argue that one must look at the fact that a surplus of revenues over costs exists *in general*. Indeed, without such a *general* profit-phenomenon, it is highly questionable that the capitalist system could survive.

Without this generalization, one would be forced to offer a theory that explains the profits or losses of *individual* entrepreneurs in their concrete circumstances. Why do some entrepreneurs make huge profits, others moderate profits, and still other suffer losses or go bankrupt? To adequately explain this would mean to leave the scope of economic theory and go into psychological and sociological theories of different types of entrepreneurs; to search for concrete reason why this entrepreneur is successful and this other is not. But this is not the problem we want to solve, we want to solve the profit-phenomenon as a general phenomenon, and we need to find general reasons why profits appear in general.

### 3.3 The Return to Debt-Capital and the Return to Equity-Capital

To argue that we want to address the 'problem of interest' *in general* at the same time also gives us the possibility to leave another possible complication out of the scope of our inquiry. The general problem of interest is often needlessly complicated by swiftly involving two specific types of the return to capital into the treatment of the interest-problem. These two more specific types of the return to capital we may call the 'return on debt-capital' and the 'return on equity capital', colloquially known as 'interest' and 'profit'. One cannot adequately address these types of the return to capital without first explaining how the return on capital in general can arise in the first place. It indeed happens a lot that interest is paid on money-loans, and it is an important phenomenon to explain. But as far as business-loans are concerned, the payment of loan-interest can only take place if the business itself can in the long-run achieve positive returns on the money spent on factors of production (on 'investment'). The first thing to explain is the return on capital in general. Once this phenomenon is explained one can

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<sup>123</sup> Van Dorp (1933) uses this complication as an argument against the Agio theory.

take the next step towards the more specific problems involved in the distinction between ‘loan-interest’ and ‘profit’, i.e. between the return on debt-capital and the return on equity-capital<sup>124</sup>.

### 3.4 Capitalist and Entrepreneur

According to the Walrasian tradition, an equilibrium is defined as a situation in which factor-prices equal revenues. No surplus of revenues over costs exists in such an equilibrium (Walras, 1954, 224). As far as there are ‘entrepreneurs’ in such an equilibrium, they are entrepreneurs that neither make profits nor suffer losses (ibidem, 584). The same is true for Clark’s ‘static conditions’, in which a capitalist will make an income called ‘interest’ on a source of income called ‘capital’ (which stands for a fund of capital goods). But a ‘profit’ does not exist in static conditions, according to Clark (1908, 201-203). Adopting either the Walrasian or Clarkian framework would mean to distinguish between a ‘capitalist’ as the owner of a fund of capital goods and collector of ‘interest’ (on the one hand) and an entrepreneur as the organizer of production and collector of a ‘profit’ (on the other hand).

Böhm-Bawerk, however, is not so strict at all in distinguishing between a capitalist or a capital-goods owner (on the one hand) and an entrepreneur (on the other hand)<sup>125</sup>. Böhm-Bawerk also does not care to explicate what should be the difference between ‘capital-interest’ (*Kapitalzins*) and entrepreneurial profit (*Unternehmergewinn*) (1890, 9). He uses the terms ‘capitalist’ and ‘undertaker’ as interchangeable terms throughout the *Positive Theory*. *Kapitalrente* (‘return on capital’) *Kapitalzins* (‘capital-interest’) and *Kapitalprofit* (‘capital-profit’) are synonyms to Böhm-Bawerk. Böhm-Bawerk’s non-distinction between capitalist and entrepreneur is explainable from the point of view of one of his theses: One of his main theses is that capital goods are *not* sources of income, at least not ‘independent’ sources of income, but ‘intermediate products’ (1890, 232-246). That thesis cannot be freely discussed if one adopts the working hypothesis that capital goods bring their owner an income that can be separated from the income of entrepreneurs.

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<sup>124</sup> The relation between the shares of equity-capitalists and debt-capitalists is very important. For Austrian Economics, in which the lending of fiduciary media has since Mises been such an important topic, there can even be a special case of debt-capitalist, namely those that obtain debt-capital by issuing fiduciary media.

<sup>125</sup> One example of this is his use of the phrase “Capitalist-Undertakers” (1891, 315)

#### 4. The Concept of the *Source of Income*

##### 4.1 Sources of Income and Factors of Production

A *source of income* is the thing that corresponds with an income. To F.A. Walker, one of Böhm-Bawerk's opponents in the first 'capital controversies' around the 1890's, those things that one can 'place against', or correspond with, different types of incomes can be listed quite simply: Land can be placed against the income called 'rent'; labor can be placed against the income called 'wages'; and 'capital' (by which he meant capital goods) can be placed against the income called 'interest' (1892, 405).

A noticeable difference between productivity theorists and Böhm-Bawerk is that the former do not, in fact, distinguish between 'factors of production' on the one hand and 'sources of income' on the other hand. Their thought behind the indistinction between 'factor of production' and 'source of income' must be quite straightforward: One owns and contributes a factor of production; all output must be explained in terms of combinations of factors of production; so all income must be related to a factor of production. All factors of production must have their 'factor share'. This point of view can be tabulated as follows (cf. Walker, *ibidem*).

<i>source of income / factor of</i>	
<i>production</i>	<i>income</i>
<i>land</i>	rent
<i>labour</i>	wages
<i>'capital' (i.e. capital goods)</i>	interest

We can now contrast this point of view with Böhm-Bawerk's. To Böhm-Bawerk, land, labour and capital goods are indeed factors of production. But if we would want to list Böhm-Bawerk's 'sources of income', that he places against the incomes rent, wages and interest respectively, we could not come up with listing those factors of production (land, labour and capital goods). We would have to name land against rent, labour against wages. But against interest one would either have to list 'Private Capital' or *means of subsistence*. We have already explained the reason why 'Private Capital' is the source of interest to Böhm-Bawerk when he thinks of the individual capitalist: It is not sufficient for the individual capitalist to bring in capital goods. He must also pay wages and rents (Van Dorp, 1937, 68-72). From this consideration, capital goods can not be the sole thing in the capitalists' source of income.

Böhm-Bawerk goes further than this because he, in a sense, denies capital goods as being part of the capitalists' source of income at all. Böhm-Bawerk distinguishes between "originary factors of production" (land and labour) and capital goods (which he called "intermediate products") in both his production theory and his distribution theory. This distinction has hardly implications for his theory of production; for example, the distinction does not take from capital goods the status of 'factor of production' nor does it strip the study of the use of capital goods of its importance<sup>126</sup>. The distinction between "originary factors of production" (land and labour) and capital goods ("intermediate products"), however, is of the utmost importance in his distribution theory. Böhm-Bawerk admits "originary factors of production" the status of a source of income, but he denies this status, eventually, to capital goods. What is the justification for this?

#### 4.2 The Source of Income in the Subjective Sense

The *Rentenquelle* or 'Private Capital' is the source of income *in the subjective sense* of the capitalist, for it lists what an individual capitalist needs, *from his subjective point of view*, in order to gain an income called 'interest'. That capitalist needs means of subsistence (i.e. means of paying real wages and real rents); and he needs capital goods (production facilities, machinery, materials, fuels). If we move to what the source of income is to the worker, we can find the answer quite quickly. Employment, or work, is obviously in a *subjective* sense the 'source of income' of the labourer, since employment is clearly a quid-pro-quo between a service delivered on the one hand with a payment for that service on the other hand. The German word for wage – *Lohn* – means both 'wage' and 'reward' and as such is self-explanatory. Böhm-Bawerk does not think that explaining the wage-phenomenon is so difficult, since a wage is obviously part of a quid-pro-quo (1891, 54). Likewise, land is the 'source of income' in a subjective sense to a landowner. Renting is clearly a quid-pro-quo between a piece of land that is temporarily relinquished for use for a tenant by the landowner (on the one hand) and a price or 'rent' paid in return for this use by the tenant to the landowner (on the other hand). Work and land-use are the conditions which are met – from the point of view of the income-earners – that make it possible that their wages and rents *come in*. This is why employment and landownership are seen as sources of income.

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<sup>126</sup> On the contrary, capital goods (tools) are of tantamount importance in explaining productivity, as can be gauged from the important status of the 'law of roundabout production' with Böhm-Bawerk.

### 4.3 The Source of Income in the Objective Sense

The great difference between Clark's and Böhm-Bawerk's distribution theory is that the latter also recognizes a 'source of income' in the objective sense. According to Clark:

“The interchange of products disguises, but does not destroy, the dependence of the individual on nature. A laborer's income may seem to really come to him as a payment from another man; but in essence it is still the response that nature makes to his own labor--it is his own virtual product.” (1908, 53)

Clark only recognizes the workers' own labour as a source of income. It only *seems* so that another man realizes the workers' income! There is with Clark only a subjective source of income<sup>127</sup>.

However, Böhm-Bawerk does investigate from where, from what *outside* source, the means of payment, with which wages and rents are actually paid, *come in*<sup>128</sup>. With Böhm-Bawerk the condition that the worker must meet in order to obtain a wage-income (the source of wages in the subjective sense) is not the same thing as where that wage-income actually comes from (the 'source of wages' in the objective sense). The first question is rather simple, as we have seen: Work is delivered to either an entrepreneur or a consumer, and for this service a wage (a reward) is paid. For the second question Böhm-Bawerk clearly follows a doctrine laid out by the 'classical' economists before him: a wage is an *advance*. This means that the wage is not derived from the product which the worker helps to produce. Rather, the product is only the *reason* for which a wage is paid. The product of the work is not the *content* of the wage. The wage is paid by the capitalist with a *previously produced* output<sup>129</sup>.

This concept of the wage as an advance was ingrained in the wage fund doctrine of the British classical economists (which dates at least back to Quesnay's concept of *avances*). There is a production-theoretic underpinning: The landworker, who is now tilling the land, is clearly not sustained today from the grain which the land will yield once today's tilling of the land has contributed to a harvest of

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<sup>127</sup> Here Clark seems to explicate a kind of economic solipsism, i.e. a denial of other agents in the economy.

<sup>128</sup> Böhm-Bawerk sometimes uses the phrase 'income theory' as an alternative to distribution theory.

<sup>129</sup> According to Taussig and Wicksell, the capital controversies of the 1890's were essentially a debate on the question whether real wages were advances (paid out of former-period products) or paid out of 'product' (i.e. current revenues) (Wicksell, 1934, 188-189; Taussig, [1896] 1935, 1). In Cohen's assessment of this debate, the wage fund is not even mentioned at all (Cohen, 2008).

new grain. The landworker is fed from *previously produced* grain. The input of the landworker does not immediately result in an output. Böhm-Bawerk adopts parallel theses in his production theory on the one hand and in his distribution- or income theory on the other hand: Input is prior to output – one can derive from his production theory; wages are prior to revenues – one can derive from his production theory. Wages are paid from a previous output. It is this previous revenue that is accumulated by capitalists and spent by capitalists on wages. The accumulation out of which wages are paid is what Quesnay and Ricardo called ‘advances’; it is what other classical economists called a ‘wage fund’, it is what Jevons called ‘free capital’, while Böhm-Bawerk rebranded it as a ‘subsistence fund’. With Böhm-Bawerk the ‘source of wages’ – now understood in the objective sense of the *where* from which wages come in – is a ‘wage fund’, from previously produced output which is accumulated to pay wages (Veblen, 1892).

With Böhm-Bawerk the wage fund is the source of wages in the objective sense for the workers; but at the same time the wage fund is the source of interest in the subjective sense for the capitalists. We see this clearly in the end of the *Positive Theory* in the section ‘The Rate of Interest Under Market Conditions’ where a *literal* ‘wage fund’<sup>130</sup> is the thing given up by capitalists during a production period. The wage fund is the first condition that is met by capitalists in order to derive a *Kapitalzins* (‘capital-interest’; ‘return to capital’) at the end of the production period. The source of interest in the objective sense is thus simply the revenue – i.e. the capitalists’ gross income – obtained at the end of the production period. From that revenue the ‘return on capital’ – which forms the net income – is determined by an accounting procedure. From the revenues (at the end of the period) the wages fund (paid during the production period) is subtracted, and the ‘interest’ is the difference between revenues and wages fund, it is what is left-over, it is a surplus (Van Dorp, 1937, 163).

In conclusion of this section, we can provide the following table to contrast Böhm-Bawerk’s point of view on sources of income<sup>131</sup>:

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<sup>130</sup> The section is translated as ‘The Rate of Interest Under Market Conditions’ in the Hincke & Sennholz-translation of the *Positive Theory* (1959), it is translated as ‘The Rate in Market Transactions’ in the Smart-translation (1891). It is interesting that Böhm-Bawerk, by literally using the word ‘wage fund’, does not hide an affiliation with the wage fund doctrine.

<sup>131</sup> After Böhm-Bawerk has elaborated on his ‘three grounds for interest’ (his time-preference theory) he begins a new part of his *Positive Theory* which is originally called “Der Ursprung des Kapitalzinses” (translated as „source of interest” in the Smart-translation and as “the origin of interest” in the Huncke & Sennholz-translation). In the first sentences of this part Böhm-Bawerk argues that time-preference is the ‘source’ (*Quelle*) from which



source of income	<i>subjectively</i>	<i>objectively</i>
<i>of workers</i>	services rendered	wages fund ('advances')
<i>of landowners</i>	land provided	wages fund ('advances')
<i>of capitalists-entrepreneurs</i>	wages fund ('advances')	revenues ('product')

#### 4.4 The Wage Fund and 'Intermediate Products'.

Böhm-Bawerk's initially defines 'Private Capital' (the *Rentenquelle*) as comprising both means of subsistence *and* capital goods. Both stand at the beginning of the road to interest, so to speak. However, in the end of the *Positive Theory* there is a section on 'The Rate of Interest Under Market Conditions', the core of what has been dubbed the 'new wage fund theory' (Åkerman, *ibidem*). In this treatment of the distributive shares of capitalists and workers, capital goods stand only midway between paying workers on the beginning-of-period, and obtaining a revenue on the end-of-period. In 'The Rate of Interest Under Market Conditions', capital goods are only 'intermediate products'. They appear and disappear in the *process of distribution* between workers and capitalists, but they are not part of the *Rentenquelle* anymore, as the *Rentenquelle* is narrowed down to comprising only means of subsistence; i.e. it is only a wage fund.

This aspect of Böhm-Bawerk's theory can be affiliated with that Ricardo's theory, which is perhaps the archetype of economic doctrine in which the wage bill is equated with 'capital'. About Ricardo's conception of 'capital' St. Clair writes:

"Not only does Ricardo treat capital as the only source of wages<sup>[132]</sup>, but he appears in these extracts to regard capital as consisting exclusively as a fund for the maintenance of labour; otherwise, how could he say that every increase of capital will raise wages? And that the increase in the demand for labour is in proportion to the increase in capital? Yet Ricardo was well aware that there is much capital in the form of machinery and plant, even if he sometimes appears to forget it. [...] he tells us that 'Capital is that part of the wealth of a country which is employed in production, and consists of food, clothing, tools,

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capital-interest pulls its origin (*Ursprung*) and that he will expound further on this. This expounding culminates in the wage-fund theoretical argumentation that wages are advances when Böhm-Bawerk writes of a 'subsistence market'. It seems that Böhm-Bawerk puts the *ultimate cause* of the phenomenon of interest in time-preference. In this guise Mises uses the phrase 'originary interest' (*Urszins*) (1940, 474.

<sup>132</sup> Here St.Clair uses the phrase 'source of wages', like Veblen, in the objective sense.

raw materials, machinery, etc., necessary to give effect to labour.’ [...] he refers to shipping, docks and canals as capital. [...] Nevertheless, there was a tendency on his part, which he never completely overcame, to think of capital as consisting only of a fund for the support of labourers” (ibid , 87-88, [1957] 1965).

This conclusion about Ricardo is rather uncontroversial. Kuenne argued that for “a Ricardo [...] it was sufficient to abstract capital as a circulating fund of subsistence goods for the sustenance of labor in the current production period” (1992, 337)<sup>133</sup>. Garegnani argues that “in determining the rate of profit Ricardo operated *as if* capital consisted entirely of the wages advanced for the year” (1984, 300). In fact, Fetter argued that this view was widespread among other classical economists, since “a thought that was destined to grow until a certain kind of ‘circulating’ capital, subsistence for laborers, came to be looked upon by J. S. Mill and others as the very essence of the capital concept” ([1930] 1977, 145).

Now it is precisely this “tendency [...] to think of capital as consisting only of a fund for the support of labourers” – which one can find with Ricardo *and* Böhm-Bawerk<sup>134</sup> – which calls for a justification (c.f. Gehrke & Kurz, 2018<sup>135</sup>). Why should *capital* not be more broadly defined as all the things the individual entrepreneur makes expenditure on - ‘circulating capital’ (means of subsistence and goods-in-process) *and* ‘fixed capital’ (cf. Eagly, 1974)?

If there is a justification for narrowing the *Rentenquelle* down to a wage fund, it must have something to do with a generalization from the individual entrepreneur towards the class of entrepreneurs; or what comes down to the same thing; the generalization of the individual interest-phenomenon to the general interest-phenomenon. Van Dorp has shown that labelling capital goods as ‘intermediate

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<sup>133</sup> Kuenne has argued that “The theory propounded by Böhm-Bawerk sought to integrate capital and interest into the whole of value and distribution theory in a manner that was Walrasian in spirit” (1992, 325). Kuenne furthermore argued that for “a Ricardo [...] it was sufficient to abstract capital as a circulating fund of subsistence goods for the sustenance of labor in the current production period” (ibidem, 337). Kuenne subsequently contrasts this Ricardian view of capital with Böhm-Bawerk’s ‘Austrian’ view of capital, which sees capital as “a succession of intermediate products moving through the production process” (ibidem). In other words, he argued that to Ricardo ‘capital’ is a wage fund, a fund of consumers’ goods, while to Böhm-Bawerk ‘capital’ are the capital goods (machines and materials) which mature into consumer’s goods. This seems to me either a confusion of Böhm-Bawerk’s ‘Social Capital’ or production-theoretic capital (which are capital goods), with his ‘Private Capital’ or distribution-theoretic capital (of which means of subsistence form an essential component).

<sup>134</sup> On Böhm-Bawerk in relation to Ricardianism, see Schefold (2018).

<sup>135</sup> Professors Gehrke & Kurz argue that “Ricardo’s blunder [of identifying the “rate of profits with the rate of surplus value”] was due to the simplifying assumption he typically entertained in much of his observations on the wage–profit relationship; namely, that capital consists entirely of, or can be resolved entirely into, wages.” (2018, 437).

products' has in fact everything to do with thesis that only advanced 'means of subsistence' are actually the source of income when the *general* profit-phenomenon is under discussion. She writes:

“The capitalist supplies the labourer with consumption-goods; doing this is identical with investment. Now there are only two ways of getting the disposal of any productive intermediary goods, either by having them produced by labour or by buying them. This brings no change in the relative position of capital and labour, only in the relative position of some persons, both capitalists. It there for, is not of importance to our inquiry.” (1937, 77)

In other words, transactions between capitalists, which involve (in real terms) exchanges of capital goods for consumption goods, do not affect the distribution of consumption goods between capitalists and workers. Therefore, these transactions are immaterial towards explaining the shares of capital and labour in total output.

Van Dorp also points out that Böhm-Bawerk probably did not even see the full implication of his own labelling of capital goods as 'intermediate products':

“Böhm Bawerk has not seen that the source of interest which we are searching for is not represented by private capital. All the private capital together is not the social-interest-yielding-capital: much has to be subtracted, viz., all mutual obligations between capitalists. But it is a concept of the same nature!” (ibidem, 177)

The closest to which Böhm-Bawerk comes to pointing out that the concept of 'intermediate products' refers to transactions among capitalists, is when he writes:

“If the different stages of one and the same production process were united in the hand of one and the same undertaker, he would not buy any previous product: all previous and intermediate products needed would be made, from the beginning, by the workers in his employment. Here, therefore, his entire 'business capital' would evidently be directly devoted to advancing subsistence to labourers. As it is, under the division of labour, he gets his previous products made by other undertakers, and buys them from these other undertakers. This amounts to saying that, by this purchase, he takes upon himself the burden of the advances hitherto borne by the other undertakers, and thus puts them again in a position to take upon themselves the burden of

advancing subsistence for the following period of production [<sup>136</sup>]. These previous and intermediate products, then, thus purchased, he gets worked up by labourers who are directly in his pay. In this way, therefore, by his wage payments he advances subsistence directly to one set of workers, and indirectly by his ‘outlays’ to a number of other sets (employed in the preceding stages).” (1891, 320)

We can conclude that, if one goes from private capitalist to the class of capitalists, if we move from the first approximation of the phenomenon of interest with individual entrepreneurs to that interest-phenomenon in general, then there is a clear justification to purge capital goods from the concept of *capital* (‘capital’ in the sense of the source of income of the capitalists). The problem of distribution theory is, after all, to explain as far as possible the relative shares of ‘labour’ and ‘capital’ as aggregates<sup>137</sup>, so transactions between capitalists *must* be left out. Furthermore, we want to explain the interest-phenomenon in general. This justifies on the one hand to see capital only as a wage fund, and on the other hand one can give capital goods their place in the distribution process by identifying them as ‘intermediate products’.

## 5. Production Theory and Distribution Theory

The phrases “originary factors of production”<sup>138</sup> (land and labour) and “intermediate products” (capital goods) appear both in Böhm-Bawerk’s production theory and in his distribution theory. However, it is mainly seen as a production-theoretic terminology. Since, Hayek (1931) and Burchardt (1931) the common interpretation and summarization of Böhm-Bawerk’s conception of the ‘structure

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<sup>136</sup> I believe that, from Böhm-Bawerk’s thesis that the later-stage entrepreneur “takes upon himself the burden of the advances hitherto borne by the other undertakers”, one can take a next step and conclude that the profits of all higher-order entrepreneurs are, like wages, *advances*. We will return to this point in the next chapter, when we disaggregate the class of entrepreneur-capitalists back to different stages or industries.

<sup>137</sup> The clash between wage fund theories and marginal productivity theories is often seen as a clash between the attempt to explain aggregates and the approach of explaining individual wages rate (Fetter, [1896] 1977, 26; Rothbard, 1977, 5). To Fetter, the aggregate wage bill is explained by summing individual wages. The common sense of the approach of explaining individual wage rates is, of course, that the more productive worker will earn a higher wage than a less productive one. But the disadvantage of the individual approach is that one does not get much further than this undeniable fact that the more productive worker earns more than the less productive. It only explains wages from the standpoint of a subjective source of income. It does not explain at all where the content of wage-payments comes from. The main thesis of Taussig’s *Wages and Capital: An Examination of the Wages Fund Doctrine* ([1896] 1935) seems to be to show that the *objective* source of wages lies in previous output, output to which the worker is in fact not contributing anymore.

<sup>138</sup> The German original is “originären Produktivkräfte”. Smart translated this as “original productive powers”. Sennholz and Huncke as “originary productive forces”. Hayek uses the phrase “original means of production”; Rothbard uses the phrase ‘original factors of production’. “Originary factors of production” is used in the translation of R. von Strigl, *Capital and Production* ([1934] 2000).

of production' is that the production process must be *linear*. That is, that it always begins with "originary factors of production" (land and labour); passes through the station of "intermediate products" (capital goods); and ends in consumption goods (Leontief, 1938; Hagemann; 1994, 112-113). This has led to acceptance of the idea that according to Böhm-Bawerk there should be some 'first stage of production' in contemporary economies in which only land and labour are producing without the help of 'intermediate products' (capital goods). Much ridicule has followed this interpretation, Leontief writing that "[i]f Böhm-Bawerk did actually set out in search of this hypothetical first stage, he would find himself now still on the road". It is all polemics. Both Böhm-Bawerk and Hayek recognized that 'intermediate products' could be put back to an 'earlier' or 'higher' stage of production<sup>139</sup>.

There is also a variant of this complaint (that Böhm-Bawerk's 'Austrian' view on the structure of production assumes a non-capital using first stage of production) levelled from the point of view of Neo-Ricardian economics. This is that it is also 'linear' or 'vertical' in another respect, because it neglects the 'circular' characteristic of the production process. 'Commodities are produced by means of commodities', which simply means, when its mystique is undone, that the Neo-Ricardians regard the food of the labourer as a basic factor of production, but that at the same time the production process also results in food. Since the beginning and end of the production process is food, production is regarded as 'circular'. This circular aspect is what the Austrians do not recognize:

"In striking contrast to the circular vision of the productive process, the vertical vision of the Austrian approach turns out to be a further variant of neoclassical analysis, which conceives of the production process as 'a one-way avenue that leads from 'Factors of Production' to 'Consumption Goods' (Sraffa)." (Hagemann, *ibidem*)

That this complaint against Böhm-Bawerk's 'Austrian' vision of the structure of production is extremely misleading, is shown by what Böhm-bawerk writes himself:

"our conception of the Intermediate Products [...] embraces all those goods which come into existence during the production process, the goods which carry it on and help to complete it; but it does not embrace the initial fund of consumption goods

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<sup>139</sup> The fact that there are 'circularities' or 'whirlpools' in production does not mean that there is no hierarchy or structure to production. See for example Helmstädter (1965) and Lowe (1976, 34).

needed to commence the process. It therefore leaves out the first link in the chain, which is a very important one” (1891, 42)

The common interpretation that ‘intermediate products’ stand midway between land and labour (on the one hand) and consumption goods (on the other hand) is due for revision. First, of all, in Böhm-Bawerk’s production theory, the fund of subsistence goods is just as elementary in commencing production as are land and labour. But the central topic of Böhm-Bawerk’s production theory is the tool-making and tool-using aspect of production. Secondly, Böhm-Bawerk’s main concern is, in the end, the explanation of interest. Now in dealing with this distribution-theoretic question, it is entirely justified to distinguish between labour and land on the one hand and capital goods on the other hand. The former may be designated as ‘originary factors of production’ since they get their income (objectively) from a wage fund, or better, a *wage- and rent fund*. The latter may be designated as ‘intermediate products’ as they stand *between* expenditure of the means of subsistence (the wage fund) on one end of the *distribution process*; and the gross income (revenues) of the capitalist on the other hand of that distribution process. Böhm-Bawerk’s distribution process is certainly ‘circular’ in the sense of beginning and ending with the same thing: ‘means of subsistence’.

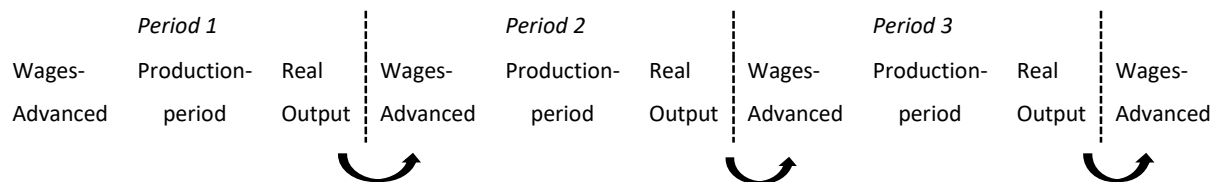
In a production-theoretic sense, capital goods are inputs in the same way as labour and land are inputs. Capital goods do not only arise *within* the production plans of economic actors, i.e. they do not only stand *between* inputs and outputs as ‘intermediate products’ in production processes. Only in the special case of a Robinson Crusoe, who commences his first production plan after stranding naked on a desolate island, we can designate capital goods as ‘intermediate products’ and deny them a place among the initial conditions of the production plan. But in the rest of all relevant production processes, capital goods always stand at the beginning of new production plans (even though these capital goods are always left-over products from former plans). Böhm-Bawerk’s production theory is not very clear in this respect and it is unfortunate that he already labels capital goods as ‘intermediate products’ in his production theory while he probably could have better waited with that labelling until the discussion of his actual distribution theory.

## **6. Van Dorp’s development of the new wage fund theory**

### **6.1 Dividends as the Cause of Profits**

Van Dorp has provided a very simple wages fund theory in order to only resolve the problem of distribution (1937, 75-114). Her point of departure is precisely the concept of the wages fund as the *initial datum*, as well as the employment of a periodical thought-construction. Van Dorp divides the

progress of time into periods of weeks. In order to acquire the help of labour and land, capitalists need to pay wages and rents out of a previous accumulation of output (the ‘wage fund’). The size of this previously accumulated fund Van Dorp regards precisely as the *datum*, but it is a datum from the point of view of the current period.



The first conclusion of the periodical analysis is that after a period is over, the capitalists own the whole real output of consumer goods. With respect to this stock of consumer goods produced under their direction, they have no obligations towards the workers and land-owners that have contributed to this output, because the capitalists have already paid for labour and land through advances, i.e. wage-payments funded out of previous-period production. So the capitalist must now decide what to do with this stock of consumers’ goods which he owns outright<sup>140</sup>. Now there are two things the capitalists can do with this stock of consumers’ goods. The first thing that they can do is consume a part of their output. That is, they take *dividends*<sup>141</sup> out of the accumulated revenues of their enterprises<sup>142</sup>. The second thing they can do is to use a part of these goods as a ‘wages fund’ for the next period, as advanced payments to workers and landowners. That is, they use it as *reinvestment* in order to acquire

<sup>140</sup> An objection against the wage fund doctrine has to do with the aspect of a ‘stock’: “In an economy of temporally overlapping production processes, the total amount of commodities available for consumption must be treated as a flow rather than a previously accumulated stock, and it is only in the case of positive net investment, when efforts are made to *increase* the size of the flow, that a lag akin to that envisaged in the wage-fund theory can be regarded as occurring” (Gordon, 1973, 17). The thought behind the objection is undoubtedly that, in reality, a cost-flow occurs simultaneously with a revenue-flow. But this simultaneity is no evidence for the absence of a lag between the two flows. The flow of ‘advances’ (i.e. wage payments) to workers is *in fact* still lagging behind the revenue-flow that comes in. This is evidenced by the fact that firms – both individual firms and in the aggregate – have a working capital base to be in operation. If there was no lag between the cost-flow (of wages-costs) and the revenue-flow, then the presence of the ‘working capital’-phenomenon would be inexplicable. See on this point also Magnan de Bornier (1990, 135).

<sup>141</sup> A dividend can also be taken out when there are losses. In the simplified periodical analysis, all revenue comes in right at the end of a period, all these revenues are owned outright, and the capitalists are in principle free to hire or fire their workers in the next period. Of course, in reality this is all a little more nuanced, but it remains so that even in the case of losses a dividend can often be taken out. That would simply mean that in the next period operating- and capital expenditure will be less than in the former period.

<sup>142</sup> Van Dorp does not use the term ‘dividends’. She writes of profits taken out and profits reinvested. Hence dividends are not the same as profits.

again the help of the ‘originary factors of production’ they need if they want to continue producing in the next period<sup>143</sup>.

Taking dividends out of the output of consumption goods that is finalized at the end of a period has consequences. The more dividends the capitalist take, the less ‘wage fund’ there is left over for the next period. But as long as *some* dividends are taken out of the former-period revenues, the total former-period revenues can never be spent in the form of wage-payments. So if production is stationary, in the sense that in each period an equal amount of consumption goods are produced, the aggregate *advanced* wage bill of each period can never be as high as aggregate revenues at the end of the period, so long as some dividends have been taken out of former-period revenues. Therefore, there must occur a difference (‘surplus’; ‘margin’; ‘spread’) between the advanced wage bill and the revenues of the next period. This difference is what is called *profits, interest* or the *return to capital*. Profits of the current period are thus caused by the dividends taken out in the former period. The phenomenon of profits in general can be explained with reference to the existence of the taking-out of dividends in the former period. *Dividends* are the initial independent variable we have been looking for in solving the problem of interest<sup>144</sup>.

## 6.2 The Wages-Fund-Stream Theory

The weakness of Böhm-Bawerk’s ‘new wage fund theory’ (in the section ‘The Rate of Interest Under Market Conditions’), according to Van Dorp, was that Böhm-Bawerk only considered a single, one-off period. Böhm-Bawerk’s model starts from a few premises: *First*, there is a *single* ‘period of production’ (from input to output); although this single period can be *lengthened* into a duration of multiple years. *Second*, Böhm-Bawerk assumes a given wage fund at the beginning of this period, implying that, if for example the ‘period of production’ is doubled, wages will be halved. *Third*, Böhm-Bawerk assumes – based on his own theory of roundabout production – that lengthening the period of production will increase output. Van Dorp argued that profit-maximizing capitalists would, under such conditions, be incentivized to lengthen the period of production as far as they can, implying that wages will be depressed as far as possible. According to Van Dorp, Böhm-Bawerk’s premises thus

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<sup>143</sup> When the stock of consumer goods is used in this latter way we could speak of Jevons ‘free capital’: By “free capital” Jevons meant “the wages of labour, either in its transitory form of money, or its real form of food and other necessaries of life” ([1871] 1965, 243).

<sup>144</sup> Van Dorp argues that how much the capitalists consume is a datum for economic theory (1937, 77). But this datum could be described in terms of time-preference: The more capitalists consume, the higher their ‘time-preference’, the less they invest, and *vice versa*.



leads to an ‘iron wages law’ (1933, 17)<sup>145</sup>. The major problem that Van Dorp identifies with this conclusion, which she draws from Böhm-Bawerk’s ‘new wage fund theory’, is that it does not correspond with the facts. After all, under capitalism workers are not sweated to bare-subsistence wages at all.

Indeed, Böhm-Bawerk limits his scope to a single period in ‘The Rate of Interest Under Market Conditions’. This single-period analysis leads to certain unrealistic notions: First, in the single-period scope, wages are paid beforehand almost ‘once and for all’. Second, the revenues coming in at the end seem only to serve to replenish the capital that was lost by spending it on wages, and as a net income on top of that recuperation of wage-costs. End-of period output serves no other functions but those. To Van Dorp, this limitation to the scope of a single period is the problem underlying Böhm-Bawerk’s ‘new wage fund theory’. It denies a continuous character of economic life<sup>146</sup>. But there is a way out. Once the scope of the single period is transcended, and we put our field of view on a sequence of periods, one can see that revenues are the direct source of the ‘wages fund’. To say that wages are advances means, after all, that wages are paid out of former-period output. It is not so that output has nothing to do with factor-payments. The thesis of wages-as-advances does not deny that (former-period) output at least *can* influence (next-period) wages.

Van Dorp writes:

“We can only see the wages-funds as a stream coming in every week and therefore being continually influenced by output. Therefore if we imagine an output of £70 and a wage of £40 and a profit of 75 per cent. this profit will soon disappear as

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<sup>145</sup> Van Dorp’s thesis that Böhm-Bawerk’s model in the section ‘The Rate of Interest Under Market Conditions’ (of the Positive Theory) leads to an iron wages law, as well as her development of the new wage fund theory, was debated in the Viennese *Zeitschrift für Nationalökonomie*. Richard von Strigl (one of Böhm-Bawerk’s students) admitted that he totally ignored the wages fund in his *Angewandte Lohntheorie* (‘Applied theory of wages’, 1926). In Strigl’s *Kapital & Production* (published 1934; translated as *Capital & Production*, 2000) the wages- or subsistence fund subsequently takes a prominent place. For other interpretations of ‘The Rate of Interest Under Market Conditions’ see Takata (1934), Dorfman (1959), Magnan de Bornier (2008) and Fillieule (2012).

<sup>146</sup> To many critics of Böhm-Bawerkian capital theory (Knight, Burchardt, E. Schneider), the phenomenon of the *continuity* of economic life must be addressed by adopting a static model. The alternative way of treating continuity is the cutting-up of the lapse of time into distinct ‘economic periods’, as Böhm-Bawerk in fact does in the section called ‘The Theory of the Formation of Capital’ in the *Positive Theory*. But Böhm-Bawerk did not use such a sequential construction in ‘The Rate of Interest Under Market Conditions’. Cutting-up of the lapse of time into distinct ‘economic periods’ is precisely the way in which Van Dorp handles continuity.

entrepreneurs will invest the bulk of their profits in production, which means that perhaps the next time wages will be raised by £25. Böhm Bawerk has paid no attention to the origin of the wages-fund! If we bring these corrections into Böhm Bawerk's wages-fund theory we get the right wage-funds-stream theory." (1937, 162-163)

Thus Van Dorp argues that, even though a former period may be concluded with high profits, capitalists will probably be highly incentivized to reinvest these profits in their companies for the next period. High profits make it possible for capitalist to reinvest, so those who refuse to reinvest the bulk of their profits may be outbid for 'human resources' by their competitors in the coming period. Without reinvestments of profits, their enterprises may lose pace with competitors.

Hence Van Dorp points with her wage-funds-stream theory towards the *free cash flow* phenomenon, i.e. that the cash flow that need not be harked back into the enterprise, and which can be freely used for consumption by the capitalists, is the actual 'net income' of 'capital' (Koller et. al. 2010, 17-44). Also, it shows that with respect to actual business practice one cannot dwell only on profits. In the bookkeeping practice of everyday business, there is not only a profit & loss statement dealing with revenues and costs, but also a cash-flow statement dealing with receipts and disbursement.

## 7. Conclusion

The major advance of Böhm-Bawerk's capital theory over the classical wage fund theory was that Böhm-Bawerk came practically near the demonstration that capital goods are not a source of interest with respect to the general 'problem of interest'. His notion of capital goods as 'intermediate products' is in line with the tendency of Ricardo and others to regard only wages-expenditure as *capital* (understood as the source of income). By extending Böhm-Bawerk's single-period model of distribution to a multi-period model, Van Dorp showed that the fundamental thesis of the wage fund doctrine - that wages are advance payments<sup>147</sup>- has implications for the problem of interest. She showed that if wage-advancements (which are the source of interest in the general profit-problem) for one reason or another were lower than revenues, the surplus between costs and revenues (that is called 'interest' or 'profits') is explained. The reason that wage-advancements are lower is simply that the capitalist must consume some part of the output themselves. Out of revenues entrepreneurs draw their dividends.

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<sup>147</sup> The other thesis associated with the wage fund, that there is some *eternally* given wage fund which determines the wage rate of all workers, was probably what was most objectionable about the wage fund doctrine.

With that the principle problem of the theory of distribution is solved. But a lot of more specific problems remain. The most important problem that Van Dorp leaves untouched is that of the relative profits within the class of entrepreneurs. In particular, the profit-rates of making capital goods versus consumption goods, and with that the understanding of economic growth, she left untouched. It seems to me that that is the point for further development of the wage-funds-stream theory.

## 6. A ‘Real’ Theory of Saving & Investment<sup>148</sup>

### 1. Introduction

#### 1.1 The Aim of the Theory of Saving and Investment

The theory of distribution revolves around a question that is limited in scope: How does the distribution of income between workers and capitalists (and perhaps also landowners) work? It is a question about the distribution of the pie, but not about the question how the pie is made bigger. We will now delve into the latter question, but we do it under the assumption that a reinvestment of one’s piece of the pie may have something to do with growing the pie. In other words, we believe we should attack the latter question with the help of the answer to the former.

However, let us start first with this consideration: If the demand for apples rises and that for oranges falls, the traditional theory of the price mechanism, of theory of profit equilibrium, would assert that profits of apple-production rise and profits of orange-production falls. As a consequence, more capital would be invested in apple-production and less in orange production. As production (supply) of apples grows and that of oranges declines, profits on apple-production fall again, while those on oranges rise. As such an interaction is identified in the forces of demand-and-supply that determine the prices of products, and the profits on the production of those products which determines how much resources will be devoted to that production. This mechanism or system, which determines the allocation of resources, is what economists call the *price mechanism*, an *equilibrium* or the ‘equilibrium-tendency’.

What if people want more apples and oranges in the future, and are willing to forego apples and oranges now to obtain more of them in that future? Is there a similar mechanism at work? That is, is there some sort of price mechanism or equilibrium tendency in the supply of present and future wants? In the literature such a mechanism is sometimes referred to as an “intertemporal equilibrium” or an “intertemporal price equilibrium” (Hayek, [1928] 1984; Samuelson, 1957); an “intertemporal price mechanism” (Leijonhufvud, 2004, 154; Trautwein, 2012, 273) or as a “saving-investment mechanism” or “saving and investment mechanism” (Schumpeter, 1946; Corry, 1962; Hutchison, 1978, 170). A theory of the saving and investment should have as its aim whether such a *saving and investment*

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<sup>148</sup> A first draft of this chapter was prepared for the *Journée d’étude en économie autrichienne*, 10 décembre 2021, at UCO Angers - Salle Tradition.

<sup>148</sup> Especially with the Austrian School: Bohm-Bawerk’s *The Positive Theory of Capital* (1891); Strigl’s *Capital & Production* ([1934] 2000); Hayek’s *The Pure theory of Capital* (1941). But this is also true for Marx’ *Capital* or many other books on ‘capital theory’ such as J.A. Kregels’ *Theory of Capital* (1976).

*mechanism*<sup>149</sup> is at work in the market economy, and what its key elements might be. This is the main aim of this chapter.

The Keynesian school of economists have in fact more or less maintained that a saving and investment mechanism is at the least dysfunctional<sup>150</sup>, or simply non-existent. The long dominance of Keynesian economics has resulted in a situation in which the phrase ‘Paradox of Thrift’ is a much more familiar term in economics than either ‘intertemporal equilibrium’ or ‘saving and investment mechanism’. According to the Paradox of Thrift, and its closely related model called the ‘Keynesian Cross’, saving is self-defeating. An increase in savings leads to a lower aggregate demand for consumption goods, which in turn is – according to the Keynesians – detrimental to investment conditions. In other words, money can be saved and made available for investment, but precisely the act of saving brings the rate of return on investments down, and therefore makes investment less likely. Hence the paradox<sup>151</sup>. The question, of course, remains whether the Keynesians have not jumped too fast to their conclusion that a saving and investment mechanism is non-existent<sup>152</sup>.

## 1.2 The position of the theory of saving and investment within economics

What is called the or *theory of saving and investment* has a largely overlapping meaning with other phrases in economics. What is called the *theory of capital* is very often more or less the same field as what others describe as the theory of saving and investment. The same is true for phrases such as the *theory of saving*; the *theory of investment*; the *theory of capital formation* and the *theory of growth*<sup>153</sup>. The common aspect of all

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<sup>149</sup> We prefer ‘saving and investment mechanism’, since the term ‘intertemporal’ implies that there exists some sort of trade between the future and the now. But it is contentious to assert that *temporal economics* is analogous to *spatial economics*. Obviously in the case of spatial economics there is interregional- and international trade. But whether chronology allows for an actual trading between the future and the now – which is what the term ‘intertemporal’ seems to imply – is debatable (at the least).

<sup>150</sup> For example, Professor Trautwein discusses “failures of the intertemporal price mechanism to coordinate investment and saving” (2022)

<sup>151</sup> James Mill argues in his *Commerce Defended* (1808) in the following way about paradoxes: “that the secret of which [Rousseau] availed himself in his writings to excite the attention of mankind, was the employment of paradoxes. When a proposition is so expressed as to bear the appearance of absurdity, but by certain reasonings and explanations is made to assume the semblance of truth, the inexperienced hearers are, in general, wonderfully delighted, give credit to the author for the highest ingenuity, and congratulate themselves on a surprising discovery.” The ‘Paradox of Thrift’ seems have all the elements Mill mentions.

<sup>152</sup> Hanns-Joachim Rüstow writes in his *Theorie der Vollbeschäftigung der Freien Marktwirtschaft* (1951): “Der unzureichende Preismechanismus der Klassiker muß durch einen „Investitions-mechanismus“ ergänzt werden. (9). He thus suggests a mechanism to exist, although he adheres to Keynesian thought and does not see this as a self-regulating mechanism of the market, but a mechanism which the government must put in motion.

<sup>153</sup> For example: Bresciani-Turroni, “The Theory of Saving” (1936); Haavelmo, *A Study in the Theory of Investment* (1960); Röpke, *Die Theorie der Kapitalbildung* (1929); A. Lowe, *The Path of Economic Growth* (1976); Dobb, *An Essay on Economic Growth and Planning* (1960). All such works have very overlapping topics.

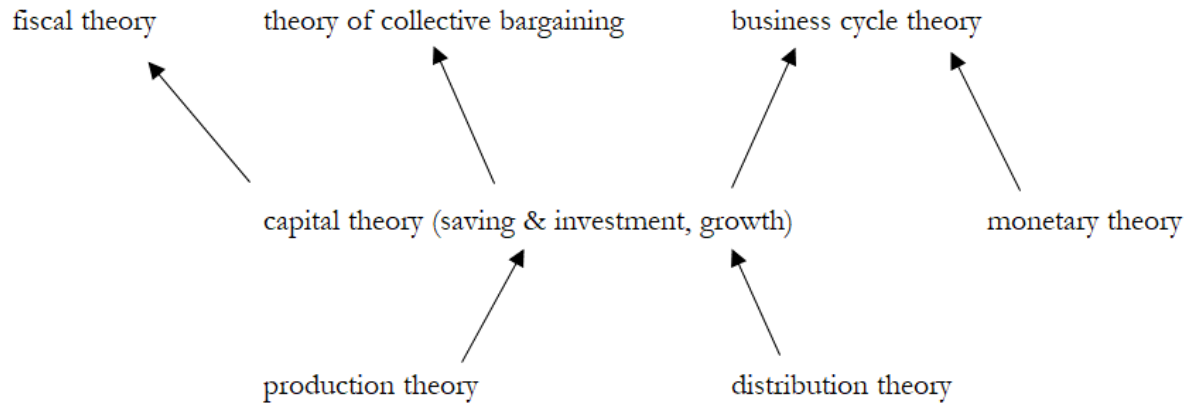
these theories is that they usually deal with the combination of the topic of the growth of the capital stock and with the topic of the return on capital for different investment possibilities. Furthermore, books and articles on the theories of capital, saving and investment, and growth, will usually discuss the capital formation theories of the better-known capital theorists such as Marx, Böhm-Bawerk and Wicksell.

The theory of saving and investment thus builds further on *production theory* on the one hand and *distribution theory* on the other hand. The former deals with the *technical-physical constraints*; the latter deals with the phenomena income-generation and income-distribution. For example, it needs to reckon with the *social constraint* facing the capitalists that they cannot get workers to work for them unless they advance income to these workers<sup>154</sup>. The theory of saving and investment stands midway between the fundamental subfields of production theory and distribution theory on the one hand, and more advanced fields of economics on the other hand. The theory of saving and investment (or capital theory) is generally seen as preliminary to business cycle theory (Bresciani-Turroni, 1936, 2; Kaldor, 1937, 201)<sup>155</sup>. But it can also be preliminary to *fiscal theory* (analysing the results of tax-intervention on incomes, saving and investment) or the *theory of collective bargaining* (analysing the results of strikes and strike-threats on income distribution and on saving and investment). The schema below shows the position of the theory of saving and investment between other subfields of economics:

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<sup>154</sup> On the one hand there are the *technical-physical constraints*: If more output of consumption goods must be produced eventually, first a number of new or 'labour-saving' capital goods must be produced, which usually entails certain *resource-shifts* from consumption goods production to capital goods production. But more output of consumption goods usually also requires a higher input of raw materials, necessitating the development of mines, wells, heavy industries, and the like. On the other hand, one needs to study in what ways the *incentives* – the profitability and remunerability – will or will not enable the required resource-shifts.

<sup>155</sup> Bresciani-Turroni writes: "in this last decade the problem of saving has again attracted increasing attention [...] It was realised that a correct theory of saving was necessary in order to explain the vicissitudes of the Trade Cycle" (1936); Kaldor wrote shortly thereafter (1937): "The last few years have witnessed the emergence of a tremendous literature on the theory of capital and interest-stimulated, no doubt, by the urgency of finding the appropriate theoretical criteria for a policy designed to mitigate economic instability."



The theory of saving and investment is a *real* theory of saving and investment in so far as monetary influences are disregarded (when we assume *neutral money*) or when we are dealing with a hypothetical barter economy. In this chapter, we will mainly stick to such an analysis in real terms<sup>156</sup>. That is, we will assume that consumption goods, rather than money, are the goods generally accepted as means of payment for all other goods. Instead of money-payments, we assume that workers are directly paid in consumption goods and can barter these against other consumption goods; entrepreneurs that produce consumption goods use these goods as payment to workers, and exchange the consumption goods they keep as dividends also against other consumption goods. These consumption goods producing entrepreneurs also use consumption goods as payment for machinery. The machine producing entrepreneurs must thus first exchange machinery against consumption goods in order to obtain the consumption goods which subsequently will be used to advance wage-payments to workers.

### 1.3 The Theses

This chapter takes a step further from the theory of functional distribution, which was expounded in the last chapter. In the last chapter, capital goods were left out of the discussion of the problem of functional distribution (i.e. the problem of the distribution of income between capitalists and workers).

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<sup>156</sup> The ‘classic’ contribution on the theory of saving and investment in all the contributions of the Austrian School is probably Hayek’s “Gibt es einen ‘Widersinn des Sparens?’ (1930), translated as “The ‘Paradox’ of Saving” (1931). However, this article is an analysis of saving and investment in money-terms. If we look at another Austrian’s contribution, Strigl’s *Capital and Production* ([1934] 2000) – in which the concept of the wage fund plays a prominent role – we may point to Professor Hülsmann’s introduction to its English translation in which Professor Hülsmann writes: “so far as the general procedure of the analysis is concerned, Strigl does in fact not heed his announced intention (p. xxx) to first analyze a barter economy and only then turn to dissect the impact of the ‘Veil of money’” (2000, xx). One of the aims of this chapter is to give an ‘Austrian’ and ‘neo-Wage Fund’ approach to the theory of saving and investment by piercing through the veil of money.

Capital goods are transacted between capitalists and therefore do not affect the distribution between capitalists and workers. But once we want to understand the growth of the capital stock, we will need to bring capital goods into the discussion. After all, the amount and composition of the capital stock is the measure of how mechanized or ‘capital-intensive’ the economy is. By bringing capital goods into the discussion we will bring in the conclusions from the theory of production.

In this chapter we will defend four simple theses:

1. The profits of the capitalists of higher order stages are *advances* coming from the capitalists of lower order stages.
2. In relation to any final output of consumption goods, the profits of higher order stages are *chronologically prior* to those of the lower order stages.
3. Transactions of capital goods affect the distribution between different groups of capitalists. Some capitalists predominantly sell capital goods, while others predominately buy capital goods. A higher price of capital goods raises revenues for one group (machine producers) while it raises the machine-cost of another group (machine users). For example, if all else remains the same, higher prices of machinery raises profits (and profit rates) for the machine producing industry and lowers profits (and profit rates) for the consumption goods industry - and *vice versa*. Therefore: *The price of capital goods must be the operating mechanism of any tendency towards profit-equilibrium between capitalists in different stages of production.*
4. In order to understand both the incentives towards the growth of the capital stock, as well as its effects on the structure of production, we cannot just think of *investment in fixed capital* as a single dimension. We need to make the relative distinction between *investment in more labour-saving equipment* and *investment in less labour-saving equipment* in order to understand the incentives and effects of saving and investment.
5. The accumulation of funds before actual investment spending - called ‘plain saving’, or ‘hoarding’ - is a key feature of the saving and investment mechanism. The reason is that plain saving depresses the gross profits of the consumption goods industries relative to higher-order sectors of the economy, whereby an important incentive is created to release factors from the consumption goods industries, and towards the higher-order sectors.

#### **1.4 Organization of this chapter**

This chapter is organized as follows: In the second section, we will discuss the classical, Austrian and Keynesian concepts of saving and investment in order to clear the path towards a proper problem-



statement for the theory of saving and investments which will follow in section three. In sections four we will take the first steps of a positive theory of saving and investment by elaborating on the four theses which were already mentioned in this introduction. In section five we will elaborate on these theses by providing a theory on the mechanism of saving and investment. After that section we will conclude.

## **2. The Preliminary Problem of the Definition of ‘Saving and Investment’**

### **2.1 The Classical and Austrian Concepts of Investment**

In a paper on a similar topic as the present paper, Professor Hülsmann investigates “the relations between three structural variables: the interest rate, the gross savings rate, and the length of the structure of production” (2010, 1). Few would disagree that the interest rate is a phenomenon explained from the theory of distribution or the theory of interest. Few would disagree that the ‘structure of production’ is part of production theory or ‘capital theory’. But both production theory and distribution theory seem to use their own notions of ‘savings’. Our earlier treatment of both theories makes this clear, and we will put the different definitions of savings to the forefront:

In the *production theory* of Böhm-Bawerk, ‘saving’ means non-consumption, or lessened consumption, *in the near future*, and it is related to the formation of capital goods:

“if an increase of capital is to become possible, obviously a still greater proportion of the current productive powers must be withdrawn from the consumption of the present, and transferred to the service of the future; of his ten hours of labour our Crusoe must devote *one* to renewing his weapons, and *less than nine* to gathering berries and killing game, if he is to make the new capital he desires in what remains free of his labour time. To put it generally, he must curtail the immediate consumption of the current period to such a point, that it uses up the produce of fewer (past and present) productive powers than come into existence anew in the same period; he must, in a word, save productive powers.” ([1889] 1891, 105)

With Böhm-Bawerk and Hayek, we see clearly that with ‘saving and investment’ is meant the same thing as ‘building capital goods’, in short, ‘capital formation’ (*Kapitalbildung*). ‘Saving’ and ‘investment’ refer to two sides of the same thing: The building of capital goods, the ‘investment’, necessitates that

resources are diverted from making consumption goods. Hence the building of consumption goods involves, or necessitates, a ‘saving’ in the sense of the temporary non-production of consumption goods. A temporary non-production of consumption goods implies a non-consumption of consumption goods.

We find also, in the theory of roundabout production, that a production process can have multiple indirect stages, that ‘investment’ comes in degrees. Given ‘wisely chosen methods’, when more stages of production are performed, i.e. when there is a higher degree of ‘investment’, there will be a higher output in the end. Here there is some notion of a measure of ‘capital intensity’.

When we now turn to distribution theory, we see a different notion of ‘saving and investment’. In distribution theory - to be precise in the *wage fund* theory of distribution which forms a part of classical economics - ‘saving’ is an act on the part of the capitalists to not-consume a part of the consumption goods they become owners of at the end of the production process. To Van Dorp, ‘investment’ is a term identical with ‘saving’, and it is a *binary* thing: *Either* the capitalists consume consumption goods themselves, *or* they use these consumption goods as wage-payments (or ‘advances’) to ensure the cooperation of labourers in the next period.

Van Dorp cites Adam Smith in support of this notion of saving:

“What is annually saved is as regularly consumed as what is annually spent, and nearly in the same time too; but it is consumed by a different set of people. That portion of his revenue which a rich man annually spends, is in most cases consumed by idle guests, and menial servants, who leave nothing behind them in return for their consumption. That portion which he annually saves, as for the sake of the profit it is immediately employed as a capital, is consumed in the same manner, and nearly in the same time too, but by a different set of people, by labourers, manufacturers, and artificers, who re-produce with a profit the value of their annual consumption.” (Cannan-edition page 320, Book II, Chapter III)<sup>157</sup>

So, in the wage fund theory of distribution, there is no question of an actual non-consumption from the aggregate point of view (that is, from the point of view of all classes, i.e. capitalists and workers).

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<sup>157</sup> Van Dorp cites Smith on page 92 of her *Simple Theory of Capital* (1937). Interestingly, Hayek, *The Pure Theory of Capital* (1941, 272), shortly discusses precisely this proposition of Adam Smith. Possibly it is a response to Van Dorp’s *Simple Theory of Capital* which Hayek mentions in the bibliography of the *Pure Theory*.

What is produced is also consumed, what is produced is not unconsumed from the perspective of everybody, what is produced is simply partly unconsumed by a certain class.

Here we see a possible disagreement on the definition of ‘saving and investment’<sup>158</sup>. In the *wage fund* theory of distribution, all ‘investment’ is simply paying consumption goods *as wages* to workers, and nothing else. All wage-payments are ‘investment’, all revenues above wages costs are profits. There are no *degrees* of ‘investment’ since the actual duration of investment is not important in explaining the profit-phenomenon itself. For the explanation of interest, it is irrelevant how many workers are working in indirect stages and how many in direct stages. In the (Böhm-Bawerkian) theory of production, however, there are degrees of investment, since production can be made ‘longer’ or ‘shorter’, it is important how many workers are working in indirect stages and how many in direct stages.

Some authors enter the theory of saving and investment from the steppingstone of production theory. They are more accustomed to the imaginary construction of a Crusoe Economy in which there is simply no question of one class (capitalists) paying consumption goods to another class (workers). From the perspective of Crusoe, of ‘man versus nature’, things are as Böhm-Bawerk explains: Saving is non-consumption in order to produce capital goods, and the production of capital goods comes in degrees or stages. Of course, another set of authors has entered the theory of saving and investment from the steppingstone of the wage fund theory of distribution. They are less accustomed to the imaginary construction of a Crusoe Economy, and see ‘saving and investment’ from the imaginary reconstruction of the actual capitalist economic system. In that system, one can take the point of view of the capitalists as a class. The consumption goods that the capitalists have produced and become owners of, but which they do not consume themselves and pay as wages to workers, are actually consumed by the workers.

But there is no actual disagreement about definitions once we recognize that ‘saving and investment’ means different things in two different theories – in production theory and distribution theory. Both definitions cover a different aspect of economics. The problem is not in definitions, but in bringing the fields of production theory and distribution theory together.

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<sup>158</sup> Seidel (1939, 420) notes the divergence in the point of view on saving and investment or ‘capital formation’: “Im Gegensatz zu dieser „volkswirtschaftlichen Theorie der Kapitalbildung“ steht die Lehre, daß durch das Sparen Verbrauchsgüter — deren Produktion nicht eingeschränkt, höchstens in der Richtung verändert wurde — zur Alimentierung zusätzlicher Investitionsgüterproduktionen frei werden.“

I believe they can be brought together quite simply. Once we incorporate the possibility, into the theory of saving and investing, that capitalists can also pay shares or bonds to workers in exchange for their services, instead of consumption goods, the difficulty is resolved. In the reality of a money-economy this is in fact what happens very often ‘under the veil of money’: Wage-earners use their money-income to buy shares and bonds (directly or indirectly via pension funds). Hence an abstention from consumption is not something that can only be undertaken by the capitalist classes, but also by the workers<sup>159</sup>. This incorporation opens the possibility that the output of consumption goods can be diminished, in order to free-up resources that can then be used for capital goods formation.

## 2.2 The Keynesian Concept of Induced Investment

Keynesianism has furnished economics with a distinction between *autonomous investment* and *induced investment*. There has been some discussion on the precise meaning of the terminology (Ulmer, 1952). The term *autonomous investment* seems to mean a type of investment that follows from the free exercise of the will, a decision on the part of income-earners to save income and turn it into investment, rather than turn income into consumption. The term *induced investment* seems to mean a capital formation that results from better market-conditions for selling goods. The Keynesian meaning of induced investment is very clearly explained by Samuelson. He writes:

“Any practical businessman will tell you that he is more likely to add to his plant or equipment if his sales are high relative to his plant capacity.” (1948, 270)

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<sup>159</sup> In *A Simple Theory of Capital* (1937) Van Dorp argues in the thirteenth chapter (entitled: “Positive Theory of Wages and Profit or Loss”): “What does it mean that wages are paid? To answer this question we must for the moment think apart from money: we then see that wages are consumption-goods. The labourer wants no capital-goods; what could he do with them? He wants only consumption-goods. So the capitalists supplies the labourer with consumption goods; doing this is identical with investment” (77). The definition of ‘investment’ as ‘capitalists supplying labourers with consumption goods’ is carried on in the sixteenth chapter (entitled “Savings and Investments”) in which she maintains that investments (and also ‘savings’, what is to Van Dorp a synonymous term) only consist in handing over consumption goods from one class (capitalists) to another (workers). However, on the first page of the thirteenth chapter Van Dorp had argued that she is not writing about “a distribution between different persons, but between persons performing different functions”, and that “the person of a labourer can have a vested interest in the leading of a concern: he can have either a share or a bond. He may therefore be a labourer in his own service” (75). But Van Dorp has developed this point no further. To develop it further means to recognize that saving is not *exclusively* a handing over of consumption goods by capitalists to workers. The phenomenon of abstention from consumption by not letting production goods ripen into consumption goods, through re-allocating them back into use for the production of production, is precisely what occurs when workers are (under the veil of money) paid in shares or bonds.

He furthermore writes:

“Induced investment means that anything that increases national income is likely to be good for the capital goods industries; anything that hurts national income is likely to be bad for those industries. This throws a new spotlight on the age-old question of thrift versus consumption. It shows that an increased desire to consume--which is another way of looking at a decreased desire to save--is likely to boost business sales and increase investment. An increase in thriftiness, on the other hand, is likely to make a depression worse and reduce the amount of actual net capital formation in the community. *High consumption and high investment go hand in hand rather than being competing.*”  
(*ibidem*, italics in original)

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The distinction between *autonomous investment* and *induced investment* is fallacious because the latter term refers to *circumstances under which investment is undertaken*, rather than the essence of investment itself (i.e. the choice to use resources to produce producer' goods, rather than to acquire or consume consumption goods).

What one must distinguish in is the differences in circumstances under which investment takes place. We can distinguish between the circumstances that consumption spending increases (and profit-margins on producing consumption goods tend to increase) on the one hand, and the circumstances that consumption spending decreases (and profit-margins on producing consumption goods tend to decrease) on the other hand. The Keynesians have again and again promoted the former type of circumstances as the object of economic policy. The latter type of circumstances is ignored by them and not given serious thought.

Samuelson was not wrong when argued that “[a]ny practical businessman will tell you that he is more likely to add to his plant or equipment if his sales are high relative to his plant capacity.” However, any practical businessman will also tell you that a downward pressure on profit-margins is a common occurrence in the economy, and that in general the solution to this downward pressure on profit-margin is to reduce costs by increasing mechanization and automation. Decreasing profit-margins

stimulate the acquisition of more labour-saving equipment, increasing profit-margins decrease the need to acquire more labour-saving equipment.

### 3. The Problem of the Theory of Saving and Investment

#### 3.1 A Short Recapitulation of the neo-wage fund theory

Before we state the main problem of the theory of saving and investment, we should recapitulate the *neo-wage fund theory* of the chapter before this one. The *neo-wage fund theory* explains the phenomenon of interest by help of the conception in which all ‘capital’, or all ‘investment’, are wage-payments which *consist* of consumption goods (St.Clair, [1957] 1965, 87-88; Böhm-Bawerk, [1889] 1991, Van Dorp, 1937). This conception can be defended on the ground that capitalists are treated as one functional class. Because once the capitalists are treated as one class, all expenditure on machinery and raw materials (on ‘capital goods’) can be regarded as *internal transactions*, as transaction *within* the class of capitalists themselves. All revenues of capitalists on the sales of capital goods cancel out against all the expenditure of the capitalists on capital goods. No excess of revenues over costs can exist with respect of capital goods when we regard the capitalists in general. To explain the profit-phenomenon *in general*, that is, the income of capitalists in general, this is perfectly legitimate. This means that it suffices to have a *simple* definition of ‘saving and investment’. There is only one dimension of investment, only more or less consumption goods can be advanced, each period, towards workers. In order to determine the average individual wage rate, the whole wage fund of a period must be divided by the number of workers employed. Only the *breadth* of investment, that is the number of workers put to work through advances in each period, is of relevance. Any notion of a *depth, length, capital-intensity* or *degrees of roundaboutness* of investment, by which we gauge how much time it will take for capital-goods building to help yield new consumption goods, is disregarded. In order to understand the phenomenon of profits in general, we do not have to look at how many workers are employed in building machinery relative to how many workers are working in the consumption goods sector. ‘Saving and investment’, in the functional theory of distribution, is paying wages, and nothing more. Transactions of capital goods is a phenomenon that is, in fact, *eliminated* from the theory of distribution by designating these capital goods as ‘intermediate products’. Capital goods stand as ‘intermediate products’ *between* an ‘input’ or ‘capital-investment’ of wage-payments consisting of consumption goods (on the one hand) and an ‘output’ or ‘revenue’ of consumption goods (on the other hand). How many capital goods are built, and worn and torn, *between* wage-expenditures and revenues is not relevant in order to explain the existence of profits.

Capitalists advance consumption goods to workers, by which wages are generated. Under the direction of the capitalists the workers produce an output, an output from which the capitalists subsequently take dividends. These dividends imply that not the whole output of consumption goods can, in the next period, be advanced again to workers. If output remains stationary, the costs of the capitalists (the real wages advanced or its money-sum equivalent) must be lower than the output of the capitalists (the amount of consumption goods produced or its revenue in money). Hence, they make a profit.

### 3.2 The Main Problem of the Theory of Saving and Investment

In the *theory of saving and investment*, the production of capital goods becomes the central topic. We know that capital goods are produced to increase output, to ‘grow the economy’. We want to understand, to begin with, the allocation of workers between machine-production and consumption goods-production (Hayek, [1929] 1933, 60). Going into more detail, we would want to understand the allocation of workers into more stages of indirect labour than just one. We want to explain the incentives to expanding the capacity to produce, *given* the constraints that current productive capacity poses on the will to expand. The theory of saving and investment deals with the allocation of resources with respect to the near future and the distant future<sup>160</sup>.

In other words, what the neo-wage fund theory leaves out of consideration in order to provide a solution to the problem of functional distribution – namely the production of capital goods – is brought back into consideration in the theory of saving and investment. The *general* rate of interest is a *datum* for the theory of saving and investment. The only type of the rate of interest given thought in our theory of saving and investment are the *sectoral* rates of profit – the rates of profit for a sector such as the machine producing industries or the consumption goods industries.

In the *theory of saving and investment*, we take the *breadth of investment* – the number of workers put to work in a period – as given. Our interest lies in the *depth, length, capital-intensity* or *degrees of roundaboutness* of

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<sup>160</sup> Eucken writes on the “main problem of capital theory”: “*How are labour and natural forces, as well as the existing means of production of a people, used to provide for the present, the near and the distant future?* That is the big question. Economics has solved the question of how the productive forces are distributed to satisfy the individual types of needs - for bread, meat, housing, etc., for example. It has shown how the most diverse needs fight, as it were, for the productive forces and how the struggle is decided. A second, equally important question is closely connected with this cardinal question: The needs that arise today, tomorrow, the day after tomorrow, in two or three months and in years, day after day, all fight with each other for the productive forces that are there today. Some want to shorten the maturation periods, others to lengthen them. This struggle must also be decided. How? *That is the main problem of capital theory.*” (1937, 539, his emphasis)

investment (Gadolin, 1939). We want to know what determines the allocation of workers among *vertical* sectors, and with that also the allocation of any capital goods that can be shifted in depth.

#### 4. A Positive Theory of Saving & Investment: Key Propositions

##### 4.1 The Profits of Capital Goods Producers are *Advances* from, and are *Prior* to, the Profits of the Consumption Goods Producers

We can disaggregate capitalists by initially dividing them into two further classes. On the one hand those producers who *finalize* the consumption goods: The consumer goods industries. On the other hand, those who do not finalize the consumption goods, but who make all the ‘capital goods’ or ‘intermediate products’ that are inputs into the consumer goods industries. These latter are simply the capital goods industries. We will postpone a further disaggregation for the moment, as this first disaggregation already brings us to an important point.

When the machine building industries pay wages to their workers, these wages are, in real terms, an *advance* of means of subsistence (consumption goods) to these workers. After all, the machines, the construction of which will be performed by the workers, are not yet completed. Even after the machines are completed, and delivered to the consumption goods industries, these machines will help to put out consumption goods a long into the future. Therefore, one can say that wages are *prior* to profits.

When the consumption goods producers purchase the machinery from the machine producers, the consumption goods producers take upon themselves the burden of the advances hitherto borne by the machine producers (to paraphrase Böhm-Bawerk<sup>161</sup>). However, the consumption goods producers pay a bit more than just a compensation for the wages that the machine producers advanced previously. Normally the machine producers will make a profit from their sales, i.e. a surplus over their previous costs (including wages paid). Hence, the consumption goods producers, besides relieving the machine producers of the burden of advances, also *advance a profit* to the machine producers. After all, the

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<sup>161</sup> Böhm-Bawerk writes: “under the division of labour, [the undertaker] gets his previous products made by other undertakers, and buys them from these other undertakers. This amounts to saying that, by this purchase, he takes upon himself the burden of the advances hitherto borne by the other undertakers, and thus puts them again in a position to take upon themselves the burden of advancing subsistence for the following period of production” (1891, 320).



machines delivered to the consumption goods industries will help to put out consumption goods long into the future. The final production and sales of consumption goods have not been completed at all.

That the machine producers are advances from the consumption goods producers means the same thing as saying that the profits of the machine producers are *prior* to the profits of the consumption goods producers. If we look at a particulate production and distribution process - that has begun with the construction of machinery, and ends with a continuous output (for as long as the machinery is not worn out) of consumption goods made with this machinery – the machine producers will get their profits sooner in time than the consumption goods producers.

#### **4.2 The Prices of Capital Goods are Limited by the Extend of the Subsistence Fund**

The neo wage fund theory of distribution's central question is why entrepreneurs do not bid up wages until no surplus of revenues over costs is left (Böhm-Bawerk, 1891, 314<sup>162</sup>). The answer is that, from the previous-period output which forms the objective source of the wage fund, already a dividend will have been drawn by the capitalists. Given a stationary output, the wage fund (the cost) can therefore never be so high as the output (the revenue). Hence a profit must arise.

If we split-up the capitalists into two groups, the machine producers and the consumption goods producers, it is the latter group that becomes the owner of the final output of consumption goods. They will first take dividends from the output and subsequently decide how to allocate what is left. What is left (what we call the *wage fund* or *subsistence fund*) will be used as advances to workers to ensure their services in the next period. But worn-out machinery must also be replaced, so a part of this subsistence fund will not be exchanged against labour-services but against machinery.

Now if we pose the question: Why is the price of machinery not bid-up, by the consumption goods producers, until the point that the price of machinery is so high that there is no gap left between revenues and costs (wages-cost and machine-cost)? The answer will be along the same lines as the answer why wages will not be bid-up until the point where wages are so high that profits have been extinguished. Obviously, because the consumption goods producers have drawn dividends out of previous-period output, the amount of means of consumption goods which can be used as means of

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<sup>162</sup> “to show and explain how the market price of the productive good ‘Labour’ must always be less than the value and price of the finished product of labour’

payment for both labour-services and machinery, will not be as high as revenues (under stationary conditions).

### 4.3 A Numerical Example

We can now discuss a numerical example of a stationary economy<sup>163</sup> with two sectors in which there is a profit equilibrium. Each period will look the same. The economy is stationary since dividends will be equal to profit and wages are not turned into capital.

<i>Consumption Goods Industry</i>	Output of Consumption Goods	Wage Expenditure	Machine Expenditure (replacement machinery)	Sectoral Profit	Sectoral Profit-Rate
	100	25	55	20	25.00%

<i>Machine Producing Industry</i>	Revenue (in Consumption Goods) of Sold Machinery	Wage Expenditure on machinery	Wage Expenditure on machine-tools	Sectoral Profit	Sectoral Profit-Rate
	55	34	10	11	25.00%

Aggregate Wage-Expenditure	69
Aggregate Profits	31
Average Sectoral Rate of Profits	25.00%
General Rate of Profits (Aggregate Profits/Total Wage-Expenditure)	44.93%

The *general rate of profits* (Aggregate Profits divided by Total Wage-Expenditure) is higher than the *average* of the sectoral rate of profits. In each sector, expenditure on capital goods is counted as an investment ('invested capital' or 'capital expenditure') in order to compute the sectoral rate of profit (sectoral profits divided by sectoral wage-expenditure plus sectoral machine-expenditure). In the general picture, however, all revenues made on selling machinery are cancelled-out by the expenditure on machinery. In general, there is no profit or loss on transaction in machinery. Hence machine-

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<sup>163</sup> That this economy is stationary means that there is no net capital accumulation. All expenditure on machinery is equal to the depreciation of the machinery. That the economy is stationary also means that profits are equal to dividends. No part of profit is reinvested.

expenditure does not matter in computing the general rate of profits. In fact, if we look only at the machine-producing industries, which must build its production-capacity, there is no machine-expenditure. There is only wage-expenditure for workers who are producing machinery. The same sum that is spent on machinery by entrepreneurs in the machine producing industries on purchasing machine-tools, is received by entrepreneurs in the machine producing industries on selling machine-tools. Hence the only net expenditure that machine-producing entrepreneurs make is wage-expenditure<sup>164</sup>.

#### **4.4 The operating mechanism in a tendency towards profit-equilibrium**

In the numerical example showed in the section right above, a *profit-equilibrium* between the two sectors of production is assumed. However, the question is of course whether a profit-equilibrium, or a tendency towards a profit-equilibrium, would exist (and if it would exist, how it would operate).

This question can be answered fairly simply. We have already claimed that transactions of capital goods (between capitalists) do not affect the distribution between capitalists and workers. But transactions of capital goods (between capitalists) do affect the distribution between different groups of capitalists. Some capitalists predominantly sell capital goods, in this case the machine producers. But other groups of capitalists predominately buy capital goods, in this case the consumption goods industries. It follows that a higher price of capital goods will raise the revenues of the machine producers, while it raises the machine-cost of the consumption goods producers. If all else remains the same, higher prices of machinery raises profits (and profit rates) for the machine producing industry and lowers profits (and profit rates) for the consumption goods industry - and *vice versa*. We arrive then at the following proposition: *The price of capital goods must therefore be the operating mechanism of any tendency towards profit equilibrium between capitalists in different stages of production.* If capital goods are raised in price and if this raises profit-rates for producing capital goods (relative to consumption goods), this will incentivize capitalists to produce more capital goods, to invest more resources into capital goods production – and *vice versa*. The increase in production of capital goods must lower their prices, and it must lead to a profit-equilibrium between capital goods production and consumption goods production<sup>165</sup>.

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<sup>164</sup> I am treating the general rate of profits as the rate of profit per year in which the economy is considered as a *going concern*.

<sup>165</sup> I have argued in “A Development of the Theory of the Ricardo Effect” (2017) that, under a system of fiduciary media, this tendency towards profit-equilibrium can be broken.

Suppose for some reason, *current* profit-rates are higher in the consumption goods industry than in the machine producing industry. That means, consumption goods producers have a higher profit and can, as such, draw a higher dividend. Instead of drawing dividends, the consumption goods producers could also reinvest their profits. How could the tendency towards a profit-equilibrium operate? Since the profits are relatively high in the consumption goods industry, capitalists would want to invest in this industry. In order to obtain the high profit-margins in the consumption goods industries, investors will need to obtain the type of machinery (the plant & equipment) used in the consumption goods industries. Hence, the relatively high profits in the consumption goods industries will lead to a situation in which capitalists will bid against each other in acquiring the machinery that is available for delivery at the beginning of the next period. The price of machinery will be bid up. This will lower the profit-rates of the consumption goods industries. It will make the profits of the machine producing industries higher. Such a bidding process does not need to be accompanied by any reallocation of workers from one industry to another. It also does not need to affect the aggregate saving and investment of the capitalists combined. What will happen is that the capitalists, that own the consumption goods industries, will have to reinvest more of their previous output, and thus draw less dividends, in order to acquire consumption goods producing machinery. The machine producers, on the other hand, see their expectable profits go up by the same amounts as the expectable profits of the consumption goods go down. The profit rates of both industries equalize.

#### **4.5 Labour-Saving Machinery Cuts Wage-Expenditure per Unit of Product**

Suppose that all workers in the economy are pilots and flight-attendants on and that each airplane is a similar type of airplane that has the same capacity to carry passengers, the same fuel-efficiency, the same durability and maintenance costs. Furthermore, suppose that we are thinking in a relative short-run in which the population (or better, the workforce) will not grow. The only thing that could increase the output of consumption goods (exemplified by more capacity to carry passengers) is to replace at least a part of the existing flying-machines by flying-machines that can carry more passengers with the same amount of crew. This type of change towards more labour-saving machinery is what Hawtrey called *capital deepening*. He contrasted this with building more of the kind of machinery that is already in general use, which he called *capital widening* (1937, 35-36).

The driving force of capital deepening is, of course, that more labour-saving machinery lowers wage-expenditure (to be precise, it lowers direct labour cost) per unit of product produced. For example, a more labour-saving flying machine carries more passengers per crewmember than a less labour-saving

flying machine. This lowering of operating expenditure widens the gap between operating expenditure revenues, which is the rationale for acquiring more labour-saving machinery.

We know from Böhm-Bawerk's theory of roundabout production, that this capital deepening, *ceteris paribus*, requires a longer production roundabout. In other words, it will cost the machine producing industries more wages to build the more labour-saving machinery. Unless the entrepreneurs in the consumption goods industries are willing to pay long before the more labour-saving machinery will be delivered, there will need to be some capital freed up in order to start the production-roundabout.

#### **4.5 Capital Deepening and the Structure of Production**

In order to obtain the more labour-saving machinery, factors of production must be made available to make this machinery. If we concentrate upon labour, there are roughly three scenarios of re-allocation.

(1) If the workers to be re-allocated are hitherto tied-up in the *direct* production of consumption goods, then consumption goods production will diminish. Since workers are re-allocated from the consumption goods industry to the machine producing industry, in the short-run this will result in a lower output of consumption goods. Obviously less workers will be available in utilizing the same machinery hitherto used in the consumption goods industries. Only once the more labour-saving machines are built and delivered to the consumption goods industries can output (with a diminished number of workers) be increased again. The only exception to this case is when the remaining workers in the consumption goods industries will work more overtime or double-shifts (but this implies less leisure time, which is also a consumption good).

More likely scenarios are that *within* the machine producing industries the predominant type of changes will occur<sup>166</sup>. One of these scenario's (2) is that, with the same number of workers, the machine producing industries will be taking a longer time to produce more labour-saving machinery when they build this machinery with their current machine-tools. Another possibility (3) is that improved machine-tools are needed to produce the more labour-saving equipment, which can also be done by

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<sup>166</sup> Because in reality the skill of all workers is not at the same level. Workers building machinery are more likely to have more skills in this job than those working in the consumption goods industry. In the machine producing industries, there are workers that use machine-tools to produce all kinds of machinery for the consumption goods industries. But there are also workers that use machine-tools to produce further machine-tools. It is more likely that such workers shift their output than it is by getting men from the consumption goods industries to start working with machine-tools. Of course, there are many exceptions, and even consumption goods producers use machine-tools (e.g. car manufacturers).

increasing the time-to-built of machine-tools, or by re-allocating some workers from producing machinery for the consumption goods industries towards machine-tool reproduction.

## **5. A Positive Theory of Saving & Investment: The Saving & Investment Mechanism**

### **5.1 Some Definitions**

We will use the term *saving* as meaning, when referring to capitalists, a non-consumption of consumption goods output by capitalists, and thereby a relinquishment of consumption goods to workers. In other words, saving means an increase in the wage fund or subsistence fund. A less simplifying notion of saving would also mean, when referring to workers, an acceptance of payment for work in ownership-shares of enterprises, instead of payment in consumption goods.

The term *investment* means the allocation, in either breadth or depth, of workers to different stages of production. An *increase in the breadth of investment* is defined as a situation in which more workers are put to work. It does not matter whether these new workers are formerly unemployed persons that leaving their state of idleness, immigrants or children reaching the age of employability. An increase in the breadth of investment can take place if the workforce grows, *even though the wage fund* (i.e. saving) *remains the same*. An *increase in the depth of investment* is defined as a situation in which workers are re-allocated from employment in the consumption goods industries (or a state of unemployment) towards the machine producing industries. More specific, an increase in the depth of investment implies that a re-allocation towards increasing the capacity of the machine producing industries is a *deeper* investment than re-allocation towards jobs in the machine producing industries in which workers make machinery for the consumption goods industries. An even less specified notion of investment would also take regard of the allocation of workers towards the raw materials industries. Re-allocation of workers towards the exploration for mineral resources, and the putting into operation of mines and wells, would be a deeper type of investment compared to the re-allocation of workers towards the mere exploitation of mines and wells.

The changes in the breadth and depth of investment refers to the *re-allocation* of workers to longer or shorter roundabouts of production. These terms are not the same, at least not exactly the same as the terminology used by R.G. Hawtrey (and many after him) of the “Widening and Deepening of Capital” (1937, 35-36). The phrase *capital widening* refers to the extension of the production capacity that do not change the degree of automation (or degree of mechanization); the phrase *capital deepening* refers to the

extension of the production capacity that increases the degree of automation (or degree of mechanization).

## 5.2 Changing the depth of investment without increasing the wage fund

In the stationary economy, where net saving remains zero, the whole wage fund is enough to employ all workers. From period to period, the *breadth* of investment<sup>167</sup> remains the same. If we also assume an equilibrium in the sectoral rates of profits (i.e. profits for consumption goods production is the same as profits for machine production).

We should ask now first whether the *depth* of investment could be changed without changing the amount of the wage fund and the breadth of investment. That is, without changing the aggregate wage-bill, could it be conceivable that capitalists increase the amount of workers in the machine producing industries, by withdrawing them from the consumption goods industries? Or to formulate yet in other words: Is it conceivable that operating expenditure in the consumption goods industries will go down to the extent that operating expenditure in the machine producing industries is going up.

As this re-allocation is technically conceivable, what *incentive-constraints*<sup>168</sup> are there in this respect?

The entrepreneurs of the consumer goods industries could certainly re-allocate some of their wage expenditure towards employing workers in the capital goods industries (if they would also own an enterprise in that industry). After all, the capitalist offer wages in exchange for services at the factory of their choosing. A direct consequence is that the output of the consumption goods industries goes down. Under the assumption that the wage fund remains the same, this decline in output of consumption goods must result in a decline in profits and dividends. However, the incentive-constraint is that, by taking workers out of the consumption goods industries, such entrepreneurs would *forego profits in the near future at the hitherto ruling sectoral rate of profit* (which is in equilibrium with the rate of profit of the machine producing sector). The question is whether this opportunity cost is not bigger than what is gained by re-allocation. Likewise, some entrepreneurs in the machine producing industries could re-allocate their workers towards more production of machine tools, or towards longer roundabouts for making machinery for the consumption goods industries. But also, here the point is that they will forego profits in the near future. The question that such entrepreneurs

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<sup>167</sup> By which we mean the number of workers employed, not the size of the wages fund.

<sup>168</sup> Lowe calls this “*motor or force analysis*”, which is “studying the patterns of behavior and motivation that initiate and sustain the motion of the system along the structurally determined path” (1976, 17).

will have to answer to themselves is whether this opportunity cost, to forego profits in the near future, is not bigger than what is gained by re-allocation. The profit-increase expected by having workers produce machines or machine-tools should be higher than the loss in profits in making consumption goods. But the economist cannot say whether the entrepreneurs will do so or not: It is simply a trade-off between the subjective value these entrepreneurs put upon near future profits versus more distant future profits. The matter of a tendency towards a profit-equilibrium is not involved here.

Certainly we have here one more possible form of saving and investment: That in which entrepreneurs forego profits and dividends (the part of output they would usually consume) by way of re-allocating the workers that hitherto produced the dividends (i.e. consumption goods that capitalist consume), towards the capital goods industries. In this way, capitalists forego consumption, but they do not actually relinquish consumption goods to workers<sup>169</sup>. There is, of course, a limit to such a type of saving and investing, because it cannot be larger than profits. Once it becomes larger than profits, the wage fund must be affected.

In fact, this type of saving is very similar to the type of saving (already mentioned) in which workers asking more payment in shares and bonds (in capital-ownership) rather than payment in consumption goods. For also in this case the production of consumption goods must decline, at least, if we assume in this case that dividends remain the same. Upon such a decline in consumption goods output, workers will be re-allocated towards the machine producing industries. Here the re-allocation is not effected by a tendency towards a profit-equilibrium, but by the subjective value of payment in shares and bonds increases above the subjective value of payment in consumption goods.

### **5.3 Changing the depth of investment by increasing the wage fund**

What now if the depth of investment is attempted to be changed by entrepreneurs by increasing the fund of subsistence goods from which wages can be paid? Such a decision on the part of entrepreneurs would evoke several changes. But there are two general ways of re-allocating workers. Entrepreneurs could (1) re-allocate workers from the consumption goods industries to the capital goods industries

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<sup>169</sup> Bresciani-Turroni (1936, 8-9) writes: "Böhm-Bawerk draws attention to the fact, which however is implicit also in Walras' theory, that the goods from whose consumption savers abstain need not exist physically, as was assumed by the classical writers. Böhm-Bawerk's primitive fisherman saves through turning aside for a while from the catching of fishes and devoting instead part of his time to the construction of a boat. Saving therefore essentially consists in setting free a certain amount of original factors of production, namely, the services of labour and of land, through which new capital goods are produced. Therefore, what is saved is not consumption goods, but productive resources".



or (2) re-allocate workers within the capital goods industries towards employment on longer production roundabouts for capital goods.

In the case of (1) a two-edged sword is operating. On the one hand changes will be evoked directly in the consumption goods industry, on the other hand changes will be evoked in the capital goods industry. If we look first to the consumption goods industry the following will happen in the short-run: The output of the consumption goods industries will diminish, because some workers, hitherto paid to work in the consumption goods industries, will no longer be paid to work there. Since output is lowered this re-allocation will also diminish profits in the consumption goods industry in the short-run. The lower profit-margin incentivizes the acquisition of more labour-saving machinery above less labour-saving machinery. More labour-saving equipment will rise in price relative to less labour-saving machinery (capital broadening equipment). However, the supply of the more labour-saving machinery will not have changed in the very short-run.

The changes evoked in the machine producing industries in the short-run are that more workers are employed there. This will increase the demand for the more versatile machinery that the machine producing industries use to make machinery for the consumption goods industries: The demand for, and prices of, machine-tools (*a fortiori* for more labour-saving machine-tools) increases. Hence profits for the highest stages of production, those making the most versatile equipment (especially the most modern versatile equipment) increases.

The demand for (more modern) machine-tools is also additionally stimulated by the fact that the declining profits in the consumption goods industries are leading to more demand for the more labour-saving machinery and less demand for the less labour-saving machinery. The machine producers will need to supply the consumption goods industries more and more with the former type of equipment. But the machine producers can only fulfill the demand for the more labour-saving machinery, and harvest the profits obtainable in selling them, by first engaging in the longer detours of production necessary to produce such more labour-saving machinery.

In conclusion, the effects of the attempt to increase the depth of investment by increasing the wage fund is that first profits will rise in the highest stages of production (machine-tool making); subsequently in the production of (more labour-saving) machinery for the consumption goods industries. Lastly, once the labour-saving machinery arrives to the consumption goods industries, the amount of consumption goods put out can be increased again and profit-margins in this final stage of

production will rise again. Thus, there is an order in the changes in profit-rates evoked by increased saving (increases in the wage fund). The profits of the higher order stages go up first, and profit-equilibrium can only be restored once the more labour-saving equipment, that is to be produced, reaches the consumption goods industries.

#### **5.4 Changes in the Depth of Investment Induced by Plain Saving**

The possibilities discussed in the preceding two sections principally affect the *distribution* of consumption goods between capitalists and workers. But in both cases there is no very *clear* incentive for the consumption goods industries to release factors of production to be re-allocated to higher stages of production.

We then arrive at a third possibility of capital deepening. This is that capitalist-entrepreneurs keep the total wage fund unaffected, lower their dividends, but hold ('hoard'<sup>170</sup>) the amount of money they have saved in their purses. In doing so they are accumulating funds with the purpose to eventually make big purchases, a phenomenon also called *corporate saving* or *Selbstfinanzierung* ('self-financing'). It is, in other words, a 'plain saving' or 'hoarding' which implies lower spending on consumption goods. This lower spending on consumption goods thus lowers the revenues (and receipts) of the consumer goods industries. This plain saving puts a downwards pressure on the *gross profit margin* of the consumer goods industries (CGI)<sup>171</sup>. For the CGI, relative profitability can only be restored by lowering capacity utilization (especially for the least profitable products) or by increasing automatization and thereby lowering wage-costs per unit produced. In the short-run, lowering capacity utilization is to be expected. Under plain-saving, workers are thus made available for the capital goods industries. The capital goods industries will need to expand and modernize their own production facilities, as well as expand production of more labour-saving machinery. After all, it is to be expected that consumption goods producers place orders to obtain more labour-saving machinery once the time arrives on which they expect to have accumulated enough funds to pay for such machinery. There does not have to be an immediate spending on machinery by the consumption goods industries for the machine producers

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<sup>170</sup> Professor Hülsmann prefers the phrase 'holding' over 'hoarding' as the latter term has been used in a pejorative sense. See his *The Ethics of Money Production* (2008, 64). The upside of the phrase 'hoarding' is, however, that its meaning is less ambiguous in the economic literature than phrases such as 'saving' and 'investing'.

<sup>171</sup> Garrison "Resources are bid away from late stages of production, where demand is weak because of the currently low consumption"

to invest in more ‘roundabout’ production. There will always be demand for more labour-saving machinery<sup>172</sup>.

The results will be the same if wage-earners decide to spend less on consumption goods and ‘plain save’ more of their incomes. Also in this case money is first not spend. To put it in more technical words: The velocity of money is brought down to zero for a certain duration. When accumulated funds are spend again this will often be on durable consumption goods (which have similar characteristics to fixed capital goods as they provide services for a long time into the future) or it will be on capital goods, whereby wages are turned into capital.

### **5.5 Disinvestment**

When the capitalists take more dividends, they have less funds to pay workers: the wage fund decreases. This is obvious. What are the further effects?

We need to consider the different type of circumstances of the two principal groups of capitalists: The Consumer goods producers and the machine producers. The consumer goods producers use their wage fund to advance wages to workers and to pay for machinery (i.e. take over the burden of advances from machine producers). Now the consumption hoods producers decide to increase dividends. Increasing dividends implies that they need to cut on operating expenditure (wages for direct labour) or on capital expenditure (wages for indirect labour). Increasing dividends will likely mean that the consumer goods producers cut capital expenditures, since cutting operating expenditure will diminish near future revenue and profits. In other words, cutting operating expenditure would diminish the possibilities to draw dividends in the near future, which is contrary to the stated goal.

The machine producers will also be more likely to cut capital expenditure (which in their case means to have theory employees work on reviewing expanding or modernizing the capacity of the machine producing industry) than operating expenditure (employing workers to make machinery for the consumption goods industry). Also, with the machine producers, cutting operating expenditure would diminish the possibilities to draw dividends in the near future, which is contrary to the stated goal. But there is another effect. Machine producers, as capitalists, are not only confronted by the implications

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<sup>172</sup> Keynesian are perhaps right in arguing that an important difference between an imaginary real-exchange economy and a money-economy is that the latter has a type of good (money) that can and will very easily be hoarded. Perhaps this difference was somewhat overlooked by classical- and neo-classical economists. However, the conclusions that Keynesians make about this hoarding are nonetheless very wrong.

of their own choice to draw more dividends out of their revenue; they must also cope with the fact that revenues decline because the consumption goods producers are cutting expenditure on machinery. The result is that profits in the consumption goods industries increase relative to profits in the machine producing industries. A profit-equilibrium can only be restored once the increase in dividends has seized.

## 6. Conclusion

Marxist or Marxist-leaning and Austrians or Austrian-leaning economists agree that it is technically necessary that the higher order stages or higher order industries expand before the lower order industries. For growth to take place, the capacity of the machine producing industries must be expanded *before* the capacity of the consumption goods industries could be significantly and sustainably expanded (e.g. Hayek, 1935; Dobb, 1960; Lowe, 1976, 110-112).

The Marxist- and Keynesian theories on saving and investment, however, often cast doubt on the ability of the incentive-structure of the market economy to put economic growth in the necessary technical order. Keynesians repeatedly claim that profits on the selling of consumption goods should rise first, before investment in higher stages of production can be induced. The Marxist economist M. Dobb, who made use (like many) of splitting the economy into two sectors – a consumption goods sector and a capital goods sectors – was also very sceptical about the ability of a free-market mechanism to follow the necessary technical procedure in which first many resources must be invested in the capital goods sector, before the consumption goods sector can be expanded. He wrote:

“a development path characterized by a high (even moderately high) [proportion of investment devoted to the capital goods sector] is a very improbable one for a capitalist economy to pursue [...] The reason for this improbability is that such a development path implies, *par excellence*, an investment in increased productive capacity in the capital goods industries *in advance* of any foreseeable expansion in the market for them.” (1960, 47, his italics)

There are three main reasons why it is not improbable at all. The reasons are the theses we have put forward in this chapter: We may round off the conclusion with three findings why the free play of

market forces concerning saving and investment should work fine, that why a (self-regulating) *saving and investment mechanism* exists in a market economy:

First, in a market economy, the profits of the higher order industries are *advances* from lower-order industries; the profits of higher order stages will therefore be *chronologically prior* to those of the lower order industries. Acts of saving make the profits in early stages go up first, because saving is always a form of advancing.

Second, downward pressure on the profit-margins of the consumption goods industries should not lead us to think that the ‘inducement to invest’ declines. What a downward pressure on the profit-margins of the consumption goods industries incentivizes is the acquisition of more labour-saving machinery. Plain-saving, or ‘hoarding’ is of key importance, as such non-spending is an irreplaceable element in a functioning saving and investment mechanism.

Third, the higher-up in the hierarchy of production, the more ‘inchoate’ or formless the intermediate products are compared to the intermediate products closer to being turned into consumption goods. The machine-tools of the machine producing industries will be helpful, later on, in creating virtually any type of more specialized machinery needed in lower stages of production. But also, if we look at mining and the heavy industries, it should be obvious that the products they turn out – raw materials – are literally in their *raw* state and not yet formed into any particular type of consumption goods. For example, steel can be turned into cars, machines, building materials, bicycles, garden tools, etcetera. Higher order producers do not have to worry about the question whether the higher-order goods they produce will be turned into one particular type of consumption goods or the other. The steel-producer is not concerned with the question whether the steel he sells will be turned into bicycles, furniture, or this or that brand of car, whether there is demand for this kind of consumption good or another kind.

# 7. Real Stylized Facts of the Business Cycle

## 1. Introduction

Having developed a theory of the real-side of the economy, with a conception of the structure of production that is summarised by the three-sector pie-chart model, and the concept of the saving and investment mechanism, we now want to apply this more systematically to some empirical considerations. One of the main aims of this dissertation is, after all, to elucidate the real aspects of the economy, especially of the business cycle, by using Real Analysis.

In order to apply Real Analysis in a study of the business cycle phenomenon (i.e. the business cycle *problem*) we need a description of that business cycle. As argued in the introduction of this dissertation, the commonly used description of business cycles is firstly very brief. Often only a very few typical patterns – called ‘stylized facts’ – are presented about business cycle. Secondly, the few stylized facts that are provided tend to emphasize a *nominal* description of the business cycle. Namely, the business cycle is commonly described as dips in the long-run trend of growth in *Gross Domestic Product* (which is a nominal statistic).

If we want to elucidate the business cycle we need a more detailed description of it, a description which includes, besides a number of *nominal* stylized facts, a number of *real* stylized facts. In section 2 of this chapter we will therefore provide such a more detailed description.

In sections 3, 4 and 5 we will explain four typical patterns of business cycles in the real economy with the help of the theory developed in the previous chapters of this dissertation. If possible such real patterns will be elucidated by more empirical examples. We will emphasize three groups of typical patterns in the real economy: First, in section 3, we will explain the general rise in capacity utilization (and its correlative, higher employment) during the upswing. Second, in section 4, we will elucidate the growing delivery lead times of fixed capital goods during the upswing. Third, in section 5, we will elucidate the declining physical inventories during the upswing and the growth of such inventories in the downswing, as well as the closely associated circumstance that *mill head grades* of metal ores tend to decline during the upswing<sup>173</sup>. In section 5 we will also continue with an explanation of the cyclical

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<sup>173</sup> Metal ores are sometimes called ‘primary materials’ while the word ‘raw materials’ is used often to indicate both ores and the metals derived from them, as well as many other materials.

pattern of capacity utilization, but with a focus on the declining capacity utilization in the downswing (rather than the increase in capacity utilization discussed in section 3). In section 6 we will conclude.

This chapter will not provide a *complete* business cycle theory. Our aim is to put some light on the *real* pattern of the typical business cycle, to demonstrate how real stylized facts relate to each other and how such real stylized facts relate to nominal stylized facts (i.e. to the monetary aspects). A more detailed analysis of the money-side of the business cycle lies outside the scope of this chapter in particular and this dissertation in general.

## 2. A More Detailed Problem Description of Business Cycles

### 2.1 Nominal Stylized Facts of Business Cycles

Apart from the fluctuations in GDP itself, the fluctuations in orders for new capital goods can be named as a very typical characteristic of the business cycle. In fact, it is a much more pronounced fluctuation, as is quite evident if one compares the 1992-2023 fluctuation in GDP (figure 1) with the 1992-2023 fluctuations in capital goods orders by manufacturers<sup>174</sup> (figure 2) below:



The nominal stylized fact to be noted here, on the spending on capital goods, is that during the upswing capital expenditure rapidly increases, but will take steep dives again in the downswing<sup>175</sup>.

<sup>174</sup> The component of GDP called 'investment' also includes durable goods purchases.

<sup>175</sup> Spending on fixed assets is something that economists used to call *investment in fixed capital*. It is often called *capital expenditure* in the business world nowadays. Both in the terminology of economists as well as in the vernacular it is often simply called *investment*. However, the original distinction employed by economists of investment in fixed capital (spending on fixed assets) and investment on circulating capital (operating expenditure) is preferable from a scientific point of view. In national income accounting, 'investments' means spending on specific types of fixed assets, such as *new* capital goods. Spending on securities, second-hand capital

Closely related to the amounts of spending are the prices at which exchanges are made. The original French terms for the upswing and downswing were *hausse des prix* (price-rise) and *baisse des prix* (price-decline). A well-known stylized fact of business cycles is that inflation (defined as the rise in the price-level) is ‘pro-cyclical’, that is, the price-level typically rises faster in the upswing compared to the downswing (Moore, 1982, 175-210). In fact, many prices in the downswing decline.

The *producer price indexes* also indicate rising prices for both capital goods (fixed assets) and for the raw materials that are inventoried (current assets). The spending on inventories can be linked rather directly to the so-called *commodity markets* in which homogenous products (iron, copper, gold, mercury, wood, corn, grain, etcetera) are bought and sold. Such raw materials which are traded on commodity markets are usually processed into finished consumer goods or finished machinery. Precisely because commodity markets are relatively transparent in their price-formation some generalizations about the price-movements on those commodity markets have become well-established. It has often been observed that a cyclical pattern of commodity prices exists, a pattern which has been termed *commodity price-cycles*, *commodity cycles* or even *commodity super-cycles*. With respect to the commodity price-cycle a closely associable stylized fact has been stated by many observers. This is that once the spot prices of certain commodities start going upwards within a wider boom of the economy, the futures- and forward prices of those commodities will also rise but will still be considerably below the spot prices (Humphreys, 2015, 90-106; Galán-Gutiérrez et.al. 2023; Jorion, 2009, 241; J. Smith, 2009, 158; Leuthold, et.al, 1989, 110; Lachmann & Snapper, 1938). The phenomenon that future- or forward prices which are below spot prices is usually called *backwardation*.

The stylized facts reported on *profits* is that in upswings they are typically higher than in recessions. Profits are generally procyclical (Mitchell, 1913; Pulling, 1978; Dore, 1997). The immediately underlying dynamic is that, “[w]hereas at the beginning of an expansion prices are typically rising faster than costs, at the end costs are typically rising faster than prices [...] putting a squeeze on profits” (Moore, 1983, 283; cf. Hayek 1939, 29). The declining profitability can, off course, also be associated with eventual losses and even business failures. The ‘liabilities of business failures’ (the total amount

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goods, or operating expenditure is not seen as ‘investment’. *Nota bene*, in the financial press – *The Economist*, *Financial Times*, *Bloomberg* – the great upswings in capital expenditure has more and more been termed the *capex boom* in the past 20 years (*capex* being an abbreviation of *capital expenditure*).



of debt by enterprises which are involved in proceedings which may lead to bankruptcy) is seen as a leading indicator of business cycles (Simpson & Anderson, 1957; Moore, 1983)<sup>176</sup>.

A relatively recently discovered stylized fact is the *inverted yield curve* as a predictor or precursor of recessions. The observation behind it is that, under normal conditions, short-term bonds usually have a higher yield compared to longer-term bonds. When the yield of various bonds are depicted in a graph, the curve in the graph will typically bend from a low yield for short term bonds towards increasingly higher yields for long-term bonds. Such a curve is called a *positive yield curve*. However, it has often occurred, some months before an official recession has set in, that the positive yield curve becomes *inverted*, meaning in this case that the yield on short-term bonds rises above the yields on long-term bonds (Keen, 1989).

When we look at the nominal- or monetary side of affairs – the changes in investment spending, price indexes, profits, bond-yields and so on – we should not omit the purely monetary factors as well. The 19<sup>th</sup> century French economist and statistician Clement Juglar (1862) already compiled time-series on metallic reserves (actual gold and silver money in the vaults of banks); bank notes in circulation; and the total balances on current accounts. Economists have since taken a serious interest in the movement of such *monetary aggregates*. There are many time-series available in which changes monetary aggregates - such as ‘M1’; ‘M2’; ‘M3’ – are tracked. The stylized fact *used to be* that monetary aggregates grew in the upswing, and contracted in the downswing (Juglar, *ibidem*). Many economists, then and now, would also argue that such expansions and contractions in credit (and thus of money-substitutes in circulation) were the main cause of the *hausse des prix* (price-increases) and *baisse des prix* (price-declines). However, the last 50 years have seen a great intensification of monetary management on the part of central banks<sup>177</sup>. One of the ways in which central banks tend to deal with crises in the banking sector is precisely to counter contractions in the money supply through a number of measures such as *quantitative easing*. Hence great contractions of money supplies after crises are not necessarily a stylized

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<sup>176</sup> In Austrian Economics the concentration of losses and bankruptcies in the crises-part of the business cycle is also called the *cluster of errors*.

<sup>177</sup> A first great impulse came with the end of the Bretton Woods System under president Nixon of the U.S.A. in the early 1970's. With that, the U.S. Dollar was no longer tied to gold, giving the Federal Reserve more flexibility. A second great impulse came with the establishment of the European Central Bank and the common European currency, the Euro. The Euro made currency competition less intense, and made more monetary intervention in Europe easier on the part of central bankers.

fact of business cycles anymore. The stylized fact of modern business cycles is that “monetary aggregates show reduced growth rates in contractions, but not absolute declines” (Dore, *ibidem*).

## 2.2 The Real Stylized Facts of Business Cycles

We can now turn to the ‘real’ stylized facts of business cycles. That is, typical aspects of the business cycle that must be stated in physical- or technical measures of economic activity<sup>178</sup>. The most referenced ‘real’ stylized facts of business cycles in contemporary discussions are closely related. These are the *employment-rate* and *hours worked per worker*<sup>179</sup>. A closely related statistic is the *average workweek* (Bry, 1959) During upswings, employment typically increases in terms of the amount of people having paid employment, but also the number of hours worked per worker typically increases. The latter statistic is especially measurable in the manufacturing and mining industries, where paid overtime is the norm<sup>180</sup>. Both higher employment and higher hours-worked-per-worker are indicators of a higher *capacity utilisation* of all the plant & equipment in the economy (Hornstein, 2002).

One very important ‘real’ stylized fact about business cycles, which refers to the production of fixed capital, which was stressed in the pre-war business cycle literature, is that the investment goods industries are more ‘cyclical’ than the consumption goods industries (Röpke, [1932] 1936, 25; Mitchell, 1913, 471-72, 483-84; Aftalion, 1913, 30; Hayek, 1931, 29; 1933, 59-60). To be more precise, the capital goods industries have a comparably higher utilization of their equipment than the consumption goods industries. In other words, there develops a very high *capacity utilization* in the machine producing industries during the upswing, the *order backlog* of machine producers increases<sup>181</sup>, and the *delivery lead times* of machinery are becoming relatively long<sup>182</sup>. This ‘real’ stylized fact can easily be associated with

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<sup>178</sup> Kydland & Prescott (1990) have used a similar phraseology, namely a distinction of ‘real facts’ and ‘nominal facts’. However, they do not use ‘real facts’ as a phrase referring exclusively to physical magnitudes, but rather to deflated (inflation-adjusted) nominal figures.

<sup>179</sup> When macroeconomic textbooks discuss the stylized facts of business cycles, this will usually be mentioned, for example Mankiw (2013, 277) and Williamson (2018, 105-107). Abel, Barnanke and Croushore state in their *Macroeconomics*: “Output, total hours worked, and average labor productivity all are procyclical.” (2013, 308)

<sup>180</sup> Employees in ‘white collar’ (office-jobs) probably work more hours per week in upswings as well, but the hours such employees put in are less likely to be paid as overtime compared to the ‘blue collar’ (factory-workers).

<sup>181</sup> The German statistical bureau, *Destatis*, has since 2014 estimated a range which “indicates for how many months companies would theoretically have to produce goods until all orders on hand are fulfilled”. *Destatis* does this for consumer goods, capital goods and intermediate goods. The order-to-shipment ration is also used as an indicator of backlogs.

<sup>182</sup> Zarnowitz writes about the business cycle in general of “[p]rocyclical movements in delivery lags” (1992, 10).

the great cyclical alternations in expenditure on capital goods (Zarnowitz, 1992, 95; Nalewaik & Pinto, 2015).

With reference to what economists call ‘circulating capital’ (raw materials, semi-finished products), probably the most important ‘real’ stylized fact of business cycles was uncovered through statistical work by economists between the 1930’s and the 1950’s (Blodgett, 1935; Lachmann & Snapper, 1938; Abramovitz, 1950). It has to do with the *levels of the inventories* of many types of raw materials (also called *commodity stocks*) during the cycle. Of these researchers, foremost Moses Abramovitz pointed out in his *Inventories and Business Cycles* (1950)<sup>183</sup> that the level of inventories of many types of raw materials, as well as finished goods, move *inverted* compared to the alternations of GDP. That means that, at the ‘upper turning points’ of business cycles (which are the points where growth in GDP changes into a slowdown or decline of GDP) inventories of raw materials are usually at their lowest points. But at the ‘throughs’ (i.e. the lower turning points of business cycles) stocks of raw materials are usually comparatively high.

One typical finding about the mining industry in ‘boom’-times of high demand and high metal prices, is that the *ore grade* of ores that are refined into raw materials tends to decline<sup>184</sup>. The explanation for this phenomenon is always the same: a higher price for the metal, combined with a higher volume demanded, warrants the higher operating costs involved in refining lower grade ores. Hence, a higher demand for commodities makes it possible to profitably mine and sell lower grade ores (Tilton & Guzmán, 2016, 75; Tilton, 2014; Crowson, 2012; Gocht et.al. 1988, 113; Janković, 1967, 317; Spencer, 1940, 67; Schumann, 1938).

### 2.3 A Summary of the Main Nominal- and Real Stylized Facts

We can sum-up the aforementioned nominal- and real stylized facts about cyclical upswings in the following table:

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<sup>183</sup> Since Abramovitz’ *Inventories and Business Cycles* (1950), a similar book has not appeared. Nowadays most statistical materials are no longer published and interpreted in books, but are made available through the website of central banks or research bureau’s such as the American *National Bureau of Economic Research*.

<sup>184</sup> The *grade of ore* is defined as the amount of the wanted material per ton of total material extracted containing this wanted materials. For example, a higher grade of iron ore means that the amount of iron per ton of extracted iron ore is higher. The grade of ore is of great importance in mining as the physical cost of processing ore into the wanted material product becomes lower the higher the grade of ore, and vice versa. The reason a mine is closed is usually not that no more ore can be extracted from it, but that the ore grade from the ore that can still be extracted has become too low to make further operation of that mine economically viable. The grade of ore that is actually refined is called the *head grade*

<i>Indicator</i>	<i>Nominal Stylized Fact</i>	<i>Real Stylized Facts</i>
capacity utilization	strong increases in 'operating expenditure'	higher employment, more hours worked, higher
machinery production	strong increases in 'capital expenditure'	long delivery lead times
inventories	increase in financial inventory investment	declining physical volumes
mining & 'heavy industries'	high prices for raw materials, backwardation in commodities forward markets	declining ore grades

In the section below we will explore the real stylized facts mentioned above in some more detail.

### **3.Capacity Utilization during the Business Cycle**

What is the cause of the higher capacity utilization in the upswing, and what is the cause of the lower capacity utilization in the downswing? We will argue in this section that the cause of the higher capacity utilization must be sought in the monetary sphere, to be precise in credit expansion and the subsequent rise in nominal consumer spending. However, we will not argue in this section that the direct cause of the lower capacity utilization of the downswing must also be sought in the monetary sphere, that is, that the lower capacity utilization is caused by credit contraction and by declines in nominal consumer spending. We will argue that the decline of capacity utilization in the downswing is attributable precisely to the real pattern of the preceding boom, but this part of the argument will be postponed to section 5.

#### **3.1 Fiduciary Credit Creation as a Stimulus to Higher Capacity Utilization in the Boom**

When banks create money-substitutes<sup>185</sup> they usually do so when they lend these money-substitutes to entrepreneurs (as business loans) or to consumers (consumption loans). The former type of additions to the money supply we have termed the *expansion of fiduciary credit*. We will focus upon the consequences the first type.

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<sup>185</sup> That is, claims (such as bank notes payable at sight or balances in checking accounts) to actual money (the actual 'base money' which can either be gold- or silver coins or the 'cash' of a fiat currency).

Entrepreneurs spend the fiduciary credit, perhaps together with some of their own funds, on factors of production. This fiduciary credit, when it is spend by entrepreneurs, is received by of wage-earners or by other entrepreneurs. In the latter case, the money substitutes will again be spend on either wages, received and spend as dividends, or on the products of other entrepreneurs, and so forth. Hence most fiduciary credit will sooner or later add to consumption spending. Only a part of fiduciary credit remains in circulation among entrepreneurs only. When money-substitutes (created through fiduciary credit) are spend on wages, the bulk of those money-substitutes will be spend on consumption goods once these wages are spent. As far as intermediate products have been produced, the cost of these goods were already born by the producers under who's direction they were produced. Fiduciary credit that is injected after intermediate products are produced and offered on the market, inflates their selling prices, but not their costs. Hence fiduciary credit spent on produced intermediate products leads to higher profits for these goods than would otherwise be made. This may very likely lead to higher dividends and higher consumption spending on the part of entrepreneurs.

Most of the fiduciary credit will also be spend on wages and capital goods rather than that it will be hoarded or 'plain saved'. The reason is simply that the banks demand an interest-payment for the credit provided, which necessitates the entrepreneurs to only take up such credit once it can be spend on factors which are adding to the gross profits of their businesses.

Of course, entrepreneurs regularly need to re-acquire the services of workers; they need to re-acquire raw materials; and from time to time they will need to invest in replacement machinery. Often entrepreneurs will need to acquire more expensive labour-saving machinery in order to stay competitive. Here we meet another aspect of fiduciary credit. Fiduciary credit expansion adds to the total money-demand for factors of production. If we look at an aggregated balance sheet, i.e. a balance sheet of all businesses combined, fiduciary credit expansion results in a situation in which a greater proportion of the capital on the liabilities side of that balance sheet is becoming debt capital. Another result of fiduciary credit expansion we find on the assets-side. Fiduciary credit expansion raises factor-prices to levels which factor-prices would not reach without fiduciary credit. This rise in factor-prices more or less forces entrepreneurs, *if they want to stay competitive vis-à-vis other entrepreneurs*, to take up credit

with the banks, to apply for business loans. For most entrepreneurs it is very difficult to avoid the fiduciary credit that banks attempt to inject into the economy<sup>186</sup>.

With respect to the *saving and investment mechanism* (discussed in the previous chapter) it should be obvious that fiduciary credit expansion, as a way of increasing the money supply, is a rather different way of financing investments than is the way of plain-saving, the accumulation of funds out of profits. Fiduciary credit expansion does not involve that money is temporarily not spend, it does not involve, or at least is not likely to involve, a temporary lowering of the 'velocity of circulation'. Plain-saving and accumulation of funds, however, does involve this temporary lowering of the velocity of circulation.

The consequence of fiduciary credit expansion must be that an increased nominal consumption spending takes place. No nominal purchasing power is withdrawn from the consumption goods market, rather some extra nominal purchasing power will arrive at the consumption goods market as wages-earners and dividend-takers find that the money-substitutes (created through fiduciary credit) come in because of their employment or because of their sales of intermediate products. The higher spending on the consumption goods markets will result in a general rise in capacity utilization, as each entrepreneur faced with an increased demand will generally first try to cope with such a rise in demand with the fastest thing he can do to increase output. This fastest thing is to increase capacity utilization, since obtaining more efficient, labour-saving machinery can (in the aggregate) not be an instant solution.

### **3.2 A Schematic Exemplification of the Higher Capacity Utilization due to higher Consumption Spending**

We can use the three-sector pie-chart model in order to illustrate and explore what happens when the initial change is that capacity utilization in the consumption goods industries goes up. In figure 7.1 below, we have indicated this increased capacity utilization by a change in the slice of the CGI-pie from 50% capacity utilisation in period 1 towards an 70% capacity utilization in period 2.

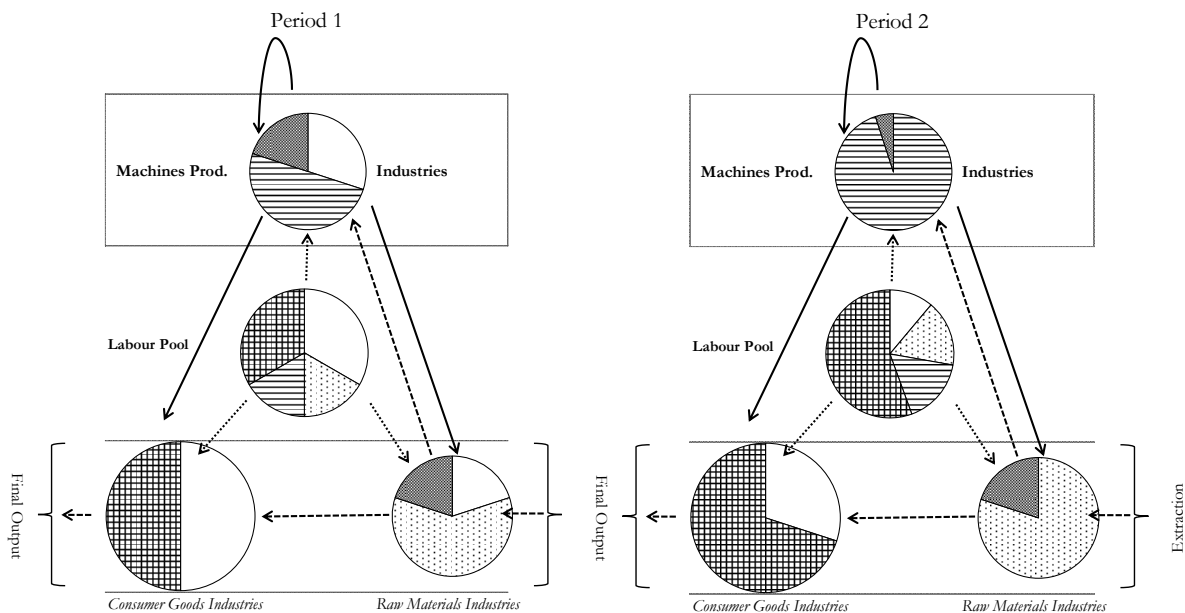
What other changes in the model should this increase in capacity utilization in the CGI provoke? In relation to the workforce (labour pool) in the middle of the model, higher capacity utilisation in the

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<sup>186</sup> I am following the *Currency Doctrine* here, the central thesis of which is that fiduciary credit propels further demand for fiduciary credit since it raises the prices of factors and collateral. The theory ultimately leads, it seems to me, to the recognition that we hold a debt-slavery theory, or a monetary theory of exploitation, once we accept that thesis.

CGI means that more workers (or work-hours) will have to be allocated to the CGI (which is also indicated in that in the first period 30% of the workforce is allotted to the CGI, while in the second period this increases to 50%). When the increase in capacity utilization is slight, it is likely that the existing workers take care of the increase in capacity utilisation through over-time or double shifts. Only substantial and longer lasting increases in capacity utilization will likely require that unemployed workers find work in the CGI, or that workers from other industries must be drawn to the CGI. but undoubtedly a great deal of workers will be drawn out of unemployment, as the consumption goods industries will be able to offer higher wages, due to the credit expansion. A part of the unemployed will find the heightened salaries more attractive than their current unemployment benefits (or whatever type of government-support they receive). Especially when wages rise and consumption goods also rise in price, but unemployment benefits are not indexed fast enough, a rise in employment is likely to appear.

Figure 7.1



But in the very short term there are no necessary other changes. Machinery will not have to be replaced immediately. The increased capacity utilisation does imply a greater consumption of raw materials by the CGI. But when some stock or inventories of raw materials exist – and the statistics suggest stock to be relatively high at the through of business cycles – these stocks will be used in the initial growth in capacity utilization. Given such stocks, the raw materials industries will not immediately have to respond to the higher capacity utilization of the consumer goods industries by increasing their capacity

utilization. But the principle of derived demand will sooner or later start to work in this respect. If a higher level of capacity utilization in the CGI continues, or strengthens, the RMI will follow suit.

In the preceding chapter, on saving and investment, we concluded that normally we would expect investment to generally take the direction of *capital deepening*, i.e. an increase in mechanization and automation, i.e. more capacity to produce per worker. The *initial* result of credit expansion is undoubtedly that the entrepreneurs accepting this credit will look for ways to mechanize and automate. However, new fiduciary credit, when it arrives in the pockets of entrepreneurs, comes not from the same source as funds which arise by hoarding and accumulation a portion of realised profits. There is no decline in consumption spending, but a growth. As long as this growth in consumption spending means that selling prices go up faster than costs, there is much less pressure to reduce costs than under plain saving. Once credit expansion is well under way a *capital widening*, i.e. expanding the existing plant & equipment with more capacity of a similar degree of mechanisation, becomes less unattractive compared to capital deepening. When profits can only be made by reducing costs, capacity-replacement (or capacity-expansion) should be realised only under a higher degree of mechanisation, as that reduces operating costs. When profits are *not* under pressure, when revenues rise quicker than operating costs, capacity-expansion on a similar degree of mechanisation is a viable choice.

If the higher demand for consumption goods and raw materials continues, then the CGI and RMI will likely want to expand their production capacity. They will certainly increase their 'capital expenditure' towards the MPI. However, there should be relatively more demand for capital widening (vis-à-vis capital deepening) under fiduciary credit expansion than under plain saving.

#### **4.The Cyclical Pattern of Machine Production in the Boom**

##### **4.1 Machine Tools Production as a 'Strategic Bottleneck'.**

In our chapter on the schematic representation of the structure of production (chapter 3) we have discussed the structure of the machine producing industries. Here we will go a little further in connecting theory with fact. We can thereto refer to Lowe again, who presented his departmental scheme in which the machine producing industries are schematically subdivided into two subsectors: One using machine tools and making machine tools; the other subsector using machine tools and making machines for the other 'department'.

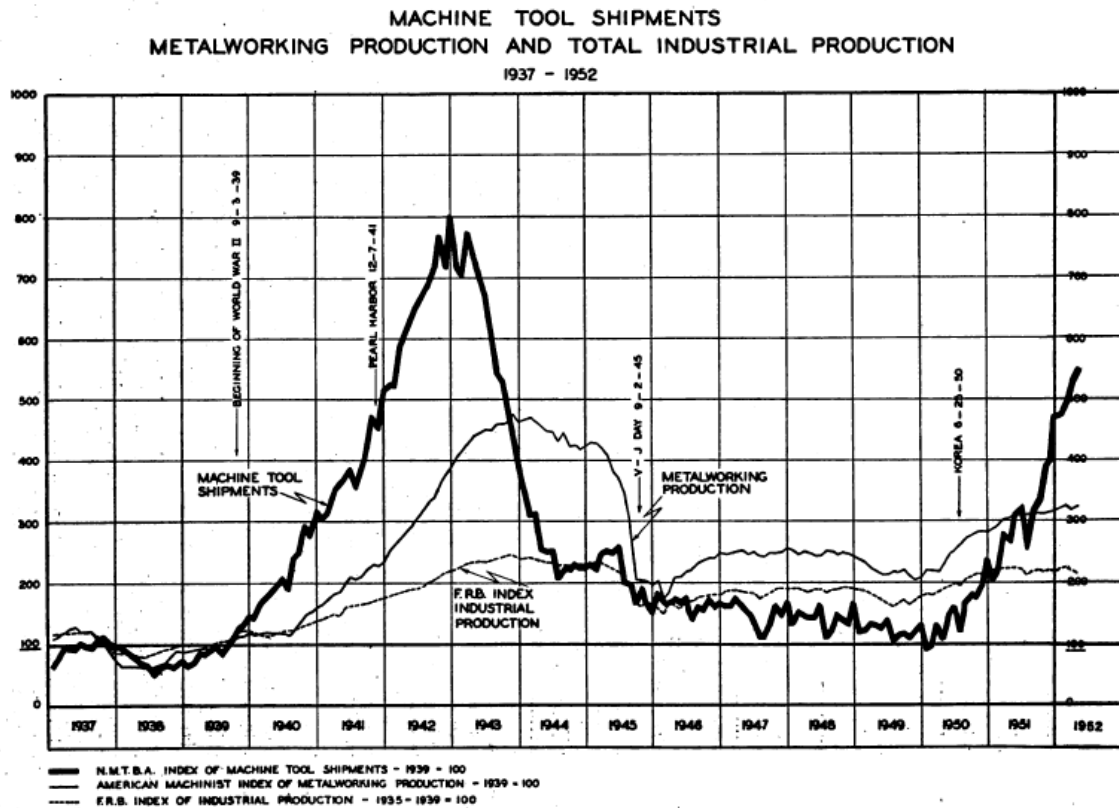
Lowe connects his theory with the facts by arguing:



“[s]uch studies of the physical-technical relationships among the main sectors of the productive structure would by no means have only academic interest. Twice during the last decade a speedy adjustment of American industry to the requirements of defense was impeded by a peculiar physical bottleneck, the lack of machine tools.” (1952, 138)

Lowe was referring undoubtedly to the second world war and the Korean war. Lowe’s claim that the bottleneck of machine tools is not merely of ‘academic’ interest can be easily substantiated. Indeed, quite apart from economic theory, the machine tools sector was discovered as a ‘strategic bottleneck’ in practice. This was especially so in relationship to wars and military supplies.

For example, a report of the United States Senate of 1952 confirms that machine-tool shortages were a strategic war-time problem. In it we find a graph plotting the machine tools shipments; an industrial production index and a metal working index (Moody, 1951, 15). The extraordinary ‘booming’ of demand for machine tools during the second world war and the Korean war is obvious:



There are in fact plenty of articles and reports on the problem of a ‘machine tools shortage’ and the ‘machine tools bottleneck’ written in the 1940’s and 1950’s. In the American military periodical *Ordnance* the following comment can be found:

“The machine-tool shortage was one of the earliest and most persistent bottlenecks in the Ordnance program during World War II. Because the Navy and Air Force had top priority, Ordnance never had enough tools to meet its needs. If any aspect of World War II mobilization may be termed a failure, it was, from the Ordnance viewpoint, the machine-tool shortage. Granted that no amount of prewar preparation would have eliminated the problem altogether, more attention to the production-equipment industry prior to 1940 would have helped greatly.” (Thomson, 1953)

Not only American sources confirm this strategic position of machine tools. For example, Japan relied mostly on imported machine tools before world war one. Machine tools were used extensively by arsenals and other military uses. During world war one, it became nearly impossible for Japan to import machine tools as these were needed domestically in their countries of origin. By the 1930’s the Japanese government had given some favours and aid to selected machine tools producers since it regarded machine tools as strategic:

“As the demand for machine tools increased, the government decided to expand the machine tool production capacity of the domestic producers to meet the increased demand. The government regarded the industry as a strategic industry and made a plan to develop the industry by selecting producers. They introduced ‘Kosakukikai Seizo Jigyo-ho’ (The Machine Tool Industry Law) in 1938. The most important provision was that the government authorised the production of machine tools by ‘patented companies’ (‘Kyoka Gaisha’) and promoted the production of high-quality machine tools for military use during the way. The ‘patented companies’ were guaranteed material supplies, tax-reductions, low-cost financing of funds and other concessions.” (Chokki, 1986, 129-130)

Hence governments have to some extent noted the *strategic* importance of machine tools, and have taken measures attempting to overcome the problems of machine-tool shortages in preparation for war. The phrase ‘strategic’ is entirely in its place in this regard. A country which is at war may use its machine-tools in the most direct production of weapons and munitions as possible. Alternatively it

may use these machine-tools to build further machine-tools in order to have a somewhat greater capacity to build weapons and ammunitions in the somewhat more distant future (Wagoner, 1968, 248; Milward [1965] 2015, 26).

The experience with machine-tools availability and -production in wartime shows a problem faced under a more or less sudden high demand for machine-tools or the services of machine-tools. It must be similar, to a great extent, to the boom in capital expenditure that accompanies the upswings of business cycles.

#### **4.2 The ‘Ricardo Effect’ as an Explanation of Machine-Tool Shortages**

In the business cycle, to be precise in the upswing of the business cycle, capital expenditure grows rapidly. Undoubtedly this growth in capital expenditure is partly due to fiduciary credit expansion. The machine producing industries are located at the receiving-end of that capital expenditure. They see an increase in demand which they can translate into taking orders for machinery. There is, however, an alternative to taking orders. Machine producing firms could decline a part of the orders and use some of their production capacity precisely for increasing their own production capacity.

The main question is thus what the machine producing industries will do once capital expenditure is rising fast. Will it take as much orders as it can, leaving little to no capacity left to increase its own capacity? Or will it decline a substantial portion of all orders, so that some significant portion of capacity is left to increase capacity? As far as we can tell there exists only one theory that provides an answer this question: This is Hayek’s ‘theory of the Ricardo effect’. Considering the rise in demand during the upswing, Hayek predicted that when entrepreneurs would have to allocate their budget between more investment in working capital (increasing capacity utilization) or more investment in fixed capital (increasing capacity), entrepreneurs would tend towards the former option. This tendency he called the ‘Ricardo effect’. The reason for this tendency is, according to Hayek:

“The answer, I think, is to be sought *firstly* in the fact that the provision for the near future will necessarily have the first attention of the entrepreneur, because if the profits which might be made in the near future are not obtained, they (and perhaps a certain amount of permanent business) will be lost to a competitor. (Hayek, 1942, 149, italics in original)”

It cannot be *a priori* established that entrepreneurs prefer profits in the short term above more uncertain profits in the long run. What is reasonable to assume is, however, that when current or near-

future profits keep rising considerably, it becomes more and more attractive to reap those near-future profits at the expense of more uncertain distant future profits.

There are also historical arguments that support Hayek's expectation of a 'Ricardo effect' in the upswing, namely arguments that can be found in studies on the machine tool industry, the subsector of the machine producing industries that produces that industries' capacity. For example, in *The British Machine Tool Industry, 1850–1914* (1976) one can read:

“The reaction of many of the leading machine tool firms to the volatility of demand was thus to play safe by refusing to over-expand in times of rising demand, and to cope with unexpected falls in demand by reductions in the labour force.” (Floud, 1976, 64)

In *Military Spending and Industrial Decline: A Study of the American Machine Tool Industry* (DiFillipo, 1986) we read that “[e]ven when business has been exceptionally good, new capital investments have been relatively low”. On the closely related type of expenditure for research and development ('R&D'), we read:

“When the business cycle has turned upward, on the other hand, many machine tool builders have still been reluctant to substantially increase their R&D expenditures. But the reason for the reluctance of many tool builders to increase R&D spending has been different during good times. Improved business for the machine tool industry has meant growing backlogs (an issue to be more fully discussed below). The point is that during upturns in the business cycle, machine tool builders have tended to worry more about reducing their backlogs than about developing new products. The major reason for this has been because, at least up until recently, when backlogs have increased, imports have also grown. Efforts to reduce backlogs, therefore, which has meant diverting capital away from R&D (for example, by increasing employment), has in large part been intended to curtail the import threat.” (footnote omitted)<sup>187</sup>

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<sup>187</sup> The decline of the U.S. machine tools industry after World War II has been the topic of various studies, among which one by the RAND corporation (Finogold et. al. 1994). The United States has had, since World War II, by far the largest military industry. Why is an important supplying industry of that U.S. military industry, the U.S. machine tools industry, then failing? DiFillipo's thesis is that 'military-Keynesianism' partly is a cause of this decline. The idea is that in recessions the government must increase military spending and as such act counter-cyclically. Another part of the argument is that military spending on machine-tools crowds out civilian spending on machine tools. Both of these phenomena are said to be detrimental to research & development in the U.S. machine tools industry, and by extension the competitive position of that industry.

In *The United States Machine Tools Industry from 1900 to 1950* (Wagoner, 1968) we read:

“In the peak years, demand exceeded the capacity of the machine tool industry and the industry expanded to try to meet this demand. There was little incentive to try to introduce radically new designs since most plants had more work than they could handle filling orders for existing models. At the end of the war, however, this situation was rather drastically changed and demand fell off while available supply for peacetime use rapidly increased. Tool builders began to place much more emphasis on replacement business. [...] An alternative stimulus to sales was to introduce improvements in machine tool design and construction which would make much existing equipment obsolete.”

In *Alfred Herbert and the British Machine Tool Industry, 1887–1983* (Lloyd-Jones & Lewis, 2006) we read, concerning the expansion of the production capacity of machine tool producers during the First World War (July 1914–November 1918), that only once it became clear that the war would not over soon, machine tool firms were willing to expand capacity. Wars were accompanied by an “initial reluctance of firms to invest in sufficient capacity” (ibidem, 8). When the First World War was nearing its end, we can read about Alfred Herbert, chairman of Alfred Herbert Ltd, one of the biggest British machine tool producers of its time:

“Sir Alfred opted for a policy of contingency, informing his directors in October 1918 that ‘the best position the company could be in at the end of the war would be to have as few commitments as possible and the maximum amount of money in the bank to be ready to jump off in any direction’. In justifying this decision to defer a programme of capacity expansion, he referred to uncertainty over future demand, but also the limited market information available to executive management” (Lloyd-Jones & Lewis, 2006, 76)

Hence there seems to be sufficient reason to add the Ricardo effect to the list of stylized facts of business cycles.

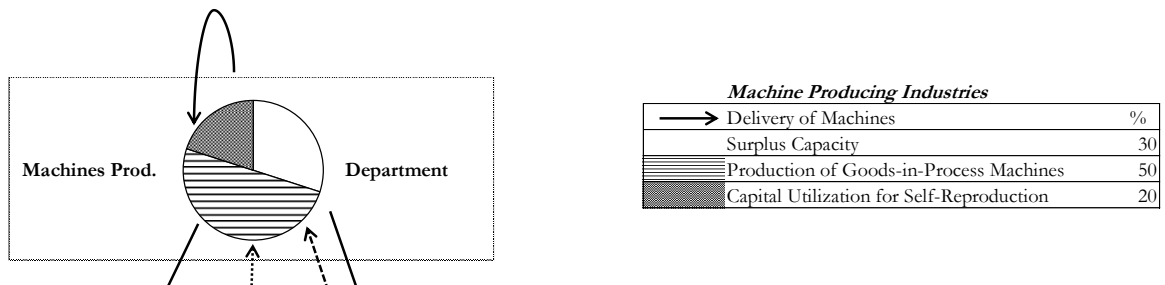
#### **4.3 A Schematic Exemplification of the Ricardo Effect in the Machine Producing Industries**

Machine-tools are used by machine tools producers themselves, and by practically all other machine producers (shipyards, aviation industry, tractor producers etcetera) and also by some consumption goods producers (car makers, bicycle manufacturers). There are also machine producing firms that can produce both machine tools and other types of machinery.

When rapid increases in capital expenditure occur, such as in cyclical upswing, the expected response of the machine tools producers is to provide much machine tools as they can. However, this must come at the expense of the expansion of the capacity of the machine tools producers themselves, as well as at the expense of research and development (that is, of a higher degree of automation). Hence a boom in capital expenditure (that is fuelled by fiduciary credit) will not lead to capital deepening but the capital widening.

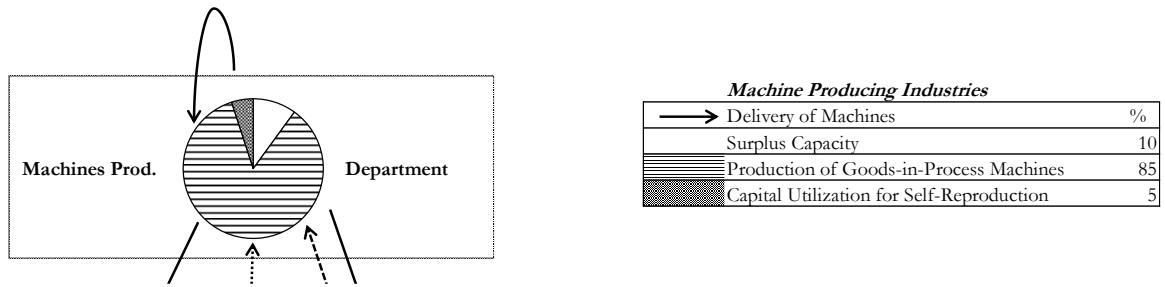
Schematically we could portray it as follows: Suppose in a stationary economy, the machine producing industries have a certain capacity of which 50% must be utilized to produce machinery that will replace the worn-out machinery of both the consumption goods industries and the raw materials industries, and a further 20% of their capacity must be utilized to reproduce its own production capacity as it wears and tears. If we only look at the section of the three-sector pie-cart model which contains the machine producing industries, a typical period in a stationary economy would be pictured as in the following figure (figure 7.2):

Figure 7.2



An increasing demand for machinery, first by the consumption goods industries but eventually also by the raw materials industries, will make the entrepreneurs in the machine producing industries increase their production of machinery for outside industries. First they will attempt to increase overall capacity utilization by attracting skilled workers or asking existing employees to work overtime. But as the labour market will get more strained during an upswing, this increase in overall capacity utilization will have its limits. Then the question becomes increasingly whether or not capacity used for replacing or expanding the own capacity of the MPI should not be utilized to serve outside customers. Eventually it will be seen that more and more of the utilized capacity in the MPI will be utilized to produce machines for outside industries, reaping profits now, at the expense of increasing its own capacity. The utilization of the machine producing industries then will look something like pictured in the figure (7.3) below:

Figure 7.3



The consequences of such a way of utilizing the capacity of the MPI must be that in the longer run the capacity of the MPI will decline. However, this effect is probably small, as it may be that the ‘capex boom’ is over in a few years. Another effect is that the MPI will drive up wages directly by its own increased demand for labour. Furthermore, the increased production of machinery directly requires raw materials. Indirectly, the delivery of machinery will increase the capacity of the CGI and the RMI. The increased capacity that the MPI delivers to the CGI and RMI will likely lead to an increased turnover of raw materials.

### 5. The Cyclical Behaviour of the Raw Materials Production and Inventories

After having discussed the behaviour of the industries that supply the fixed capital (or fixed assets) of the economy, we now arrive at the way the circulating capital (current assets) of the economy are supplied. This puts our view upon that structure in the economy that is usually called the *supply chain*. Usually, the consumer is considered as located in the end of the supply chain. Now if we follow the supply chain to its beginning, we will under way encounter a number of inventories of goods-in-process (intermediate goods). Between the bicycle-factory and the steel industry we will see inventories of steel components destined to be used in bicycle manufacturing; between the steel industries and the mines certain stocks of iron ore will exist which will be refined into iron. If we ultimately arrive at the beginning of the supply chain we encounter what economists commonly call the *primary sector*, or sometimes raw material industries. An import industry within the primary sector is the mining industry. Its subsector which is tasked with *exploration and development* of new mines can be seen as the beginning of the supply chain, or the highest stage of production for raw materials. After all, mines eventually get depleted and new mines must replace them.

The phenomenon of higher capacity utilization in the upswing and lower capacity utilization in the downswing must be tied up with the supply chain, with the inventories in the supply chain, and with the mining industries feeding the supply chain. The reason is simply that capacity utilization always

requires fuels and materials ('circulating capital', current assets). We have provided an explanation for the increase in capacity utilization of the upswing in section 3, but in this section we continue where we left off and deal with the decline in capacity utilization in the downswing. Hereto we will in the next sections discuss the real stylized facts of respectively inventories and mining during the business cycle.

## 5.1 Inventories

In the 1930's two studies appear in which time-series are presented, with reference to the trade-cycle, in which it is shown that many stocks and inventories, among which the more important, are rather 'contracyclical'<sup>188</sup>. In Blodgett's *Cyclical Fluctuations in Commodity Stocks* (1935) it is shown that many inventories of commodities move inverted with respect to the business cycle. Lachmann & Snapper (1938) found similar results when they studied different time-series. They concluded that their findings were not inconsistent with overinvestment theories (among which they put the 'Austrian' business cycle theory):

“In fact, however, practically all those [overinvestment] theories stress the importance of fluctuations in investment in fixed capital as the outstanding feature of the Trade Cycle are borne out by our material. The reason is that an increase in investment activity of this kind involves an increase in the demand for mineral products such as iron, copper, tin, the supply of which can only be adjusted with a time-lag. Hence, in the meantime stocks are bound to decrease as they are likely to augment in the case of a setback in investment activity. It follows that all over-investment theories are consistent with the results of our investigation. On the other hand, Recovery cannot possibly start in the raw material producing industries, hampered as they are by large

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<sup>188</sup> In a certain sense, the lower inventories were already noted before. The “Conversion of Circulating Capital into Fixed Capital” was one of the explanations for economic downturns in the 19th century (Hayek, 1941, 424-431). Too much railroads and trains (fixed capital); but no cargo (circulating capital) to transport on those trains. It pointed towards a scarcity of *real* circulating capital or *real* working capital. In financial terms, working capital is the money which is expendable on labour and inventory; but in real terms it is the availability of inventory and labour itself. Raffalovich writes in 1904 on a recession: “L'origine des embarras des compagnies industrielles, c'est l'absence de fonds de roulement le capital exploitation, indispensable pour la mise en marche, pour les salaires, les achats de matières premières, fait défaut, surtout aux entreprises surcapitalisées”. Hence he notes an absence of money-fonds to purchase raw materials, but it may very well be that the raw materials are so scarce that they cannot be obtained profitably with the money-funds which are available. N.B. An eye-catching example of a recent low-inventory phenomenon in a cyclical upswing was the microchip (or semiconductor) shortage that started to develop in 2020 and continued until 2023.



and increasing stocks which have to be cleared before their production can recover.”  
(1938, 452)

*If an increase in investment in ‘plant & equipment’ occurs, on the part of the consumption goods industries, then one of the first results will be a higher absolute capacity utilization in the machine producing industries. The higher activity in the machine producing industries must lead to more demand for industrial materials, such as iron and copper. But as more and more machinery is delivered to the consumption goods industries, those industrialists will surely set this machinery to work in order to haul in their ‘return on investments’. This will also lead to a higher consumption of raw materials.*

Hence from the fact that the business cycle is characterized by higher investment in plant & equipment (at least on the part of the consumption goods industries); the question to solve that follows is in how far the raw materials industries can keep up with the resulting increased demand for raw materials.

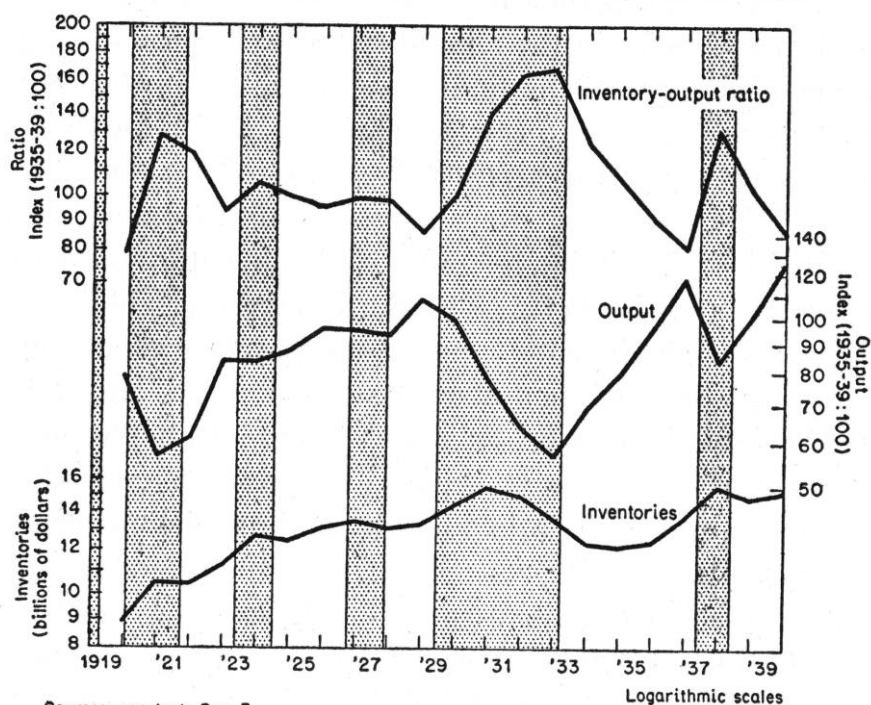
Perhaps the most important work on inventories and business cycles in the 20<sup>th</sup> century is Abramovitz’ *Inventories and Business Cycles* (1950). With respect to the presentation of the statistical data, Abramovitz’ first presents data on the inventories of ‘manufacturers’. Subsequently he present data on the inventory changes in raw materials, which he defines as “comprising goods purchased by manufacturers either from other fabricators or from nonmanufacturers but not yet manipulated by their owners” (178). Apparently, mining companies and agricultural producers do not fall in the domain of ‘manufacturers’.

One of the conclusions that Abramovitz’ presents on ‘manufacturers’ is that

“The inventory-output ratio for total manufacturing has the appearance of an inverted replica of the output index, and its inverted behavior during business cycles is apparent (Chart 14). These observations on the behavior of the ratio for all manufacturers are fully confirmed by conformity measures computed for the total and the various industry groups (Table 34), which, as indicated, were computed on the assumption that the ratios move synchronously with both output and business cycles.”

‘Chart 14’ of *Inventories and Business Cycles* (1950, 141) is reproduced below.

Chart 14  
**Total Manufacturing: Inventory-Output Ratio,  
 Output and Inventories, Constant Prices, End of Year**

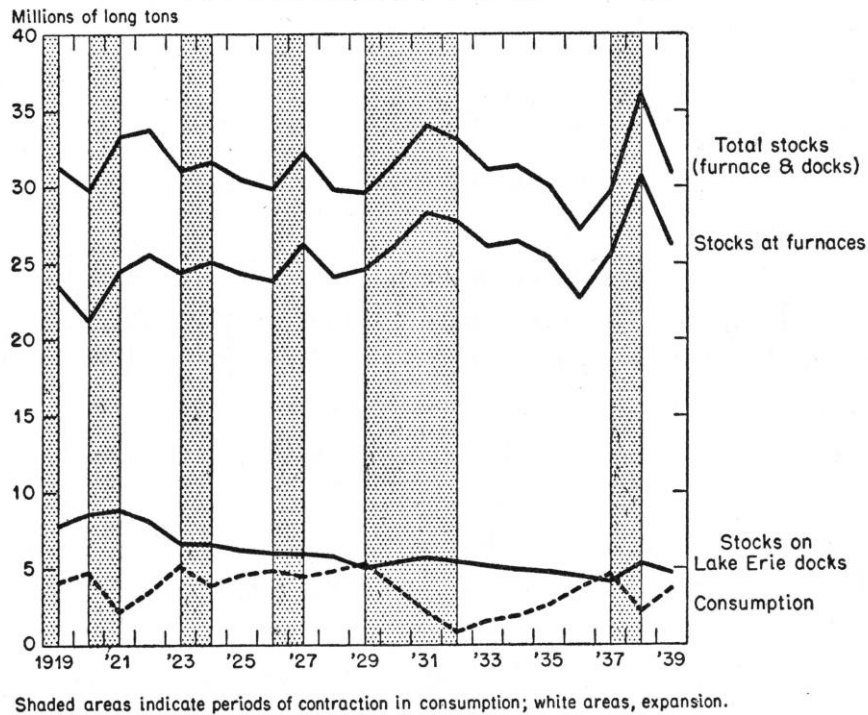


Source: see text, Sec. 3.  
 Contractions (shaded) and expansions (unshaded) are marked off by the monthly reference chronology.

In the subsequent treatment of inventories of raw materials during the business cycle, Abramovitz presents ten examples of raw materials stocks: (1) raw cotton at mills; (2) raw silk at manufacturers; (3) raw cattle hides in Tanner's hands; (4) crude rubber stocks; (5) cottonseed at cotton mills; (6) raw sugar stocks at refineries; (7) crude petroleum; (8) newsprint at publishers; (9) iron ore stocks at blast furnaces at Lower lake Points; and (10) lead stocks at bonded warehouses. Of these ten, the inventories of iron ore are probably most significant with respects to their use in both machinery (durable producer's goods) as well as durable consumer goods (cars, bicycles).

Below is reproduced 'Chart 34' of *Inventories and Business Cycles* (1950, 227), which plots the movement of stocks of iron ore in physical units (long tons).

Chart 34  
**Iron Ore: Stocks at Furnaces and on Lake Erie Docks  
 and Consumption, Monthly Averages**



With respect to these stocks of iron ore, Abramovitz' writes:

“Total stocks and stocks at furnaces, which dominate the total, were lower at the end than at the beginning of every expansion in consumption (white areas); they were higher at the end than at the beginning of every contraction (shaded areas). Only in 4 of the 20 years did consumption and stocks at furnaces change in the same direction. For total stocks there were only three similar movements.” (226)<sup>189</sup>.

## 5.2 Mining

Ultimately, raw materials are often extracted from the earth. Lastly, we can therefore address another ‘real’ stylized fact of business cycles which is closely related to commodity stocks, namely the so-called *grade of ore* – or simply the quality of raw materials – which are put out by the mining industries. The *grade of ore* is defined as the amount of the wanted material per ton of total material extracted containing this wanted materials. For example, a higher grade of iron ore means that the amount of iron per ton

<sup>189</sup> A deeper look at these iron-ore stocks should also take account of the head grade of these stocks. Abramovitz did not discuss the grade of ore in relation to his investigations into stocks.

of extracted iron ore is higher. The grade of ore<sup>190</sup> is of great importance in mining as the physical cost of processing ore into the wanted material product becomes lower the higher the grade of ore, and *vice versa*. The reason a mine is closed is usually not that no more ore can be extracted from it, but that the ore grade from the ore that can still be extracted has become too low to make further operation of that mine economically viable. When new mines are opened at the same rate as depleting mines are closed, the average grade of ore extracted throughout the mining industry should remain steady. However, the average ore grades of the various metal ores put out by mines, and the average head grades of ores accepted by mineral processers are not constant over time, but vary. Hence we can ask ourselves whether there is any generalization - a stylized fact - to be stated about this variable with respect to the business cycle?

In the field of mineral economics we do occasionally find statements about the general determinants of the cut-off grades and head grades of minerals. For example, in a German monograph on the 'economic geology of ores', we read about mercury:

*"The minimum industrial grade of ore depends on a number of factors, the most important of which is the price of mercury on the market. As mercury is a cyclical metal, with strong price fluctuations in the market, the minimum industrial grade is also very variable. During periods of high economic activity, ores with only 0.15% Hg are mined (Huanvelik in Peru), while during periods of price reduction, ores with this mercury content are not on the balance sheet."* (Janković, 1967, 317, his italics).

A far more general statement about the relation between ore grade and the price of ore is made in the handbook *International Mineral Economics*:

"Cutoff grade is a geologic/technical measure that embodies the important economic aspects of mineral production from a deposit. In other words, it is defined not only by a deposit's geologic characteristics and the technological limits of extraction and processing, but also by costs and mineral prices. As mineral prices and the various costs of extraction, processing, transportation, and other factors vary over time, cutoff grade evolves to reflect

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<sup>190</sup> In reference to iron, the ore grade, or grade of ore, is also called the *metal content of iron ore* or *iron content of ore* by the United States Geological Survey. The minimal grade of ore that a mining enterprise will want to extract, or put in the supply chain, is called the *cut-off grade*. The *mill head grade* or *head grade* is the grade of ore that is actually processed by the mills that turn ore into 'raw material'. For iron ore, different grades, called *fe content of iron ore extracted*, are used. Higher grades are sold at a higher price than lower grades, as it is more labour-intensive, capacity-intensive and energy-intensive to process lower grade ores.

these changes. If, for example, mineral prices rise and all costs stay the same, then the cutoff grade will fall, because extraction of metal from lower-quality rock now will be profitable.” (Gocht, 1988, 113).

About particular metals we can show similar findings. In *Structural changes and business cycles in South Africa* (1938) we can read that the ore grade for gold significantly declined in the upswing:

“The marked reduction in the grade of [gold] ore worked after 1932 is due to the rise in the price of gold and the greater payability of low-grade ores. This explains why the production of fine gold showed practically no rise after 1932, in spite of the great increase in tonnage of ore milled” (Schumann, 1938, 324)

Among the contemporary sources, we find that Professor Crowson writes about copper:

“Although the evidence about the influence of prices is not clear-cut, it does suggest that prices and cut-off grades may be inversely related (2012; cf. Spencer, 1940, 67).

About copper and other metals, professor Tilton makes even stringer statements. He writes:

“when mineral markets are strong and prices are high, the pressure to reduce cost and enhance productivity is much weaker. New producers have an incentive to expand production despite higher costs to take advantage of the higher prices. They push capacity utilization beyond its optimal level [...] If, as the evidence suggests, mining productivity over the past decade has largely fallen as a result of higher prices and booming markets, the implications are important. First, when the boom is over, mining productivity is likely to recover. Indeed, this occurred in the second half of 2008 and early 2009 when the Great Recession for a period sharply reduced the prices for copper and other mineral commodities” (Tilton, 2014)

### **5.3 Agriculture**

Not only in metal ore mining, but also in other areas of the primary sector we can see a ‘Ricardo effect’ in operation. In the *Handbook of Agricultural Economics* (2002) we can find the following explanation of what is to be expected under price increases for agricultural products:

“the short-run effect of agricultural price increases is to expand output primarily via increases in cultivated area and fallow reduction. This, however, causes a fall in productivity of cultivated land in the intermediate or long run. This is due to the restricted

possibility of replenishing the chemical and physical properties of the cultivated land due to the reduced fallow periods, which is not compensated for by greater use of chemical fertilizers and soil conservation investment. Agricultural output eventually falls with respect to the levels reached in the short run after the price increase, and could be even lower than its pre-price-increase levels because soils become more degraded and may not fully recover to their pre-price-increase levels.” (López, 2002, 1223)

Where in metals production a price increase results in producing with lower quality inputs (lower grade ores) we see practically the same in agriculture, as the agricultural product is produced from lower quality inputs as well. After all, reduced fallowing reduces fertility (quality) of the land put in to produce agricultural products.

#### **5.4 Implications of Inventory and Mine Depletion on Capacity Utilization**

We may conclude that, about a number of important materials, different economists who specialise on the field of mining, have concluded that price-rises for metals typically are followed by declines in the metal ore grades which are milled or refined into metal. Their conclusions are not unexpected from the point of view of economics and business administration. Higher selling prices warrant higher costs. Higher prices, make

We argue that this is again, like in the machine producing industries, a ‘Ricardo effect’. In the context of the primary sector this means that, when prices rise fast and costs lag behind, entrepreneurs will re-allocate resources from the reproduction or expansion of their production mining capacity towards the exploitation or utilization of existing mining facilities. In other words, less investment in exploration and development in new mines, or cost-reducing equipment; more investment in working capital in order to bring capacity utilization to higher levels.

The reason why entrepreneurs decide to do such re-allocations lies in the want to the near certain opportunity to capture big profits in the near future. The cost of this *modus operandi* is a greater capacity to produce in the more distant future, a production capacity of which its profitability is much more uncertain, however, than the probability of capturing profits in the near future. Lower and lower grade ores will be mined, because this is a faster way to get ore than exploring and developing new mines with higher grade ores. To refine the lower-grade ores, more fuels and other resources are required. This is a trend that will provide a higher output in the near future, but which cannot be sustained in

the long-run. There can be no clearer indicator of an unsustainable exploitation path than a declining head grade.

The ultimate consequence of a re-allocation away from exploration and development must be that the in the more distant future output of metal declines relatively to what it could have been. This relatively depleted mining capacity of the world economy explains, in our view, quite a lot about the decline or slow growth of consumption goods production in recessions. It furthermore explains an inability of governments and their central banks to ‘spend their way out of recessions’. As the data on inventories suggests, the first thing that must be achieved in order to get started a recovery to a higher level of consumption goods output, is that inventories of intermediate goods must be replenished<sup>191</sup>.

### 5.5 A Schematic Exemplification of the Ricardo Effect in the Mining Industry

We can again use pie-charts to illustrate the capacity utilisation of the mining industries, although in this specific case the phrase *depletion* instead of capacity utilisation is more fitting. But here we will slightly differentiate our approach to illustrating the production efforts. What is the same is that the mining sector uses relatively mobile machinery and manpower that can be re-allocated from one mine to another, or from exploitation to exploration and development. Both machines, miners and engineers can be utilised or ‘exploited’ for one project or another, or stand idle. However, not only men and machines are important factors of production, the *deposits* are important factors of production that warrant some special consideration.

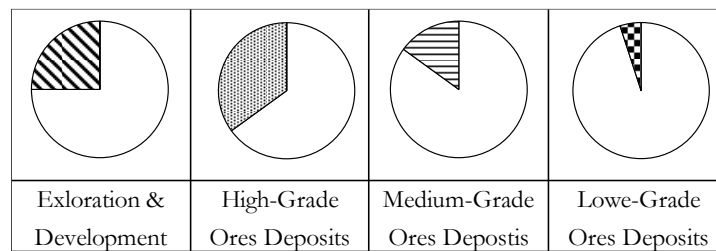
We will therefore use figure 7.4, containing four pies in a row. The slice in the first pie represents the amount of resources devoted to exploration and development for new operable deposits. The second, third and fourth pie represent existing deposits of high-, medium- and low-grade ores respectively.

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<sup>191</sup> The commodity price-cycle seems to be longer than the average business cycle, hence the adjective ‘super’ in *supercycle*. However, the upper turning points of these commodity supercycles do coincide with the relatively bigger financial crises and events; while the troughs of commodity price-cycle also seem to coincide with the relatively more depressed downswings of business cycles. For example, a boom in commodity prices occurred midway the 1970’s; the bust in commodity prices set in once a drastic change in monetary management – which is sometimes called the *Volcker Shock* – was initiated from 1979 onwards. By the end of the 1990’s commodity prices started to climb again, culminating in an upper turning point for commodity-prices as the major financial crisis of 2007-2008 began to evolve in what is called the ‘Great Recession’ of the 2010’s. Incidentally, between the Volcker Shock of 1980 and the *credit crunch* of 2007-2008 (as that financial crisis was initially named), there was no large-scale monetary disturbance, even though there were some official recessions. Halfway the 2010’s commodity prices began to rise again. It looks like the upper turning point will be around the year 2023, when the failing of a number of banks (Silicon Valley Bank, Credit Suisse, First Republic Bank).

The slices in these pies represent the yearly exhaustion of these deposits. We may assume that the amount of resources devoted to exploration and development in figure 7.4 are representative of a stationary economy. That means that the yearly depletion of the high-, medium- and low-grade ore deposits is compensated by an equal amount of newly developed (operable) deposits. In such a stationary economy, each period can be represented by the same illustration. For example, in the stationary economy we assumed that 35% of the high-grade deposits are mined each year, but also that these 35% were ‘reproduced’ through the efforts of exploration and development.

Figure 7.4



After considering the stationary economy, we might now consider a commodities boom. The initial situation (a ‘period 1’) may be similar to the stationary economy pictured above. Suppose then, that the prices of refined materials such as iron, copper and other metals increase due to increasing demand from the consumer goods industries and the machine producing industries. If initially it is assumed that this is a temporary increase in demand, a little more capacity utilization will increase the output of the mining sector. Especially the exploitation of high-grade mines will be increased (see the first of the three figures below, ‘period 2’).

In any case, we assume here that entrepreneurs respond to the rise in demand by increasing their exploitation expenditures relatively to their exploration and development expenditures<sup>192</sup>. That is, we assume that the ‘Ricardo effect’ occurs in the mining industry because in acting in such a way the profits and cash-flows of the mining industry can be greatly (albeit temporarily) increased.

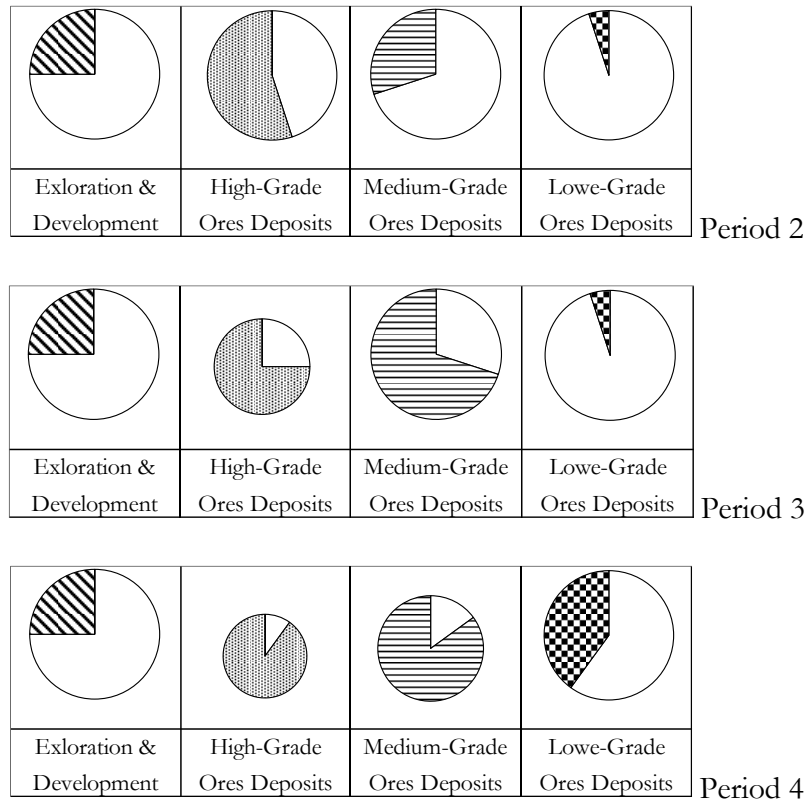
If the exploitation of high-grade ores increases to such an extent that exploration and development efforts cannot replace the exploited high-grade deposits with new ones, it must be the case that after a couple of periods the high-grade deposits become depleted (here already pictured in ‘Period 3’, in

<sup>192</sup> During commodity booms there is often a great increase in capital expenditure (investment in machinery and the like) as well. But such ‘investment in fixed capital’ is directed often towards exploitation, rather than development.



which the pie of high grade ores becomes smaller). If demand and the price-level for raw materials remains high, then this demand must be fulfilled increasingly with medium- and eventually low-grade ores ('Period 3' and 'Period 4').

Figure 7.5



## 6. Conclusion

We cannot find a distinction between *nominal* stylized facts and *real* stylized facts in either the current business cycle literature, or in macroeconomic textbooks. An obvious reason for this non-distinction is that current business cycle researchers hardly give real stylized facts their due consideration. Even despite the fact that the distinction between nominal and real, or between the money-side of the economy and the real-side of the economy, will be familiar to most economists. Perhaps lies at the core of the neglect of the real stylized facts of business cycles an inability to properly understand these facts. After all, one needs some theory of the real economy, i.e. a production theory that provides a model of the structure of production, to make sense of these facts. To put the real stylized facts on the agenda, as well as their systematic study, should be considered as a main contribution of this chapter.

With regard to the explanation of the real stylized facts we have selected four main important ones: (1) the higher capacity utilization in the upswing, which becomes a lower capacity utilization in the downswing; (2) the longer delivery lead times of the machine producing industries in the upswing; (3) the decline in the physical inventories of many intermediate goods; (4) the declining ore grades of ores mined. The concepts of the supply chain and the real structure of production (especially the pie-chart model) help as to elucidate the interdependencies between these real stylized facts. The most important conclusion is that many entrepreneurs, especially those in the machine producing industries and the raw materials industries, face the choice in the upswing between capturing near-future profits and expanding production capacity in the more distant future. The ‘Ricardo effect’ is that the profit-maximizing entrepreneurs will tend to choose to capture near-future profits, since the profitability of expanding capacity in the distant future is less certain and probably also less than near-future profitability.

# Overall Conclusion

## 1. The Theory of the Real-Side of the Economy

In this dissertation we have not dealt with the details of banking and central banking, let alone with stock markets and other financial markets. We have dealt with the ‘real-side of the economy’, by which we mean the technical-physical constraints that mankind faces, and the organisation of production that exists which copes with the constraints.

In the first main part, we have revisited the important aspects of the economic literature which deals with the real-side of economy in particular. This meant revisiting Böhm-Bawerk’s theory of production (which is the first part of his *The Positive Theory of Capital*). It further meant reviewing the history of economic thought with respect to the drawing of the scheme of the structure of production. Lastly, we discussed an aspect of the real-side which up until now has not been incorporated into the schematics of production, namely the topic of capacity utilisation. We concluded with a new model of the organisation of production, a three-sector pie-chart model.

In the second main part of this dissertation we have delved into the question how the technical-physical constraints affect the interaction of people with respect to the problem of incomes distribution and the topic of saving and investment. We have thereto first discussed the (classical) wage fund theory and the (Austrian) neo-wage fund theory, because the classical wage fund doctrine has always been regarded as a theory of income distribution that was based on the real datum of the available means of subsistence. Second, we have combined the production theory (as developed in the first main part) with the neo-wage fund theory in order to arrive at a theory of saving and investment that shows how a saving and investment mechanism functions. In the very last chapter we have applied our results in order to elucidate some real stylized facts of the business cycle.

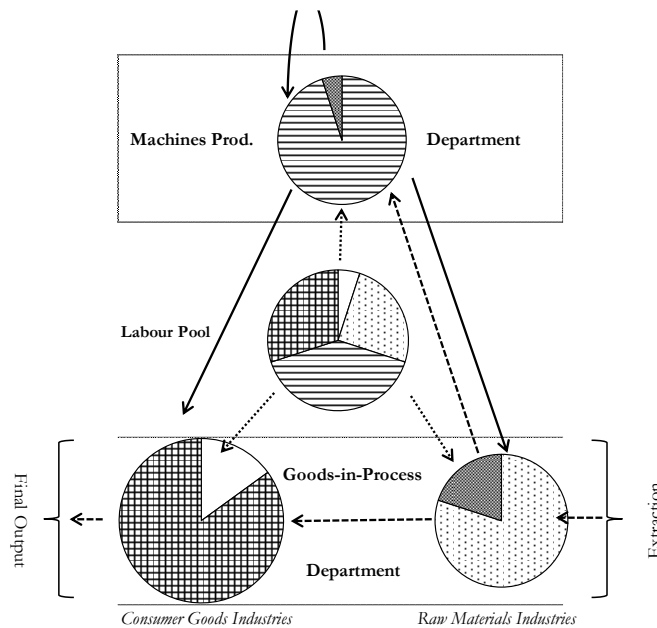
## 2. Contributions

In the theory of production it is useful to distinguish between *plan analysis* (taking the subjective perspective to the planner or actor) and *period analysis* (taking the objective perspective of a chronicler). Böhm-Bawerk’s *law of roundabout production* revolves around the trade-off between the planning horizon and the efficiency or effectiveness of the machinery produced at the end of the plan.

Our review of the history of economic thought in relation to the schematics of the structure of production resulted in list of requirements that a model of the structure of production should fulfil.

(1) a distinction between toolmaking and tool-using (2) shows that the sector tasked with tool-making also makes its own tools (i.e. the partial self-reproduction of real capital); (3) to show at third sector tasked with the extraction of raw materials which can be either shipped to the tool-builders or the consumption goods industries (4) to show how much capacity each sector has, and preferably some degree of automation (5) to show the capacity utilization in each sector; (6) the model must be applicable to a time-line.

The result of these requirements is a three-sector pie-chart model of the structure of production:



The elements of this model that may need some explanation are the pies representing each sector. The circumference of each sector's pie, or what comes down to the same thing, its surface area, measure the *capacity* of the respective sector. The *capacity utilisation* can then be illustrated by slices in the pie. One slice can illustrate the degree of non-utilisation or idleness, the other slice then the degree of utilization. But the slice representing the degree of utilisation can be divided into further slices. For example, one slice shows the capacity utilised for extending capacity of the own industry, the other slice shows it for other industries. In fact there is a fourth pie in the middle representing the work force. The slices of this pie mirror the capacity utilisation in each sector. A certain degree of capacity utilization in an industry will require a certain slice out of the workforce.

The main purpose of this pie-chart model is to give a 'one-glance' view of the relatively disaggregated resources of an economy, as well as the way these resources must be structured in a functional sense.

It shows that pulling workers, raw materials or machinery towards one industry has consequences for the other industries. For example, if the capacity utilization in the consumption goods industries is increased, and if its capacity is enlarged, this means that less workers, raw materials and machinery can be devoted to building capacity for the machine producers of the primary sector. The pie-chart model shows all resources constraints in one glance, and shows how that concepts such as the acceleration principle have severely limited applicability.

With respect to the second main part of the dissertation we explain that a saving and investment mechanism exists for which plain saving is of tremendous importance, and that a 'Paradox of Thrift' is non-existent since demand for machinery and raw materials must always precede demand for consumption goods. Not only wage-payments from entrepreneurs to workers are advances; the revenues of higher-order entrepreneurs are advances from the lower-order entrepreneurs.

### **3. Limitations**

A necessary limitation of a model of the *real-side* of the economy obviously is that it abstracts from the money-side. A financial sector and 'money-streams' are lacking in the theory and models we have developed, and as such it does not show why or how changes from the money-side arise. Another general limitation is that the influence of government interventions into the real-side have not been studied. There is no government sector in the model. One could also argue that the three sectors on which we have focussed in this dissertation is not enough disaggregation. This point will be discussed in section 5.1 below.

Another limitation is that there are limited possibilities to apply our theory to empirical or statistical information. The prominent type of data used in economics is accounting data (be it business accounting or national income accounting) and price-data. Statistical material on technical-physical aspects is not available, or at least not as readily available, as statistical material on prices. We will consider this point in more detail in the next section.

### **4. Practical Implications**

The practical problem of gathering statistics on economic matters is that there are an infinite number of facts to be collected, as virtually anything in the economy can be the subject of statistical description. Especially with reference to the business cycle, there has been an ongoing effort to establish its main or 'key' facts, its typical patterns, its 'stylized facts'. J.M. Clark, the author of *Strategic Factors in Business Cycles* (1934, 4) recognised this practical problem by his intent to provide "a limited number [of facts]

which have especial strategic importance”. The main practical problem is how one is supposed to decide what type of empirical data, especially relating to the business cycle, would be worthwhile to retrieve. Which data should we collect? Where should one look for patterns? Are there reasons to argue that one type of time-series (say the number of machine-tools shipped) is more important than another time-series (say the number of holidays on cruise ships)? According to Löwe, “an appropriate selective description of the chaotic jumble of empirical facts requires itself some conscious or unconscious theoretical ‘prejudice’...”([1926] 1997, 247). Theory must guide empirics.

One practical implication of this dissertation is that the theory of the real-side of the economy suggests which data should be collected. First of all, the general implications is to give as much attention to the real-side as is given to money-side or nominal-side data. Second of all, the three-sector model of the structure of production provides a guide to selecting relevant ‘real’ data: The employment figures and data on average hours worked are important, and fortunately, widely recognised as important cyclical indicators. However, there is little attention, certainly in textbooks, to inventories of commodities in terms of physical units. Furthermore, the ore grade of the ore that leaves the mines seems only discussed in the field of mining economics and is hardly discussed in business cycle studies. The same goes for the depletion of existing mines and the development of new mines. To a certain extend the delivery lead times of machinery and other durable capital goods is on the radar of statistical bureaus, but deserves some more attention. For example, it is interesting to know how much machinery is in fact produced for the machine producers themselves, and how much is shipped to other industries.

## **5. Further Research**

### **5.1 Modelling the Structure of Production**

The three-sector model illustrates three sectors - consumer goods industries, machine producing industries and raw materials industries. Arguably this is not an exhaustive representation of actual affairs, a further disaggregation always seems possible. Two further sections are

It would be a further disaggregation of resources if the accounting category of *fixed assets* were split-up into buildings and machinery. Since a machine producing industry is already in the three-sector schema it would imply to give building (the activity) and buildings (the output) a separate treatment. As such a *real estate sector* could be a useful addition to the model.

Another limitation of both the theory and model developed is that it is not extended into *spatial economics*. The sectors in the model are functional, their geographical location is not specified as part

of the problem to be solved. However, it is a general fact that the type of industries considered are not evenly distributed across the globe. Certain countries and regions are much more associable with mining and other forms of primary sector-activity, while other countries and regions are much more involved in manufacturing. This may have some sort of impact on the real-side. But it is difficult to see how geographical location could be integrated into a model that is meant to illustrate the functional interdependencies of the organisation of production.

However, one impact of geographical dispersal is certain: Output is transported from one place to another. Therefore, a *transportation sector* could be added to the model as a separate sector, by which one important aspect of spatial economics is addressed. From the perspective of explaining business cycles this would be a sensible thing to do. Especially the shipping industry (which can be considered a transportation subsector) is known for its *shipping cycle*. The *container volume* (the amount of containers transported) and the *dry bulk volume* (the tons of raw materials transported) are very cyclical statistics, as it indicates that the container- and dry bulk volumes grow in the upswing and decline in the downswing. The container- and dry bulk volumes are also very good indicators of the overall capacity utilisation in the global economy.

## **5.2 The Theory of Collective Bargaining**

In both classical economic thought, and contemporary reflection upon that thought, the size of the wage fund was regarded fixed, as a datum. One of the conclusions drawn from this premise was that unions (by way of collective bargaining, strike-action, and so forth) cannot increase the average rate of wages. After all the wage fund is a fixed amount. In a sense this conclusion is tantamount to saying that the working class is powerless to take more from the capitalists-entrepreneurs. This implications was politically unpopular and helped in the demise of the wage fund theory, according to Hutt (1936, 204). Theoretically, the problem with the concept of a fixed wage fund is that it is very static notion, in the sense that we take only one period into account. In such a case the wage-fund is indeed fixed. But if we think in terms of a sequence of periods, the class of capitalists-entrepreneurs should be able to decide to decrease its consumption, whereby a larger wage fund becomes available (Van Dorp, 1937). A major point that is to be considered is the fact that the only type of capital that is actually capital (investment) from the point of view of the capitalists as a collective, wages, is always tied-up in intermediate products before the result of the capital (investment) comes to fruition. The results of previous labour – plant & equipment – must be operated by current labour in order to be productive

and revenue-generating. According to Hutt, this is precisely a point where the capitalists are vulnerable against labour-unions (which would now be called the *hold-up problem*).

### 5.3 The Theory of Forward Markets

One of the phenomena that the theory of forward markets must explain is that spot- and forward prices are often not the same, but show *backwardations* (forward prices being lower than spot prices) for considerable periods of time, especially in times leading up to upper turning-points (Lachmann & Snapper, 1938; Eastham, 1939). The Keynesian view that backwardation is the normal state of affairs (hence the phrase ‘normal backwardation’). But the question is whether this is so. One could argue that under stationary conditions, there is no reason why spot prices should exceed forward prices. Furthermore, a lot of reasoning about forward markets takes the subjective planning perspective of the actors, but omits the real-side. Perhaps the ‘period analysis’, and the wage fund theory built on it, will be useful stepping stones to attack the problems of the theory of forward markets. It seems that, ‘under the veil of money’, the raw materials producers exchange their raw materials for consumption goods. To be precise, the consumption goods producers advance consumption goods against raw materials. When spot prices do start to exceed forward prices, this may indicate an increasing difficulty to promise to make advances in the future, i.e., an increasing scarcity of consumption goods is occurring and expected to increase.

## 6. The Microeconomic Perspective and the Crusoe-Economic Perspective

Böhm-Bawerk expounded a production theory which was separate, and prior to, his value- price- and distribution theories (Burchardt, 1931). He thus reserved a special place for a theory of the technical-physical constraints that mankind faces, because we find that production theory<sup>193</sup> right at the beginning of his theoretical system. One reason Böhm-Bawerk seems to be providing for this stance is that the economic laws relating to the technical-physical constraints exist independently of whether people have capitalistic or communistic institutions (1891, 113).

One can argue that Böhm-Bawerk’s distribution theory is more than a theory of the distribution between profits and wages, that it also is a *growth theory* (Fillieule, 2015). But then we still find this growth theory (or theory of saving and investment) towards the *end* of Böhm-Bawerk’s theoretical

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<sup>193</sup> We have provided the phrase theory of the real-side of the economy in order to make the notion of ‘production theory’ somewhat more precise. But in the history of economic thought such a theory also has been called ‘Real Analysis’ (Schumpeter) and *Crusoe Economics*. However, only a few economists seem to have pointed out explicitly that such Crusoe Economics is actually the part of economics that is not a ‘social science’ (Lowe,[1965] 2017; Ischboldin, 1958).



system. We do not find a business cycle theory in Böhm-Bawerk's *Positive Theory*, but Böhm-Bawerk did argue about the place of a *crisis theory* in a theoretical system:

“The topic of the crisis [...] is not at the beginning of [theoretical] systems, but at the end. You can dedicate it monographically in form, but not in matter. A crisis theory can never be the study of a separate part of social-economic phenomena; it is [...] always the last or penultimate chapter of a written or unwritten social-economic system, the mature fruit of the knowledge of all social-economic processes in their interactive context.” (1898, 132)

Böhm-Bawerk's remarks show that he really put some thought in the order of the subordinate elements of economic theory, that he was systematic about developing knowledge. We have followed Böhm-Bawerk in this order.

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One of the main objectors to economics with a separate production theory (in the sense of a Crusoe Economics) was Oskar Morgenstern. He dismissed the Böhm-Bawerkian system according to which there should be a separate theory of production and argued in favour of “the thesis that economics is nothing else than price theory” (Morgenstern, 1935). Morgenstern furthermore attacked the imaginary construction of a Crusoe Economy in the introductory chapter that he wrote of the *Theory of Games and Economic Behavior* (Neumann & Morgenstern, 1944).

If we recall that *microeconomics* is a phrase that slowly began to replace ‘price theory’ – as Friedman testified in his *Price Theory* (1967, 7) – then we should be able to argue that “the thesis that economics is nothing else than price theory” lies at the origin of *microfoundations*. In any case, the core idea of microfoundations is certainly that microeconomics should be at the root of economic theorising. But at the core of microeconomics we always see posited that resources are scarce. Even Gustav Cassel, who wrote that “it ought to be possible to do away with the whole of the old theory of value as an independent chapter of economics and build up a science from the beginning on the theory of prices” ([1932] 1967, vii), argued that “the whole economic system is dominated by the principle of scarcity”

(ibidem, 9). The fundamental reason for the existence of prices is the existence of a scarcity of resources.

Microeconomics, however, does not study this notion of a scarcity of resources much deeper. It proceeds, after pointing out the existence of a scarcity of resources, practically immediately towards discussing the budget constraints and price constraints that households and firms face. Sometimes the notion or *resource constraints* is discussed, but the term ‘resources’ remains an *amorphous* notion. There is no deeper investigation into the notion of resource constraints as part of the technical-physical constraints that mankind faces, there is not an elaboration of the notion of resources into a disaggregated set of different categories of resources, and of the way in which resources relate to each other in a *structure of production*. Besides, microfounded-macroeconomics does not disaggregate the resources of the macro-economy much further either.

Not long after Stigler faulted Böhm-Bawerk for the latter’s “utter confusion of technical with economic considerations” (1968, 198), the subfield of *growth theory* began to develop upon Professor Solow’s method of “segregating variations in output per head due to technical change from those due to changes in the availability of capital per head” (Solow, 1957). In order to make such a segregation, Solow resorted to using (1) the very abstract notion of capital as homogenous units of amorphous tools measured in money-units (2) the phrase ‘disembodied technology’ in reference to know-how, blueprints and techniques; and (3) the phrase ‘embodied technology’ in reference to actual capital goods with definite shapes and applications (Solow, 1955; 1957; 1963, 42-43). Economic growth is then explained by (1) the accumulation of capital in the sense of the growth of the monetary value of fixed assets and (2) by the progress of (‘disembodied’) technology. However, only the first cause is directly measurable, the second cause is measured as a residual. Furthermore, the workings of the progress of technology are not explained, it remains a ‘black box’ to the economist (Rosenberg, 1982). Economic growth as it empirically manifests itself, in the sense of the introduction of more mechanised and automatised tooling and machinery, is therefore not really explained.

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We conclude that microfoundations – by which we mean discarding a deeper investigation into the technical-physical constraints – leads to economic theories which can only dwell *on* the veil of money. Microfoundations prevents us from more insight into the Real Economy, the events that happen behind prices, balance sheet and profit and loss-statement. It would be better to start with Crusoe

Economics first, with investigating into the technical-physical constraints that mankind faces. This provides a better set of foundations for moving forward to studying the economics of human interaction, and what is perhaps the most complex problem of those interactions, the business cycle.

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**Titre :** La th orie r elle du capital .....

**Mots cl s :** Analyse r elle, capital r el, th orie de la production, biens de surconsommation.

**R sum  :** Dans cette th se, nous soutenons que l'analyse r elle devrait  tre un  l ment fondamental de la th orie  conomique, en particulier de la th orie du capital. En termes r els, le capital peut  tre consid r  comme un bien d' quipement ou comme un moyen de subsistance. Dans la premi re partie de cette th se, nous  tudions les contraintes techniques et physiques de l' conomie en ce qui concerne la productivit , la reproduction, la subsistance et l'utilisation des capacit s. Pour ce faire, nous reviendrons tout d'abord sur la th orie de la production circulaire de B hm-Bawerk et sur sa th orie de la formation du capital. Ensuite, nous discutons de l'histoire de la pens e  conomique en ce qui concerne les sch mas de la structure de production et nous d veloppons une th orie r elle ou macro conomique de l'utilisation des capacit s. Le r sultat principal de cette partie est un nouveau mod le de la structure de production qui peut  tre utilis  dans une analyse de p riode.

Dans la deuxi me partie, nous traitons des aspects r els de la distribution des revenus, de l' pargne et de l'investissement, et du cycle  conomique. Nous revisitons et d veloppons la "th orie nouvelle de fonds du salaire", le m canisme d' pargne et d'investissement, et nous discutons des faits "r els" stylis s du cycle  conomique.

La principale d couverte est que nous pouvons identifier certains points o  les entrepreneurs peuvent  tre incit s (dans certaines circonstances mon taires)   r affecter leurs ressources   l'augmentation de la production dans un avenir proche, au d triment de la production dans un avenir plus lointain. L' conomie peut alors s'engager sur la voie d'une croissance insoutenable de la production (surconsommation), conduisant finalement   des p nuries relatives de mati res premi res et de biens de consommation.

**Title :** The Real Theory of Capital.....

**Keywords :** Real Analysis, real capital, production theory, overconsumption

**Abstract :** In this dissertation we argue that Real Analysis should be fundamental in economic theory, especially capital theory. In real terms, capital can be seen as capital goods or as means of subsistence. In the first part of this dissertation we study the technical-physical constraints in the economy with respect to productivity, reproduction, subsistence and capacity utilisation. Hereto we first revisit B hm-Bawerk's theory of roundabout production and his theory of the formation of capital. Subsequently we discuss the history of economic thought with respect to the schematics of the structure of production, and we develop a real- or macroeconomic theory of capacity utilisation. The main result of this part is a new model of the structure of production that can be employed in a period analysis.

In the second part we deal with the real aspects of income distribution, saving and investment, and the business cycle. Hereto we revisit and develop the 'neo-wage fund theory', the saving and investment mechanism, and we discuss the 'real' stylised facts of the business cycle.

The main discovery is that we can identify certain points where entrepreneurs can be incentivised (under certain monetary circumstances) to re-allocate resources towards increasing near-future output, at the expense of providing output for the more distant future. The economy can then move onto an unsustainable path of output-growth (overconsumption), leading eventually to relative shortages of raw materials and consumption goods.