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Thomas Grjebine

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**Institut d'Etudes Politiques de Paris**  
**ECOLE DOCTORALE DE SCIENCES PO**  
**Programme doctoral en économie**

**Doctorat en Sciences économiques**

**Essays in International  
Macroeconomics and Monetary  
Theory**

Thomas Grjebine

*Thèse dirigée par*

Philippe Martin, Professeur des Universités, IEP de Paris

**Soutenue à Paris le 12 décembre 2013**

**Jury :**

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*Pour Constance, et Valentine, dix mois.  
En espérant que la crise sera vaincue  
avant qu'elle ne soit adulte...*



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# Abstract

This thesis includes four essays in international macroeconomics and monetary theory. It is divided into two parts. The two first chapters, coauthored with François Geerolf, investigate the macroeconomic consequences of housing cycles on current accounts (chapter 1) and employment dynamics (chapter 2). The second part of this thesis studies the consequences of modern banking features on money creation mechanisms, notably with the development of private payment arrangements and the globalization of banking. Chapter 3 looks at the issue empirically. In chapter 4, I develop a model to investigate the consequences of these modern banking features for the provision of money and for risk propagation mechanisms.

In the first chapter, we study the causal link between house prices and current accounts. Across time and countries, we find a very large and significant impact of house prices on current accounts. In order to rule out endogeneity concerns, we instrument house prices for a panel of countries, using property tax variations. A 10% instrumented appreciation in house prices leads to a deterioration in the current account of 1.7% of GDP. These results are very robust to the inclusion of the determinants of current accounts. Following a house price increase, private savings decrease, through wealth effects rather than consumer-finance based mechanisms, while non-residential investment rises through a relaxation of financing constraints for firms.

In the second chapter, we investigate the causal effect of house price movements on employment dynamics. Using a dataset of 34 countries over the last 40 years, we show the large and significant impact of house prices on unemployment fluctuations using property taxes as an instrument for house prices. A 10% (instrumented) depreciation in house prices yields to a 3% increase in the unemployment rate. These results are very robust to the inclusion of the variables commonly used to explain unemployment rate developments. Besides the effects on unemployment rates, house prices also impact labor reallocation between tradable and non-tradable sectors: rising (declining) house prices do not only lead to hiring (firing) of construction workers, it also leads to real exchange rate appreciations that affect manufacturing activity. Over the housing cycle, total effect of house prices on employment in the tradable sector is negative.

In chapter 3, I study empirically the consequences of modern banking for money



creation mechanisms. Money privatization is seen as one of the main features of modern banking. The development of private payment arrangements and the globalization of banking have indeed led to a growing questioning of central banks' monopoly on the provision of money. This chapter analyzes empirically the reality of money privatization and renews the attention on the role of central banks in money creation mechanisms. To determine the weight of private money in modern banking, I calculate the percentage of total transactions that are directly settled in central bank money with a precise estimate in the US case, and by giving orders of magnitude for a sample of 15 countries. Central bank money represents more than 95% of the value of transactions in 12 countries. I analyze the nature of the assets used for the remaining share of transactions by studying exhaustively all the arrangements and systems in my sample of countries where settlement potentially involves private money. Empirical evidence questions the existence of a privatization of money and tends to show the monopoly of central bank money as settlement asset in modern banking.

In chapter 4, I develop a model to investigate the consequences of these modern banking features for the provision of money and for risk propagation mechanisms. Central bank money seems to be challenged by the rise of private substitutes, suggesting a privatization of money. I model the conditions for a privatization of money, i.e. for a coexistence between public and private settlement assets. I show that if banks have a balance-sheet constraint on lending, such a coexistence is not possible as only public money is accepted as a settlement asset in equilibrium. The constraint does not prevent private money creation but restricts the use of private settlement assets to separated markets. The model shows also the existence of a "settlement asset channel" as risk propagation mechanisms and the transmission channels of monetary policy are directly impacted by the settlement assets used in banking systems. A direct application of this channel can be found in international banking, through the use of the dollar as settlement asset in global finance.

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# Introduction

This thesis includes four essays in international macroeconomics and monetary theory. It focuses on two specific assets: housing and money. The first part of this thesis (chapters 1 and 2) investigates the consequences of housing cycles from an international macroeconomic perspective. The second part of this thesis (chapters 3 and 4) studies the consequences of modern banking features on money creation mechanisms.

Housing was traditionally not considered as a central issue in macroeconomics. For instance, among the 32 papers in *Landmark Papers in Macroeconomics*, edited by Tobin (2002), none was directly linked with the housing market. Standard macroeconomics textbooks either treated housing as one of many consumption goods, or neglected it all together<sup>1</sup>. For their part, housing and urban economic research virtually ignored interactions with the macroeconomy (Leung (2004)). It is probably only with the recent financial crisis that the macroeconomic consequences of housing have become a real topic of interest for economists. Existing data show however that housing bubbles are not a recent phenomenon. Interestingly, the Great Depression of the thirties was also preceded in the United-States by a nationwide real estate bubble that began around 1921 and deflated around 1926 (Nicholas and Scherbina (2012)). But unlike the closely analyzed stock market bubble of 1925-1929, this episode and its potential links with the Great Depression were quite forgotten until the recent crisis<sup>2</sup>. This 1921-1926 "bubble" was however similar in magnitude to the recent US real estate boom and bust (White (2009)). If the collapse of house prices and residential investment was recognized by contemporaries (White (2009)), it was later ignored by economists and one should wait until Temin (1976) to see a suggestion that the real estate collapse was important in the Great Depression<sup>3</sup>. The role of housing in US economic recessions was further investigated by Leamer (2007) who presented evidence that housing has been the most important sector in US economic recessions since 1945<sup>4</sup>.

Several arguments explain why it is important to include housing, and more pre-

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<sup>1</sup>For instance, the index to Mankiw's best-selling *Principles of Macroeconomics* (Gans et al. (2011)) indicates no reference to "real estate", and only three references to "housing" among which the consumer price index, rent control and the recent recession 2008-2009.

<sup>2</sup>For example, in his famous outline of financial crises, Kindleberger (1978) identified a land boom, cresting in 1925, but did not provide further commentary.

<sup>3</sup>Temin found that aggregate investment began to autonomously decline before 1929 and that the driving factor was the fall in construction after 1926.

<sup>4</sup>According to Leamer (2007), in six of the ten recessions since World War II, residential investment was the greatest contributor to weakness prior to the recession.

cisely house prices, in macroeconomic analysis. Housing contributes directly to GDP through private residential investment and consumption spending on housing services. For example, during the last 40 years in the United-States, residential investment has averaged roughly 5% of GDP while housing services have averaged around 13%, for a combined 18% of GDP <sup>5</sup>. In France, in 2011, housing's contribution represented 22% of GDP (CGDD (2012)). Housing constitutes also a significant share of household expenditures (in average 20% of personal consumption expenditures in the US) as well as total wealth. Fluctuations in house prices can imply significant fluctuations in wealth, and thus potentially significant wealth effects. For example, between 2001 and 2005, the value of real estate directly owned by the household sector in the United States increased by roughly \$10 trillion (of which half was appreciation of land) to represent 1.7 times the US GDP in 2005. Between 2005 and 2012, real estate holdings of households lost over \$6 trillion (Case et al. (2013)). Because of the collateral services of housing, house prices can have also a significant impact on non-residential investment through a relaxation of the financial constraints for firms (Chaney et al. (2012)).

In the two first chapters, coauthored with François Geerolf, we investigate house price causal effects on current accounts and on the labour market. Of course, movements in house prices can be due to many factors - risk aversion, animal spirits, expectational shocks (bubbles), etc. House prices could also comove with the macroeconomy, so whatever drives the cycle could explain this comovement<sup>6</sup>. A key contribution of this thesis is to propose a new instrument for house prices: property tax variations. Our identification strategy relies on the fact that property tax changes are driven by local politics rather than macroeconomics, so they are orthogonal to macroeconomic factors which might otherwise drive the business cycle. We treat also very carefully the business cycle dimension of house price movements. To the best of our knowledge, we are the first to instrument house prices in a panel of countries. The instrumental approach allows us to control for potential reverse causality or omitted variable problems.

The first chapter investigates the links between house prices and current account fluctuations. Studying the connections between these two phenomena is particularly interesting in the context of the recent crisis as house price bubbles and global imbalances are two often cited explanations of the crisis. For example, Obstfeld and Rogoff (2009) made the case that the global imbalances of the 2000s and the recent global financial crisis were intimately connected. For some authors, global imbalances even caused the crisis. Portes (2009) stated for instance that "global macroeconomic imbalances are the underlying cause of the crisis", as they resulted in a low financing cost. In the chapter, we show the causal impact of house prices on current accounts, not only during the recent period but over the last 40 years.

The second chapter investigates the links between house prices and the labour market. Negative effects of housing busts on employment have been much discussed

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<sup>5</sup>GDP statistics published by the U.S. Bureau of Economic Analysis (BEA (2012)). Housing services include gross rents paid by renters and owners' imputed rent.

<sup>6</sup>The comovement of the housing market and the macroeconomy has been documented notably for the US. For instance: Baffoe-Bonnie (1998), Case et al. (2000).

outside the academia in recent years. For example, in Spain, the number of persons employed in construction has almost been divided by three between 2007 and the end of 2012, and about 1.6 million persons lost their job in the sector. In the United States, around 3 million jobs in construction disappeared during the same period. We show in chapter 2 that house price effects on the labour market go beyond effects on the construction sector. If housing busts lead to job destruction, housing booms have a positive impact on the labour market, not only through the jobs created in construction but also as they impact positively labour demand via their effects on consumption and investment. Interestingly, rising house prices also impact sectoral labor reallocation between tradable and non-tradable sectors via a mechanism reminiscent of a Dutch disease phenomenon. In particular, we show that house price booms lead to real exchange rate appreciations that affect manufacturing activity and employment. If housing booms have positive impacts on overall employment in the short run, notably because of the large effects on construction, the total effect of house prices over the housing cycle is negative.

The second part of this thesis (chapters 3 and 4) investigates the consequences of recent banking transformations on money creation mechanisms, and on the power of central banks as providers of money. Money creation mechanisms are a controversial subject in monetary theory. The understanding of the power to create money is indeed deeply linked to different conceptions of the role of banks in the monetary system. A first strand of the literature considers that banks must be distinguished from other financial intermediaries as they have the specific power to create money, i.e. the scale of their assets is not limited by their liabilities. Banks do not have to wait for deposits before they make loans, they can create money *ex nihilo*. The idea that banks "create money from nothing" has a long history. It really emerged with Schumpeter (1911)<sup>7</sup>, and was later developed by Keynes (1930) in his *Treatise on Money*:

"[A]ll deposits are "created" by the bank holding them. It is certainly not the case that the banks are limited to that kind of deposit, for the creation of which it is necessary that depositors should come on their own initiative bringing cash or cheques", Keynes (1930).

Another strand of the literature considers on the contrary that private banks are mere intermediaries that channel funds from savers to borrowers thereby increasing economic efficacy by promoting a better allocation of resources. For Tobin (1963) in particular, there is no reason to attribute a special role to banks compared with other intermediaries. He criticized what he called the 'old view' according to which banks, in contrast with other intermediaries, can spread out their loans without limits since their liabilities are used as means of payment. According to Tobin, banks loans are bound by banks

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<sup>7</sup>"It is always a question, not of transforming purchasing power which already exists in someone's possession, but of the creation of new purchasing power out of nothing [...] The banker, therefore, is not so much primarily a middleman in the commodity "purchasing power" as a producer of this commodity." (Schumpeter (1911))

deposits as banks cannot create money by a simple "stroke of pen":

"Neither individually nor collectively do commercial banks possess a widow's cruse [...] Bankers cannot create means of payment to finance their own purchases of goods and services. Bank-created "money" is a liability, which must be matched on the other side of the balance sheet", Tobin (1963).

In this view, banks cannot create money *ex nihilo* as they have a *balance-sheet constraint on lending* : they can only credit money if they debit money from another account. It is however important to notice that this view does not imply a full-reserve banking system à la Fisher (1935) or Friedman (1948). The existence of a balance-sheet constraint on lending is indeed independent from the question of the reserve requirements in the banking system<sup>8</sup>.

This debate on money creation is still a very controversial subject in monetary theory and opposing views often reappear almost in the same terms<sup>9</sup>. Recent banking transformations have made this debate more topical than ever. During the last fifteen years, the development of private payment arrangements, technological innovation or the globalization of banking have indeed led to a growing questioning of the role of central banks on the provision of money<sup>10</sup>. More than ever, the process of money creation seems to take place primarily in private banks (Federal Reserve Bank of Chicago (1994)). Woodford (2000) discussed for example the role of monetary policy in a "world without money", that is without central bank money. With these transformations, central bank money seems to be deeply challenged by the rise of private substitutes, suggesting a privatization of money.

This thesis proposes an approach based on the "settlement asset"<sup>11</sup> function of money to try to settle between the two opposing views. More precisely, I investigate in chapter 3 the reality of the money privatization phenomenon that underlies the argument that private banks are major issuers of money in modern banking. In this view, banks can indeed create money as each commercial bank issues its own specific commercial bank money that has to be convertible into the money issued by another bank or into central bank money. This conception is notably expressed by the Bank for International Settlements in its report on central bank money (2003):

"[C]entral bank and commercial bank money coexist in a modern economy.

---

<sup>8</sup>It is in particular possible to have no private money creation in a 0% reserve system. This just implies that a bank can lend all its customers' deposits.

<sup>9</sup>Lately, opposing views were notably expressed by Wolf (2010) and Krugman (2012). According to Krugman (2012), "any individual bank does, in fact, have to lend out the money it receives in deposits. Bank loan officers can't just issue checks out of thin air; like employees of any financial intermediary, they must buy assets with funds they have on hand." He criticizes the "the usual claim" according to which "sure, this is true of any individual bank, but the money banks lend just ends up being deposited in other banks, so there is no actual *balance-sheet constraint on bank lending*". Wolf (2010) defends the opposing view: "The essence of the contemporary monetary system is creation of money, out of nothing".

<sup>10</sup>It is probably in payment systems that these changes are the most spectacular as bank activity increasingly takes place through private settlement arrangements (case of CHIPS in the United-States). Along with these transformations in payment systems, the much-discussed development of online currencies such as *Bitcoins* or *Amazon coins* has also shed the light on the prospect of a privatization of money.

<sup>11</sup>A settlement asset is an asset used for the final settlements of debts.

Confidence in commercial bank money lies in the ability of commercial banks to convert their sight liabilities into the money of another commercial bank and/or into central bank money upon demand of their clients. [...] [W]hile data are scarce, if the different components of payment chains are aggregated it is quite possible that in many cases the value of payments settling in commercial bank money exceeds that settled in central bank money " (BIS (2003)).

Chapter 3 explores whether central bank money is really challenged by the rise of private settlement assets in modern banking. To do so, I calculate for a sample of countries the share of the total value of transactions that are directly settled in central bank money. Transactions that are not settled with central bank money could potentially involve private money. I show however that if we can observe a privatization of payment arrangements, this does not imply a privatization of money as even in these systems, settlement involves central bank assets.

In chapter 4, I develop a model to investigate the consequences of these modern banking features for the provision of money and for risk propagation mechanisms. I model the conditions for a coexistence between public and private settlement assets. Private banks can indeed create money if they can issue settlement assets that can coexist with the existing medium of exchange, i.e. if the assets they issue can be accepted as substitutes for central bank money. I show that the existence of a balance-sheet constraint on bank lending is essential to determine the substitutability between assets. If the existence of such a constraint does not prevent *per se* private money creation, with this constraint, private assets cannot be accepted as perfect substitutes for central bank money. It results that public and private assets cannot coexist in the same market and that private assets can only be used in separated markets. This implies a segmentation between the markets where each settlement asset is used.

Policy implications of these mechanisms are not neutral both for central banks and for the transmission of shocks. The model emphasizes the importance of a *settlement asset channel*: the transmission channels of monetary policy and shock propagation mechanisms are indeed dependent on the settlement assets used in a monetary system. Shocks can propagate through the settlement asset. If different settlement assets are used, as in the case of a privatization of money, the propagation of a shock can be limited to the compartment where each asset is used. One can also expect that if a monetary system is segmented between public and private assets, the transmissions channels of monetary policy would be limited to the markets where central bank money is used.

The "settlement asset channel" described in the model finds a direct application in international banking. Not only central bank money seems to be challenged by the rise of private substitutes at the domestic level, but existing compartments between central bank monies are gradually diminishing with the globalization of banking, through notably the use of the US dollar as the settlement asset in global finance. During the recent financial crisis, because of the dollarization of European banks' balance sheets, shocks have propagated through this settlement asset and could not be limited to the US domestic banking system (McGuire and Von Peter (2009)). As settlement assets are

not perfect substitutes, the use of the dollar in global finance has asymmetric effects for central banks. It could reinforce the Federal Reserve with a globalization of the transmission channels of the US monetary policy. But, the dollarization of European banks could imply also that the ECB cannot perform fully its function of lender of last resort. Following the scarcity of dollar funding available internationally to financial institutions, monetary authorities have indeed realized during the crisis their dependency on the Federal Reserve for the provision of US dollars<sup>12</sup>.

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<sup>12</sup>In December 2007, the Federal Reserve began to establish of expand Swap facilities to provide dollar liquidity to fourteen other central banks . From December 2007 to July 2010, foreign central banks received more than \$10,000 billion from the the Federal Reserve (details in chapter 4).

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# Chapter 1

## House Prices Drive Current Accounts: Evidence from Property Tax Variations

*This chapter was written with François Geerolf<sup>1</sup>.*

### Abstract

We study the causal link between house prices and current accounts. Across time and countries, we find a very large and significant impact of house prices on current accounts. In order to rule out endogeneity concerns, we instrument house prices for a panel of countries, using property tax variations. A 10% instrumented appreciation in house prices leads to a deterioration in the current account of 1.7% of GDP. These results are very robust to the inclusion of the determinants of current accounts. Following a house price increase, private savings decrease, through wealth effects rather than consumer-finance based mechanisms, while non-residential investment rises through a relaxation of financing constraints for firms.

**Keywords:** Current accounts, House prices

**JEL classification:** F32, F36, F40

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<sup>1</sup>François Geerolf defended his thesis at Sciences Po in July 2013.

## Introduction

In a speech at the Annual Meeting of the American Economic Association, on January 3, 2010, Chairman Ben Bernanke presented a scatterplot showing a negative relationship between changes in current account and changes in real house prices between 2001 and 2006, in a cross-section of 20 advanced economies: "This simple relationship requires more interpretation before any strong conclusions about causality can be drawn; in particular, we need to understand better why some countries drew stronger capital inflows than others." This chapter takes up Bernanke's proposal to investigate the causal relationship between house prices and current accounts. A better understanding of the determinants of current accounts is key in many policy debates such as global imbalances, or the eurozone crisis.

We show that house prices are a key determinant of current accounts, using a new instrumental variable for house prices (property taxes), that varies across countries and time. Our identification strategy relies on the fact that property tax changes are driven by local politics rather than macroeconomics, so that they are orthogonal to macroeconomic factors which might otherwise determine the current account. To the best of our knowledge, we are the first to instrument house prices in a panel of countries. This is important, since no previous paper has been able to rule out that expected positive productivity shocks would drive both house price growth and current account deficits; or that the causality would go the other way around, from capital inflows to house price booms. In contrast, we treat very carefully the business cycle dimension of house price movements.

The IV estimation yields similar estimates as the OLS estimation: a 10% increase in house prices yields to a deterioration in the current account of 1.7% of GDP. This is an economically very large effect, as the standard deviation of house prices is 30.4% in the whole sample, while that of current accounts is 4.89% of GDP. The variance decomposition therefore displays a very high explanatory power of house prices on current accounts. Moreover, in contrast to the previous literature using OLS or VAR techniques, our sample contains the universe of available country-year data for house prices and current accounts; our conclusions are therefore valid across 34 countries and between 1970 and 2010.<sup>2</sup>

We investigate empirically which theoretical mechanisms are at the source of the causal relation between house prices and current account deficits. We decompose the current account into four components which we analyse separately: private and public savings, residential and non-residential investment. Most notably, private savings decrease, but this is not the consequence of the availability of home-equity extraction, nor of high Loan-To-Value (LTV) ratios. Non-residential investment increases more in countries where the private sector is more credit constrained, thus suggesting that firms use

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<sup>2</sup>Other papers, more theoretical in scope, also present evidence only for the last episode of the 2000s. See, Ferrero (2012), or Adam et al. (2011). In contrast, we use all available data on house prices and current accounts. For example, our OLS regression uses 833 country-year observations, and our IV regression uses 769, while existing work has relied more on less than 30 observations.

real-estate assets to obtain financing, as corporate finance with asymmetries of information suggests. This is consistent with firm-level evidence from Chaney et al. (2012).

**Related literature.** We shall not review here the very vast literature on the current account, which comprise the intertemporal approach (surveyed in Obstfeld and Rogoff (1995)) and the international real business cycles approach (Backus et al. (1992)). The theoretical mechanism behind our empirical analysis is closer to Caballero et al. (2008a), as it emphasizes the role of asset supply in shaping current account patterns. Closer to our paper, many commentators outside academia indeed have noted that the countries which experienced the worst housing booms were also those which ran current account deficits during the run-up in house prices. This observation is difficult to interpret because both house prices and current accounts can be expected to be affected by the business cycle, as the international RBC literature would suggest in particular. Some academic papers have started to address this issue more rigorously, but most explorations of the relationship are theoretical, and motivated the particular circumstances of the years 2000-2007. In Ferrero (2012), a shock to borrowing constraints is shown to be able to generate both house price increases and current account deficits. In the same theoretical vein, Adam et al. (2011) show that different expectations about asset prices can generate housing booms and current account deficits in those countries which are bullish about housing. Those are only two examples in a longer series of theoretical papers, which all use rough cross-correlation of cumulative increases in house prices and deterioration of net foreign asset positions as illustrative examples. This is also the case of Laibson and Mollerstrom (2010), in which (behavioral) asset price bubbles help explain the cross-country correlation between 2000 and 2006. There is a limited number of paper which look at the issue empirically. Aizenman and Jinjark (2009) use data from 1990 – 2005, and favor the reverse causality explanation. Their identification strategy relies mostly on Granger causality, and an instrumental strategy using real exchange rates or old dependency ratio to instrument current accounts.<sup>3</sup> The direction of causality has also started to be discussed separately for the US in the recent period : Favilukis et al. (2012) argue that changes in international capital flows played, at most, a small role in driving house price movements in the last fifteen years in the US, which is consistent with the conclusion of our paper. Some papers have also used structural VAR model for specific countries, or for a subsample of OECD economies, among which Fratzscher (2010) and Punzi (2007)). For example, Fratzscher et al. (2010) analyze the role of asset prices in comparison to other factors, in particular exchange rates, as a driver of the US trade balance. Gete (2010) shows that housing demand shocks identified in a SVAR model help to explain the trade balance in a sample of OECD economies.

**Outline.** The rest of the chapter proceeds as follows. In Section 1, we present the

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<sup>3</sup>However, one might worry that real exchange rates are endogenous to current accounts, and old dependency ratios directly affect house prices. Moreover, they cannot reject reverse causality for the US and the UK, and even suggest a consumption channel in the United States: "The US findings may be a case of a large real estate market in a large country, "driving" the business cycles...To the extent that it does, this finding might suggest that increased perceived wealth drives up prices and also drives up consumption and current account deficit." (p85-86) In this chapter, we find evidence for this channel in the average country.

database we have constructed on house prices and current accounts which, to the best of our knowledge, we are the first to use in a comprehensive way. We use HP-filtering to avoid spurious regression problems and compute HAC (heteroscedastic and autocorrelation) robust coefficients, since house prices and current accounts display some serial correlation. In Section 2, we present our OLS results, controlling for determinants which have been previously used in the literature, and using country fixed-effects. In Section 3, we present our Instrumental Variable results, which are not significantly different from OLS results. We use property taxes as an instrumental variable for house prices. We discuss very carefully exclusion restriction, which is that those property taxes do not result from macroeconomic factors. Consistent with this hypothesis, the instrumental variable we use is not correlated to GDP (see column (1) of Table 10). In Section 4, we decompose the current account between public savings, private savings, residential investment and non-residential investment to understand better the channels through which house prices impact the current account. In Section 5, we analyse different theories of house price and current-accounts comovements. In Section 6, we perform a simulation exercise to understand how far one can go towards explaining current accounts with changes in national house prices. Finally, in Section 7, we perform some robustness checks.

## 1 Data and estimation technique

**Data.** We construct a yearly house price database for 34 countries<sup>4</sup> for the period 1970-2010. We have 833 observations in total for the pair house prices / current accounts (average per country: 29 years). The data for house prices was drawn from a number of different sources<sup>5</sup>. We notably use the property price statistics from the Bank for International Settlements which cover a large number of countries but only for a short period of time. To complete the database, we then bring together data from various national sources (central banks, national statistical agencies, etc.). There are issues of comparability across time and countries of this house price data: house prices sometimes refer to the price of residential structures in several big cities only. However, house prices are very correlated in the same country as we show in Appendix D. Data for the current account are taken from the World Bank.

The main specification of our chapter is:

$$CA_{it} = \alpha H_{it} + \beta X_{it} + \delta_i + \nu_t + u_{it}.$$

$CA_{it}$  and  $H_{it}$  are current accounts and house prices of country  $i$  in year  $t$  respectively. More precisely,  $CA_{it}$  denotes the current account as a percentage of GDP.  $H_{it}$  denotes an index of real house prices (that is, deflated by the CPI), in base 1 = 2005.  $X_{it}$  are controls

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<sup>4</sup>Our sample comprises Australia, Austria, Belgium, Canada, China, Czech republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, United Kingdom, the United States.

<sup>5</sup>A precise description of the database is provided in Appendix B.

for current accounts.<sup>6</sup> Following the literature on the current accounts, we will alternatively use Public sector surplus, Initial Net Foreign Asset Position, Relative income, the square of relative income, young relative dependency ratio, old relative dependency ratio, financial deepening, an oil dummy, real interest rates, real exchange rates. Note that some of these controls are clearly endogenous variables, jointly determined with current accounts. For example, real exchange rates, relative income, or interest rates are clearly jointly determined with current accounts. However, we will use them in some regressions, in order to compare our results to the existing literature.  $\delta_i$  and  $\nu_t$  are country and year fixed-effects. Country-fixed effects are included in all the regressions of this chapter, and enable us to identify the effect of house prices on current accounts from the time-series dimension. We therefore control for any unobserved factor that may lead countries to have both high house prices and current account deficits. Country-fixed effect also control for the fact that house price indices may not be comparable across countries, so that we are only left with interpreting the difference from the country-mean. Finally, we also add year fixed-effects in robustness check tables (Table 17 to Table 22).

**Stationarity problems.** Due to data limitation on housing prices, most of the economies we consider are advanced economies. A first problem with regressing current accounts on housing prices is that current accounts have a downward trend (advanced economies tend to borrow from emerging countries on aggregate), while house prices have an upward trend. We therefore use a HP-filter with a smoothing parameter of 400 to detrend our data, to remove the very low-frequencies.<sup>7</sup> Using augmented Dickey-Fuller and Phillips-Perron tests, we can then reject the hypothesis that current account series contain a unit root. Moreover, after regressing current accounts on house prices, we can reject the null hypothesis that residuals contain a unit root at reasonable confidence intervals, for all series in which we have a sufficiently large sample. Therefore, we are confident that we do not have spurious regressions problems.

**Estimation technique.** Since both current accounts and house prices are serially correlated, we must be careful to use robust estimation procedures, or we would be over-estimating the precision of our coefficients. In this chapter, we only present standard errors which are robust to heteroscedasticity and autocorrelation (HAC). We use the Bartlett kernel-based (or nonparametric) estimator, also known as the Newey and West (1987) estimator. We use a bandwidth of 2, which leads that to the inclusion of autocovariances up to 1 lag. Note that automatic lag selection as in West (1994) is not available here since we use panel data. However our result are robust to different choices, for example inclusion of 2 lags. See Hayashi (2000) for more on GMM estimation with serial correlation.

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<sup>6</sup>A precise description of all the variables is provided in Appendix B.

<sup>7</sup>Our results carry on when using first differences instead of a HP filter. We discuss the choice of the HP filter parameter in robustness checks in Section 7. The relationship between smoothing parameter and frequency under which data is kept is  $\lambda = \frac{1}{[2 \sin(\frac{\pi}{T})]^4}$ .

## 2 OLS Results

The baseline regression yields the estimates displayed in Table 1. The correlation is very significant at the 1%. According to the simplest specification (column (1) of Table 1), an increase in house prices of 10% is associated with a deterioration of the current account of about 1.06% of GDP. The explanatory power of this regression is high:  $R^2 = 18.1\%$  with house prices alone. Moreover, adding our house price variables to usual determinants of current accounts increases the  $R^2$  by more than 13 percentage points (compare column (3) to column (2) in Table 1).

In columns (2), (3), (4) and (5) of Table 1, we follow the literature on the current account to compare the explanatory power of house prices with other variables usually put forward in the literature (see Chinn (2003) and Chinn and Ito (2007), and Obstfeld (2012) for recent references). In columns (2) and (3), we add the following variables:

- *Public surplus*. This corresponds to yearly public primary surplus, as a percentage of GDP. The intuition is that public borrowing increases overall borrowing from abroad, which can increase current account deficits. Note however that in a Ricardian world, this must be offset by more private savings.
- *Relative income* (and the square of relative income). This is a way to control for different stages of development. According to neoclassical theory, capital should flow from rich to poor countries where returns are higher.
- *Relative dependency ratio*. The young/old dependency ratio determines how much the population must save for retirement. Note however that this depends on whether the pension system is funded or pay-as-you-go.
- *Financial deepening*. It is more easy to finance current account deficits when the financial system is deep.
- *Initial net foreign asset positions*. From a buffer stock perspective, higher levels of initial net foreign assets should be associated with subsequent lower current account balances.
- *Oil dummies*. Oil exporters often build up reserves, which determines a positive current account balance - for example, Norway. Oil dummies were therefore added in current account regressions by researchers trying to assess the potency of the intertemporal approach to the current account.

However, note that many of these variables are somewhat endogenous - for example, relative income may depend a lot on whether a country is opened to trade, hence on his current account balance. A take from Table 1 is that these 8 variables explain only 4.4% of the variance in the current account, which is quite low when compared with the 17.7% explained if we add house prices.

Table 1: House prices and Current Accounts. OLS Regressions.

	(1)	(2)	(3)	(4)	(5)
	CA	CA	CA	CA	CA
<b>House Prices</b>	-10.61*** (1.068)		-9.887*** (1.461)		-8.310*** (1.272)
Public Surplus		-0.103* (0.0625)	-0.0257 (0.0580)	-0.0526 (0.0738)	0.00542 (0.0706)
Initial NFA		9.182 (9.205)	8.705 (7.485)	5.924 (9.096)	7.053 (7.783)
Relative income		-8.213 (8.186)	3.303 (7.959)	-4.603 (8.855)	3.459 (9.011)
Relative income sq.		-74.24 (201.4)	-7.868 (177.7)	-230.5 (262.6)	-111.0 (238.4)
Relative dependency ratio (Young)		-0.253 (0.255)	-0.451* (0.241)	-0.428 (0.261)	-0.715*** (0.249)
Relative dependency ratio (Old)		0.368 (0.445)	-0.0346 (0.440)	0.988** (0.473)	0.370 (0.474)
Financial deepening		0.00715 (0.00661)	0.00972* (0.00585)	0.00681 (0.00606)	0.00842 (0.00572)
Oil Dummy		-0.174 (0.816)	-0.345 (0.774)	0.341 (0.796)	0.0412 (0.773)
Real interest rates				0.139 (0.162)	0.180 (0.156)
Real exchange rates				-0.0580*** (0.0180)	-0.0310** (0.0152)
Observations	833	465	465	396	396
$R^2$	0.181	0.044	0.177	0.086	0.174

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Some of the controls are endogenous, notably real interest rates, real exchange rates and public surplus; but we include the controls which are common in the literature on current accounts.

**Pitfalls with the baseline regression.** Both current accounts and house prices are equilibrium quantities, which are jointly determined. Therefore, there are several issues with the OLS regression which prevent an interpretation of this correlation in a causal sense, from house prices to current accounts. The first issue is reverse causality: it is sometimes argued that a current account deficit could facilitate financing, hence a housing boom in a country (see references in Introduction).

Second, there is potentially an omitted variable problem, since many factors could drive both house price booms and current account deficits. For example, the expectation of a productivity shock in the country could both lead the country to borrow from abroad to finance present consumption and investment, and lead to house price appreciation, if housing supply is not perfectly elastic.<sup>8</sup> This omitted variable would lead to an overestimation of  $\alpha$  in absolute value. Another potential explanation would involve financial deregulation. This could lead at the same time to increased foreign borrowing, hence a current account deficit; while at the same time easing credit constraints on local borrowers, hence driving house prices up. This would also lead to an overestimation of  $\alpha$  (in absolute value).

Third, there is a clear problem of measurement errors in house prices. This is another

<sup>8</sup>Ownership of housing is usually tied to the ownership of land, which in most countries is available in inelastic supply.



reason to use an Instrumental Variable approach.

### 3 Instrumental Variable

A key contribution of this chapter is to propose a new instrument for house price changes. Our instrument is property taxes as a percentage of total taxes (we will also be using other scaling variables). Because of capitalization, unexpected increases in property taxes are immediately translated into a decrease of house prices. Of course, an ideal variable would be constituted by a single flat tax rate, which would be levied on all estates, differ across countries, and change over time. However, taxes are highly multi-dimensional, nonlinear, with several brackets, and exemptions below a certain threshold. We therefore use the share of revenues brought about by property taxation in total taxation of a country. These data are produced by the OECD. A very important element of our taxation series is that property taxation essentially uses fiscal values (as opposed to market values) which are rarely revised to reflect market values<sup>9</sup>. Since we will observe a negative coefficient in the first stage, this will not be an issue: if anything, the more frequent revision of fiscal values towards market values would only weaken our first stage instrumentation, and go against our results.

#### 3.1 Data

The taxation variable we use comes from OECD Revenue Statistics. We use a particular sub-heading: recurrent taxes on immovable property. This sub-heading covers taxes levied regularly in respect of the use or ownership of immovable property. Since all the details of this tax are important, let us quote the *Revenue Statistics* in full length: "these taxes are levied on land and building, in the form of a percentage of an assessed property value based on a national rental income, sales price, or capitalised yield; or in terms of other characteristics of real property, such as size, location, and so on, from which are derived a presumed rent or capital value. Such taxes are included whether they are levied on proprietors, tenants, or both. Unlike taxes on net wealth, debts are not taken into account in their assessment." As already mentioned, an important feature of the tax we use is how its tax base is assessed, and in particular that it is not endogenously affected by house prices. Otherwise, it would be difficult to measure the negative impact of tax collection on house prices. By contrast, we estimate a negative relationship between our taxation variable and house prices.<sup>10</sup> The possible dependence of our taxation variable on market prices is therefore not sufficiently important to overturn this negative correlation, and this effect, if existent, would go against our conclusions.<sup>11</sup>

<sup>9</sup>We describe in Table 26 the frequency of revision of cadastral values for our sample of countries.

<sup>10</sup>This explains why we cannot use as instrumental variable non-recurrent taxes (real estate capital gain taxes, transaction taxes) as they are endogenously affected by house prices (Table 9).

<sup>11</sup>A similar line of reasoning would argue that housing values as a basis of estate taxation are sometimes reassessed, and that this would also lead the taxation share as a function of GDP to be endogenous to house prices. However, once again, this would go against our conclusions: our instrument would be far more powerful and negatively related to house prices, if we divided it by house prices themselves.

This property taxation variable is available at OECD as an absolute amount of collected taxes, as a percentage of GDP or as a percentage of total taxation revenues. We use property taxation as a percentage of total taxation receipts, because we want to capture variations in property taxation that keep total tax receipts constant, since changes in total tax receipts could impact the current account directly through government borrowing. We discuss the issue of exclusion restriction after presenting the first stage, in section 3.3.

### 3.2 First Stage Regressions

**The 1st stage equation.** We use Two stage least squares (2SLS), with exogenous variation of real-estate property taxation  $T_{it}$  as an instrumental variable for house prices in the first stage. That is, the price of housing is given by the iteration equation:

$$H_{it} = \frac{H_{it+1}}{1+r} + R_{it}(T_{it}) - T_{it}.$$

The price of housing is the actualized resale price of housing tomorrow  $\frac{H_{it+1}}{1+r}$  plus the rental dividend  $R_{it}(T_{it})$  (either housing services provided to the owner occupying his home, or rents paid by the renter), diminished by the tax on property  $T_{it}(H_{i0})$  with  $T_{it}$  an increasing function, whose tax base  $H_{i0}$  was set at the beginning of the period 0, once and for all (as this is the case for the countries we consider). In the remaining, we drop the dependence in  $H_{i0}$ . Note that the introduction of a tax  $T_{it}$  may change rents charged by owners, if housing supply is not completely elastic. In effect, the real-estate tax reduces the number of homes constructed in equilibrium, as agents want to avoid the burden of the tax, and this increases the equilibrium rents  $R_{it}(T_{it})$ . More precisely, partial equilibrium tax incidence analysis tells us that if  $Q_{i\tau}^d(R_{i\tau})$  denotes the demand for housing at time  $\tau$  as a function of its price (rental price  $R_{i\tau}$ ), and if  $Q_{i\tau}^s(R_{i\tau})$  denotes the supply of housing, then denoting the respective demand elasticity and supply elasticity by

$$\epsilon_D = \frac{R_{i\tau} Q_{i\tau}^{d'}}{Q} \quad \epsilon_S = \frac{R_{i\tau} Q_{i\tau}^{s'}}{Q}$$

then, for small taxes, the net of tax rent is to the first order

$$R_{it}(T_{it}) - T_{it} = R_{it}(0) - \frac{\epsilon_S}{\epsilon_D + \epsilon_S} T_{it}$$

If housing supply is not completely inelastic that is  $\epsilon_S \neq 0$ , then the tax is not in the end borne by renters only, but also at least partly by proprietors. We indeed find in the data that our real estate tax has some negative effect on house prices, which means that renters do not bear all the tax. Iterating forward (and ruling out rational bubbles) yields:

$$H_{it} = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{1}{(1+r)^\tau} (R_{i\tau}(T_{i\tau}) - T_{i\tau}) = \mathbb{E}_t \sum_{\tau=t}^{\infty} \frac{1}{(1+r)^\tau} \left( R_{i\tau}(0) - \frac{\epsilon_S}{\epsilon_D + \epsilon_S} T_{i\tau} \right).$$

For the last equality, we assume that the tax is set once and for all, and that changes

are unexpected<sup>12</sup> :

$$\forall \tau \in \{t+1, t+2, \dots\}, \mathbb{E}_t T_{i\tau} = T_{it}.$$

We check in the first stage regression that this instrument is indeed related negatively to house prices, estimating the equation by least squares:

$$H_{it} = \gamma T_{it} + \delta X_{it} + \delta_i + \nu_t + v_{it}. \quad (1)$$

Table 2: Instrumental Variable Approach

	(1)	(2)	(3)	(4)	(5)
<b>1st Stage</b>	House	House	House	House	House
<b>Property tax</b>	-3.697*** (0.881)	-3.611*** (0.970)	-3.587*** (0.962)	-3.394*** (1.003)	-3.216*** (0.994)
Relative dependency ratio (young)		-0.0323*** (0.00730)	-0.0304*** (0.00773)	-0.0286*** (0.00716)	-0.0305*** (0.00760)
Relative dependency ratio (old)		-0.0111 (0.0158)	-0.00886 (0.0155)	-0.0119 (0.0157)	-0.0150 (0.0161)
Oil Dummy		0.00640 (0.0252)	0.0172 (0.0273)	0.00625 (0.0278)	-0.0107 (0.0287)
Relative income			0.178*** (0.0640)		
Relative income sq.			3.125 (7.724)		
Real exchange rates				0.00361*** (0.000693)	
Financial Deepening					0.00180*** (0.000405)
<b>2nd Stage</b>	CA	CA	CA	CA	CA
<b>House Prices</b>	-17.10*** (4.588)	-17.76*** (5.084)	-18.05*** (5.063)	-21.04*** (5.661)	-21.05*** (5.886)
Relative dependency ratio (young)		-0.268 (0.234)	-0.255 (0.227)	-0.413* (0.239)	-0.491** (0.238)
Relative dependency ratio (old)		-0.187 (0.316)	-0.167 (0.317)	-0.352 (0.348)	-0.0439 (0.350)
Oil Dummy		0.393 (0.872)	0.722 (0.898)	0.406 (0.916)	-1.174 (1.036)
Relative income			1.981 (2.412)		
Relative income sq.			-153.8 (200.4)		
Real exchange rates				0.0198 (0.0258)	
Financial Deepening					-0.0221 (0.0165)
Observations	769	599	599	575	553
Cragg-Donald	23.50	19.00	19.08	17.90	14.54

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. House Prices are an indice of house prices, normalized at 1 in 2005. CA denotes Current Account. Country fixed effects included in the regressions. All series are HP-filtered.

<sup>12</sup>For simplicity, we assume here a random walk for property taxes, but all that we need is that the process for tax changes is somewhat persistent to have an effect on house prices. In practice, we one can see that real world tax changes do have some persistence (see Figure 1 for the case of Spain).

**Magnitude of the 1st stage.** This regression leads to the estimates displayed in Table 2. Note that the orders of magnitude of the change in house prices following an increase in property taxes are very high. A 1% increase in the share of property taxation in total taxes leads to a decrease in house prices of about 3.7%. Our instrumentation is very efficient, our first stage displays large and economically significant estimates. Our T-statistic for this 1st stage is about 4.2 (higher than the Yogo rule-of-thumb), so that we do not suffer from weak instrumentation.

**What do we instrument?** Back-of-the envelope calculations suggest that a 1% increase in property taxes (as a percentage of total taxes) represents about 0.4% of GDP (assuming a tax take at 40% of GDP). However this change is known not to be permanent (perhaps for political economy reasons), because real estate taxes as a function of total taxes are not a random walk. Rather, tax cuts or rises approximately last about 5 years (estimating an AR(1) yields an autocorrelation coefficient  $\rho \simeq 0.8$ , or 2% of GDP). According to our first-stage regression estimates, and assuming rational expectations from the part of investors, a tax rise of 1% as a percentage of total taxes leads to a decrease in house prices of 3.7%, which is about 7.4% of GDP in capitalized losses (with a housing stock evaluated at 200% of GDP). There could be two explanations to this effect of taxes that goes beyond the fundamental effect. Either agents do not have rational expectations about the true data generating process governing taxes - for example taking tax changes as being permanent, even though they tend to mean-revert. Or our instrument may capture both fundamental and bubbly components of house prices<sup>13</sup>.

### 3.3 Exclusion restriction

For our instrument to introduce purely exogenous variations in house prices, property tax changes must not result from an omitted third factor, like economic conditions (GDP for example).<sup>14</sup> Our first argument in favor of exclusion restriction is that property taxes are usually set by local governments, and are not a tool used for macroeconomic policy.<sup>15</sup> And indeed, we verify empirically that business cycle factors such as GDP do not correlate at all with our instrumental variable (column (1) of Table 10). As an additional robustness check, we show that controlling for GDP (through our variable of relative income) does not alter our results in any significant way (see column (3) of Table 2). In the Appendix, we also show that controlling by other measures of GDP like GDP growth and GDP per capita yields similar results (see Table 11).

A second potential concern with using our tax variable as a percentage of total taxation is that real-estate property taxation variations could be driven by changes in the

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<sup>13</sup>It is unclear what pushes people to become bullish at the same time, but changes in taxes could be an element of this coordination. In particular, if there is competition between countries for being the locus for stores of value, taxes could be an element of this competition.

<sup>14</sup>Falling GDP could lead for example to fiscal austerity, and higher property taxes.

<sup>15</sup>It is only recently that some governments have started to use property taxes as a means to cool down housing markets (for example, Shanghai and South Korea). However, we do not use this very recent data and to the best of knowledge, such a macroprudential tool has only been used after the 2008 real estate crisis.

value of other taxes, which would affect (although mildly) the share of property taxes in total taxation. However, we check that this is not a problem. 95% of changes in our taxation measure come from an increase in the amount collected by property taxes, not from an increase in total taxes (in frequency terms). In the same line of thought, we show also in the Robustness section 7, and in particular in Table 12B, that smoothing our denominator does not alter the results in any way. In particular, we take an averaged value of total tax or we smooth total tax taking the trend component of a HP filter to remove business cycle frequencies. Moreover, we show that choosing other scaling variables for property taxes does not alter the results either.<sup>16</sup>

Finally, increases in total taxes, which correlate negatively with our instrument (column (4) of Table 10), could have effects on current accounts through increasing public surplus. However, this would go against our results, as it would both lead to current account surpluses, and be identified as increasing house prices in our sample. On the contrary, the purpose of the chapter is to show a decreasing relationship between those two variables.

**A narrative approach: the example of Spain.** A very important assumption for our IV strategy to be valid is that changes in the share of property taxation in the total taxes are uncorrelated with current accounts. We take the example of Spain where it is possible to shed light on four different property tax shocks over the last thirty years (Figure 1 and Figure 2)<sup>17</sup>. A first shock was the result of the decree law of 1979 which introduced an extensive package of measures for the reorganization of local treasuries, ranging from doubling the base of some property taxes (the Urban Land Tax) and the subsequent revision of all cadastral values. This decree law authorized gradual increases in property taxation, in particular with the law of 1983, whose consequence was a gradual decrease of house prices and an improvement of the current account. The reason for this change (reorganizing local treasuries) is likely to be orthogonal to other macroeconomic factors. A second shock was a sentence of the constitutional court of 1985 which overturned the law of 1983 and stopped the permanent increase in property taxation that had started in 1979. It resulted in an increase in house prices. Once again, it is very likely that the sentence of the constitutional court was orthogonal to other macroeconomic factors in the country. A third policy shock was the consequence of a law of 1987 which enabled local authorities to increase property tax rates. This possibility was first used in 1991 after the municipal elections. Between 1991 and 1993 local authorities showed a high level of activity, increasing rates annually from 0.588 in 1990 to 0.664 in 1993. This explains that the increase in property taxation was gradual in this period. These increasing rates were largely attributable to the absence of cadastral value revisions in this three-year period. When revisions were resumed effective 1 January 1994, we observe that the average rate went down that year to 0.658, and the house price decline stopped. Finally, the fourth policy shock was the consequence of a new tax reform at the end of 2006

<sup>16</sup>This method of using many different scaling variables is very common in the empirical finance literature, where dividends also need to be scaled, for example for estimating asset pricing equations - and where several scaling variables such as price or earnings are used to guarantee exclusion restriction.

<sup>17</sup>A precise description of the 4 shocks and of their consequences is provided in Appendix E

which was aiming at preventing tax frauds. In practice, the new law led to an increase of the local property tax (Impuesto de Bienes Inmuebles).

Figure 1: Instrument, house prices and current accounts in Spain

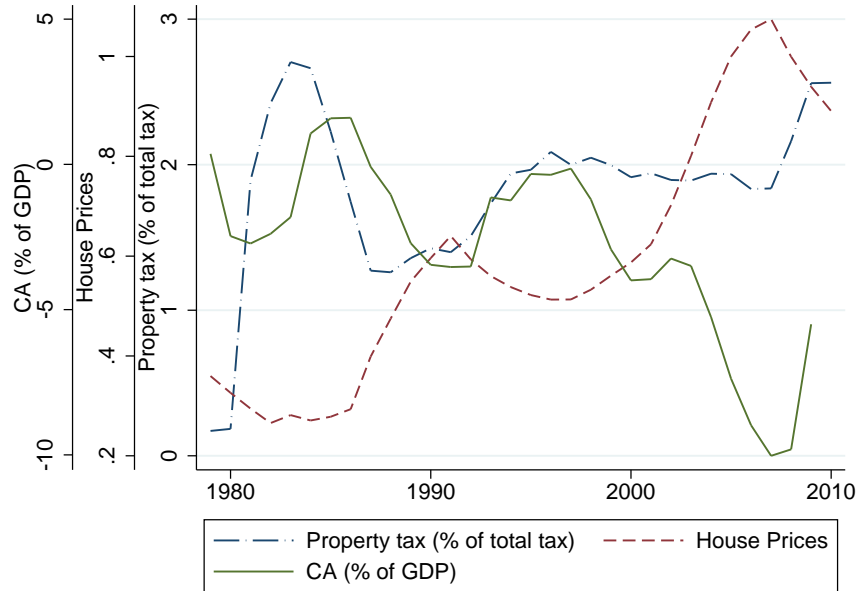
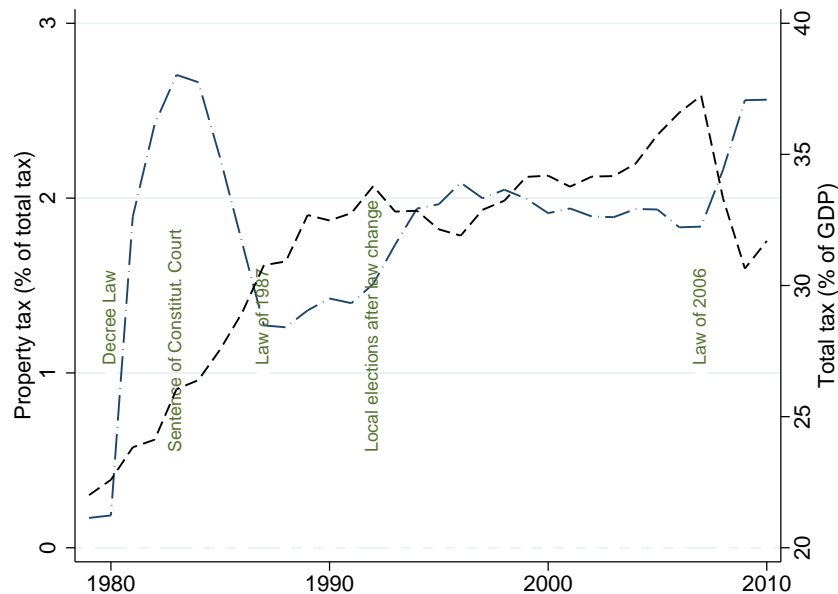


Figure 2: Property Taxes as a % of total tax (Blue), Total tax as a % of GDP (Black), and Policy shocks in Spain



**Testing for weak instrument.** We have already discussed (by means of an example) the fact that the effect of taxation on house prices is first order. We also check that the Angrist-Pischke multivariate  $F$ -test of excluded instruments is about 18, so that our

instrument is not a weak instrument.<sup>18</sup>

### 3.4 Second stage results

Using the property tax as an instrument for house prices with (1) as a first stage gives the results in Table 2. Looking at the column (1) of the 2nd stage, we get that a 10% increase in house prices yields to a deterioration in the current account of 1.7% of GDP. Note again that we present standard errors which are robust to heteroscedasticity and autocorrelation (HAC), use the Bartlett kernel-based (or nonparametric) estimator, also known as the Newey and West (1987) estimator, with a bandwidth of 2. This estimation by GMM (which for simplicity, we simply call "Instrumental Variable", even though it is a GMM generalization of IV) is not significantly different from that obtained by ordinary least squares. Comparing column (1) (2nd stage) in Table 2 with column (1) in Table 1, we interpret the increase in the coefficient with respect to OLS (in absolute value) by the fact that house prices are mismeasured and that OLS estimates are therefore biased towards 0. This suggests also that reverse causality is not at work in the data (current account deficits do not generate higher housing prices).

## 4 Decomposition of the current account

Before testing different theoretical channels for explaining the causal relation we documented, we look more carefully at the components of the current account. In particular, we decompose the current account into four components: private savings  $S_p$ , public savings  $S_g$  (which together make up for total savings  $S = S_p + S_g$ ), residential investment  $I_r$  and non-residential (business) investment  $I_b$  (which add up to total investment  $I = I_r + I_b$ ). The current account equals  $CA = S - I$ . The results are displayed in Table 3.

House prices have a causal negative impact on private savings and a positive impact on non-residential investment.

**Residential investment.** The effect on residential investment is rather muted compared to that of non-residential investment, as an increase of 10% in house prices yield to increase of the residential investment rate of about 0.46% of GDP (Column (2) of Table 3C). The IV estimate of this number is not significant, confirming that it is in any case a rather muted effect (Column (5) of Table 3C). The OLS result could be interpreted as a result of more expensive homes, which drives up construction volumes, keeping

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<sup>18</sup>Our IV strategy also passes underidentification tests (the Kleibergen-Paap rank LM statistic is 18.98 for the main specification of column (1) in Table 2), and weak identification tests Cragg-Donald Wald  $F$  statistic is 24.46, and Kleibergen-Paap Wald rk  $F$  statistic is 17.58. In the second-stage, the underidentification test Kleibergen-Paap rk LM statistic is 18.979 and the Cragg-Donald Wald identification test  $F$  statistic is 24.460, while the Kleibergen-Paap rk Wald  $F$  statistic is 17.581.

Table 3: Decomposition of the current account

	(1) OLS	(2) OLS	(3) OLS	(4) IV	(5) IV	(6) IV
<b>Table A: Current Account = Savings - Investment</b>						
	CA	Saving	Invest. .	CA	Saving	Invest.
House Prices	-10.35*** (1.136)	2.618*** (0.953)	14.07*** (1.154)	-17.66*** (5.075)	17.78*** (6.195)	38.29*** (7.543)
Observations	721	721	721	721	721	721
$R^2$	0.156	0.020	0.305			
<b>Table B: Savings = Private Savings + Public Savings</b>						
	Saving	Pr. Sav.	Pu. Sav.	Saving	Pr. Sav.	Pu. Sav.
House Prices	2.203*** (0.855)	-5.321*** (0.925)	8.375*** (1.332)	27.16*** (9.791)	-17.01*** (6.383)	46.38*** (14.38)
Observations	621	621	621	621	621	621
$R^2$	0.016	0.073	0.113			
<b>Table C: Investment = Residential + Non-residential Investment</b>						
	Invest.	R Invest.	NR Invest.	Invest.	R Invest.	NR Invest.
House Prices	11.49*** (1.046)	4.605*** (0.378)	6.829*** (0.923)	33.68*** (9.154)	1.475 (2.825)	32.17*** (9.417)
Observations	591	591	591	591	591	591
$R^2$	0.273	0.365	0.134			

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. All series are detrended using a HP-filter.

construction costs constant. For example, Spain in the 2000s witnessed a construction boom; new houses were built, often with imported capital, and that contributed to a deterioration of the current account. The take from our regressions is that this effect might be part of the story, but explains only a very thin part of it.

**Non-residential investment.** Less mechanic and more interesting is the rise in non-residential investment following house price increases. According to Column (3) of Table 3C, non-residential investment increases by 0.68% of GDP following a house price increase of 10%. Using the Instrumental Variable estimator yields a much higher estimate of 3.21% of GDP (Column (6) of Table 3C).

**Private savings.** Private savings decrease when house prices increase according to the instrumental variable specification: about 1.7% of GDP for each 10 points rise in the house price index (Column (5) of Table 3B). This is the well-known consequences of housing booms, and the much commented "wealth effect".<sup>19</sup> In light of the effect of house prices on public savings, it could also be that households are partially ricardian.

**Public savings.** Another component of a nation's savings is savings by the government. Public savings are mostly the result of a political choice, even though automatic stabilizers make public savings somewhat procyclical. The determinants of public savings are a complex issue which we do not want to examine in the main part of this

<sup>19</sup>Note however that this "wealth effect" is far from obvious theoretically, as housing is both an asset and a necessary outlay. In this respect, housing wealth is very different from stock-market wealth. Anticipating a bit, the rise of consumption following increases in housing wealth could be interpreted as an evidence for a rational bubble.



chapter ; we however give some insights in the section 7.

## 5 The role of credit constraints

Our data enables us to test two different channels through which house prices affect current accounts.

Table 4: Consumer and firm credit constraints

<b>Table A</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	CA	CA	CA	CA	CA	CA	CA
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(IV)	(IV)
House Prices	-13.93*** (1.999)	-11.55*** (1.528)	-18.21** (7.571)	-12.07*** (1.560)	-11.18*** (1.684)	-17.20** (8.702)	-101.9 (314.3)
House*LTV			0.0622 (0.0880)				
Observations	416	417	604	500	333	416	353
$R^2$	0.261	0.340	0.275	0.365	0.281		
LTV	< 80%	> 80%				< 80%	> 80%
Extraction				No	Yes		

<b>Table B</b>	Invest.	R Invest.	NR Invest.	Invest.	R Invest.	NR Invest.
	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)
House Prices	7.017*** (2.080)	5.103*** (1.313)	1.935 (1.906)			
House*1/PCGDP	581.6*** (190.4)	50.76 (86.90)	529.3*** (174.9)	3,513*** (879.9)	123.9 (308.1)	3,371*** (928.0)
Observations	664	664	664	664	664	664
$R^2$	0.477	0.429	0.354			

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and year fixed-effects are included. For LTV ratios, the threshold we use (80%) is the median.

The first channel is the consumer-financing channel. Many papers in the literature have emphasized the potential role of borrowing constraints for driving both an increase in foreign borrowing and a run-up of house prices. According to these papers, in the 2000s, the US experienced a decrease in credit constraints. At the same time, houses saw their collateral value increase and the United States borrowed more to the rest of the world.<sup>20</sup> Interestingly, our data enables us to test whether the relaxation of borrowing constraints might have triggered current account deficits, together with an increased value of housing collateral (for its collateral services). We use measured maximum Loan-to-Value (LTV) ratios and show the relationship between current accounts and house prices is no higher in countries with high LTV ratios than those with low LTV ratios.

<sup>20</sup>Note that there are theoretical issues to this explanation: it is unclear why constrained consumers, or investors, could not previously sell their house for the whole of their value, instead of buying a home and then use this home as collateral. In Ferrero (2012), as well as other papers of the like, in particular Iacoviello (2005), there is no such issue since homeownership is necessary for consuming housing services - there are no renters. Second, financial liberalization started in the 2000s, but the relationship between house prices and current accounts is not confined to the last boom, or to advanced economies, so that this explanation cannot be an explanation for the correlation before that.

According to the estimated displayed in columns (1) to (3) of Table 4A, and (6)-(7) of Table 4A, whether a country has low LTV or high LTVs makes no difference to the correlation. In columns (4)-(5) of Table 4, we show that the availability of home-equity extraction does not increase the relationship between those two variables either. The consumer-financing channel does not seem to be a feature of our data.<sup>21</sup>

A second channel is the firm-financing channel. We test whether rising housing values help relaxing financial constraints for firms<sup>22</sup>. In order to assess whether investment rises more with house prices where financial constraints are more stringent, we use as a proxy for the potential tightness of credit constraints, the ratio of private credit to GDP. This is a standard measure of financial development in the finance-and-growth literature, and provides substantial time-series and cross-sectional variation in our panel (Aghion et al. (2010)). We construct an interaction variable between house prices and the ratio of private credit to GDP. The simultaneous influence of two variables is significant for total investment and non-residential investment, as columns (1) and (3) of Table 4B show in OLS and columns (4) and (6) of Table 4B show using IV. These results confirm that the effect goes through a relaxation of financing constraints for firms. It is interesting to notice that the interaction variable is not significant in explaining residential investment. Since it is not construction firms who are the final investors in residential structures, it does not matter whether construction firms are financially constrained. Furthermore, this is consistent with the fact that houses are much less entrepreneur-specific investments, and that information asymmetries creating the need for collateral are quantitatively very low in housing investment. One can compare our estimate to other estimates found in particular through microeconomic studies of firm investment, as in Chaney et al. (2012): in their study, the representative US corporation invests \$0.06 out of each dollar of collateral. If 10% of house price increases corresponds to 20% of GDP of collateral because the housing stock is equal to 2 times GDP, then Chaney et al. (2012)'s estimate would predict a macroeconomic effect on investment of about 1.2% of GDP, which is the same order of magnitude as both our OLS and our IV estimators.

## 6 Simulating Current Accounts

Movements in house prices can be due to many factors - risk aversion, expectational shocks (bubbles), etc. Taking these movements as given, we can recover the current account patterns which would be generated by our very parsimonious linear model. An argument in favour of considering house prices as the source of exogenous shocks is that

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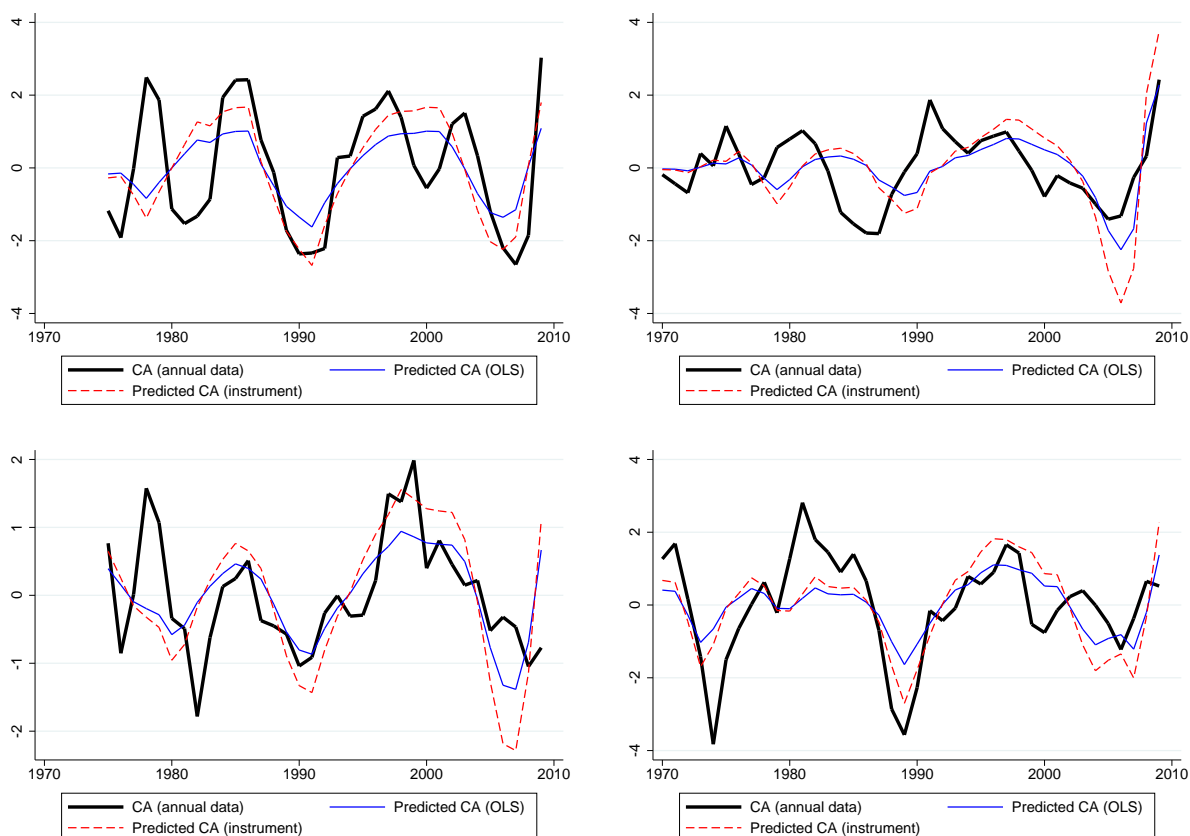
<sup>21</sup>The fact that home-equity extraction funds have been shown to be used for consumption in many microeconomic studies does not contradict our results in principle. Availability of home-equity extraction could just push more people into becoming homeowners even though they have high discount rates. These would have consumed nonetheless.

<sup>22</sup>Note however that this explanation does not explain jointly the rise in house prices and current account deficits, but only the fact that rising housing prices lead to current account deficits. In order to explain jointly the rise of house prices and current account deficits as in Ferrero (2012), one would need to assume that there was a firm-financing liberalization shock, which authorized more firms to take on loans backed by housing collateral.

taking Ordinary Least Squares or Instrumental Variable estimates yields very comparable estimates. There does not seem to be much more to the relationship between house prices and current accounts than these shocks to house prices.

The results of this simulation exercise are summarized in Figure 3. For most countries, and in particular those which have been at the center of very important policy debates recently, such as Spain, France, Germany, the UK and the US, predicted patterns of the current accounts match actual ones reasonably well.

Figure 3: Simulated current accounts and actual ones for Spain, the United States, France, and United Kingdom



**Notes:** Predicted CA (OLS) is calculated using column (1) of Table 1. Predicted CA (instrument) is calculated using column (1) of Table 2. The top-left panel is for Spain, the top-right for the United States, the bottom-left is for France, and the bottom-right for United Kingdom. All series are HP filtered.

## 7 Robustness checks

For the sake of brevity, tables corresponding to robustness checks are in the Appendices.

**Granger causality.** In this chapter, we have used an instrumental variable approach to alleviate the issues of endogeneity and omitted variables. We also check in this section that Granger causality tests confirm that house prices cause current accounts and not

the other way around. Table 5 shows that fitting simple VAR with either 1 lag or 2 lags<sup>23</sup> confirm this result: a positive shock to house prices does cause a deficit in the current account in the period after (columns (1), (3) and (5)) while capital inflows ( a negative shock to CA ) does not cause increases in house prices as can be seen in columns (2), (4), (6). One may note a very small effect of the second lag of capital inflows (only significant at 10%), but which goes in the other direction. Once again, the view that capital inflows cause housing bubbles seem refuted by the data. We have not pursued this empirical strategy in the remainder of the chapter, even though it seems to yield the same conclusions qualitatively, because Granger causality is not *strictly* causality, and more importantly because the coefficients are impossible to interpret quantitatively. Since a very important take from our paper is that the house price variable we introduce is a very good predictor of Current Accounts, VAR techniques clearly would not lead us as far as the instrumental variable. We check also that our instrumental variable causes house prices. Table 6 confirms that property taxes cause house prices and not the other way around.

**Public savings.** In Table 7, we analyse more precisely why house prices are strongly positively correlated to public savings, and even cause an increase in public savings (see column(6) of Table 3B). Since public savings are less the results of market forces, investigation into the issue is more tentative. Our data seems to point to an effect of house prices through investment then unemployment<sup>24</sup>. We have established in section 5 that non-residential investment increased more consecutive to house price increases when countries were more financially constrained: this is reminded in column (2) of Table 7A. Using then our property tax as an instrument for investment in column (3) of Table 7A points to a decrease in unemployment following investment booms. In column (3) of Table 7B, we show that less unemployment is also associated with less spending by the government, which is intuitive, as a big part of welfare state entitlements come from unemployment benefits. This is reflected into overall government savings in column (2) of Table 7B. To sum up, our data explains the pro-cyclicality of public savings with respect to housing booms by an increase in investment leading to a decrease in unemployment. In contrast, when housing prices go down, investment also plunges because financial frictions increase and unemployment increases.

**Falsification tests.** In Table 8 and 9, we perform falsification tests using other taxes available from the OECD to instrument house prices. Since those taxes are not (in principle) related to housing, we should not be getting anything out of these exercises, which is what we verify in Table 8. In Table 9, we show that most other tax takes related to housing are positively correlated to housing prices. As housing prices go up, these tax takes mechanically increase. It is therefore not possible to isolate the negative impact that tax rates shocks have on housing prices. Once again, fiscal values used for property taxation are seldom revised, which enables us to estimate the negative effect tax rates

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<sup>23</sup>To determine the number of lags, we use the Akaike Information Criterion (AIC) and the Schwarz' Bayesian Information Criterion (SIC/BIC/SBIC). For most countries, they indicate 2 lags.

<sup>24</sup>We investigate more fully this mechanism in Chapter 2.

shocks have on housing prices.

**Examining exclusion restriction: more specifications.** As already discussed previously, we show in Table 10 that GDP is not correlated with the property tax. In fact, measures of property taxation as a percentage of the total tax (column (1)) or as a percentage of GDP (column (2)) do not correlate with the GDP. So changes in property taxes do not have to do with the economic outlook. We show also that an increase in our instrumental variable does not imply increasing government revenues. Indeed, our property taxation variable correlates negatively with total tax revenues (column (4)).

**Controlling by different measures of GDP.** Our results do not depend on the measure of GDP used. In most tables, we control with relative income as it is the variable commonly used in the literature (notably in Chinn (2003) and Chinn and Ito (2007)). But our results are robust to other measures of GDP. In Table 11, we show that we could have controlled by real GDP, real GDP per capita or GDP growth without changing the results of our instrumental strategy.

**Other scaling variables.** In Table 12A, we show that using as an instrumental variable the share of property taxation as a percentage of GDP instead of using the share of this tax as a percentage of total taxes does not change the results. The results are also robust if we measure the property tax with other scaling variables, such as investment (column (2)) or private consumption (column (3)). In Table 12B, we show also that smoothing total tax does not alter the results. In particular, we take an averaged value of total tax (column (1)). We smooth also total tax using the trend component of a HP filter. For robustness we check with parameters 10 and 100 that are commonly used to remove business cycle frequencies (columns (2) and (3)) with yearly data (Ravn and Uhlig (1997)). Finally, we use as scaling variable an averaged value of the property tax (column (4)).

**Other asset prices.** One could wonder whether the negative relationship we uncover would not be true for other types of assets. In Table 13, we show that this correlation is not valid for equity prices. We use two variables to measure share prices. The first measure is Market capitalization (also known as market value). It is the share price times the number of shares outstanding as a percentage of GDP (source: WDI). The correlation between market capitalization and house prices is not significant (column (1) of Table 13). There is a slight difference when we use instead the other measure, Share prices (source: OECD). We find a very small negative relationship between share prices and current account variations, only significant at 10% (column (2) of Table 13). This very slight significance can itself be explained by the very strong correlation between house prices and share prices (column (3) of Table 13). If we first take the residual of the regression between houses price and share prices, and if we then run the regression between this residual and the current account, the relationship disappears. Intuitively, this fact can certainly be rationalized by the fact that contrary to most other assets, houses are geographically located assets. In contrast, differences in world share prices are arbitrated away in international capital markets. While share price cycles are strongly

correlated at the world level, house prices are much less correlated: regressing share prices over year fixed effects in a panel of countries yields to a  $R^2$  of 64%, while the same regression yields to a  $R^2$  of only 31% for house prices.

**Choice of HP filter parameter.** The relationship we uncover in this chapter is robust to several specifications of the cutoff frequency. Table 14 displays the result of our basic specification using different values for the HP-parameter. Any HP-filter parameter in the range 10 – 1600 yields the same results with very good confidence intervals. There is some disagreement in the literature as to which filter to use for frequencies different from quarterly data - for quarterly data, a common practice in the literature is to use a parameter of 1600. We have used 400, as in Tomz and Wright (2007). Our results are robust to other lower proposed values of 6.25 (Ravn and Uhlig (1997)), 100 in Backus (1992) or higher, such as 1600. Note that this is not very important here, as we are interested only in first moments, not in second moments, for which the choice of the HP filter is more crucial - this is in fact, what the discussion in Ravn and Uhlig (1997) is all about - notably Backus (1992)'s claim that output volatility had increased after the Second World War. When choosing our smoothing parameter, we have only two requirements in mind: that it be not too small, because we are interested in medium term patterns of the data (not only those that occur at the quarterly frequency) - that is why we do not take up propositions in the lower range, and that it be not too high, because we want to remove the trend from the data (the lower frequencies) - long run growth, which we do not seek to explain - and because we do not want our series to be non-stationary, which would cause problems of spurious regressions.

**Country groupings.** We also test whether the relationship we uncover in this article is specific to a certain type of countries, or whether it is robust across groups of very different countries. As Table 15 shows, the relationship is robust. The relationship is true in Euro or non-Euro countries (columns (2) and (3) of Table 15), and in low-income and high-income countries (columns (4) and (5)). This is also important as previous determinants of the current accounts were often specific to advanced or developing countries. Moreover, it is important to check for robustness that excluding several countries does not change the results in a significant way.

**Credit constraints: further regressions.** In Table 16, we run more regressions to examine the robustness of our findings in section 5. In columns (7) and (8) of Table 16A, we show that private savings are not more correlated to house prices in countries with high LTV ratios than in countries with low LTV ratios, further undermining consumer-financed based explanations of the correlation. In Table 16B, we check if our results on firm-credit constraints and collateral are robust to the inclusion or exclusion of country- and year- fixed effects.

**Year fixed-effects.** We did not include year-fixed effects in the baseline regression because we do not have the full sample of countries in our dataset.<sup>25</sup> But results and

<sup>25</sup>These fixed effects would capture the current account that our sample countries collectively run with the rest of the world. When house prices in our sample are above trend on average, we can capture that our sample countries are running deficits with the rest of the world.

comments of previous sections are robust to the inclusion of year fixed-effects (Table 17 to Table 22). For example, a 10% (instrumented) appreciation in house prices leads to a deterioration of the current account of  $-2.4\%$  (table 17, column (8)). First stage regressions of the instrumental strategy are also very robust to the inclusion of year fixed effects. A 1% increase in property taxes is associated with a depreciation of house prices of  $-1.9\%$  (table 19, column (2)). In the second stage of the IV strategy, the regressions are still very robust even with the inclusion of the current account controls and with year fixed effects (table 20, columns (4),(6), (8) and (10)). In tables 21 and 22, we check that our instrumental variables strategy is robust for explaining investment and saving with the controls and fixed effects. For instance, the second stage instrumental regressions are very robust for explaining investment even with the inclusion of the current account controls and with year fixed effects (table 21, columns (4), (6), (8) and (10)). In particular, 10% (instrumented) appreciation in house prices leads to an increase of investment of  $4.7\%$  (columns (4) and (6)).

**Frequency of revision of cadastral values.** In Table 23, we show that our results do not depend on the frequency of revision of cadastral values. In particular, the negative relationship between house prices and the property tax (first stage of the instrumental strategy) is no weaker in countries where fiscal values are reassessed at least every five years.

**Decades.** In Table 24, we show that our results are valid all over the last 40 years, and in each decade. House prices have a causal effect on current accounts not only in the last housing cycle (column (6)), but also in the nineties (column (5)), and before 1990 (column (4)).

**Real Exchange Rates.** In Table 25, we show that capital inflows driven by house prices could lead to exchange rate appreciation. This explains that house price increases are positively correlated with exchange rate appreciations (column (2)), and that in the IV, real exchange rates are not significant in explaining current accounts (column (1)). Granger causality tests confirm that house prices cause real exchange rate fluctuations (column (3)).

## Conclusion

In this chapter, we establish that house prices are an important factor in the determination of current accounts, probably the variable with the largest explanatory power of current accounts over the last 40 years. Our new instrumental variable for house prices allows us to control for potential reverse causality or omitted variable problems. An instrumented increase in 10% of house prices leads to a deterioration in the current account of 1.7% of GDP. Not only are house prices strongly significantly correlated to current accounts, and the coefficient precisely estimated; but this point estimate is economically very large, suggesting that house prices are the main factor determining current accounts.

We investigate empirically which theoretical mechanisms are at the source of this causal relationship. We decompose the current account into its components that we can analyse separately. Private savings decrease following house price increases, but consumer-financing explanations are not consistent with the data, as this effect is not greater in countries where financing is easier. In contrast, we show a large increase of non-residential investment following house price increases, which we demonstrate goes through a collateral effect. Housing collateral therefore plays a big role in driving the correlation between house prices and investment, confirming the predictions of Caballero and Krishnamurthy (2006) in particular.

We then simulate current accounts. Taking house price shocks as given enables to recover extraordinarily well movements in current accounts. There are many reasons to think that house prices could have a life of their own: changes in risk aversion, in the stochastic discount factor, etc. Among other stories, our results are consistent with a view of (country-specific) expectational shocks on housing as a driving force for changes in asset supply. Real-estate bubbles are both theoretically plausible, as short-sales constraints are very high on real-estate, so that pessimists are at corner and cannot express a negative opinion (as in Harrison and Kreps (1979)); and a potential participant in banking crises (see Reinhart and Rogoff (2008)). The relationship between increases in asset supply and current account deficits would then be similar to Caballero et al. (2008a), in which a decrease in asset supply a China (corresponding to a relative increase in asset supply in the United States) leads to current account deficits in the United States.<sup>26</sup> Similarly, country-specific house price bubbles could increase asset supply which leads to deficit. Bubbles would move from one real-estate market to the next, as in Caballero et al. (2008b), leading to capital flows. Those bubbles would decrease private savings, as in Tirole (1985); and increase investment through alleviating financial constraints as in Farhi and Tirole (2011).

The policy implications of our results are potentially important. Current account imbalances were on top of the macroeconomic research agenda in the year 2000s, when the US were running unprecedented current account deficits (up to 6% of GDP). If once admits that house prices had overshooted their long-run level by about 20% (this is a rather conservative estimate), then our results would suggest that house prices contributed to these deficits up to 3.4% of GDP. But after the financial crisis, understanding the determinants of the current account is no less central (see Obstfeld (2012)). In particular, since current account capital flows have shown to be a major destabilizing factor in the fate of the euro, we believe our paper can bring important insights in the context of the Eurozone crisis.

Finally, the welfare implications of potential house price bubbles are not clear. While rational bubbles solve the problem of dynamic inefficiency (as in Tirole (1985)), housing bubbles can come at cost, triggering capital flow reversals as in Caballero and Krishnamurthy (2006). This is an interesting route for future empirical and theoretical research.

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<sup>26</sup>It is very important for this result that the environment be non Ricardian, or an increase in asset supply would lead to an offsetting increase in asset demand.



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## A Tables : Robustness checks

Table 5: Granger causality

	(1) CA	(2) House Prices	(3) CA	(4) House Prices	(5) CA	(6) House Prices
Current Account (L1)	0.435*** (0.0976)	0.000322 (0.00132)	0.466*** (0.0942)	-0.000595 (0.00125)	0.365*** (0.0586)	0.00171 (0.00122)
Current Account (L2)	-0.160 (0.103)	0.00154 (0.00134)	-0.174* (0.102)	0.00208* (0.00123)		
House Prices (L1)	-10.82*** (2.809)	1.278*** (0.0515)	-9.981*** (2.883)	1.189*** (0.0496)	-6.040*** (1.344)	0.780*** (0.0385)
House Prices (L2)	5.733** (2.816)	-0.630*** (0.0530)	4.961* (2.849)	-0.547*** (0.0466)		
Observations	673	673	673	673	697	697
$R^2$	0.276	0.727	0.335	0.780	0.291	0.682
Country FE	No	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes

**Notes:** Robust standard errors are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Series are HP filtered.

	(1) Saving	(2) House	(3) Saving	(4) House	(5) Investment	(6) House	(7) Investment	(8) House
Saving (L1)	0.774*** (0.0455)	0.000386 (0.00147)	0.786*** (0.0461)	0.00190 (0.00147)				
Saving (L2)	-0.382*** (0.0440)	0.00259 (0.00162)	-0.328*** (0.0460)	0.00291* (0.00158)				
House Prices (L1)	5.127*** (1.063)	1.266*** (0.0491)	2.745** (1.066)	1.179*** (0.0453)	13.95*** (1.606)	1.270*** (0.0578)	9.455*** (1.465)	1.165*** (0.0533)
House Prices (L2)	-7.222*** (1.220)	-0.645*** (0.0518)	-3.683*** (1.176)	-0.562*** (0.0430)	-13.75*** (1.520)	-0.642*** (0.0550)	-8.514*** (1.368)	-0.554*** (0.0471)
Investment (L1)					0.640*** (0.0614)	0.000839 (0.00158)	0.706*** (0.0586)	0.00263* (0.00159)
Investment (L2)					-0.263*** (0.0611)	-0.000608 (0.00177)	-0.263*** (0.0628)	-0.00128 (0.00160)
Observations	673	673	673	673	673	673	673	673
$R^2$	0.468	0.728	0.575	0.783	0.516	0.725	0.631	0.780
Country FE	No	No	Yes	Yes	No	No	Yes	Yes
Year FE	No	No	Yes	Yes	No	No	Yes	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Series are HP filtered.

Table 6: Granger causality (Cont.)

	(1)	(2)	(3)	(4)
	Property Tax	House Prices	Property Tax	House Prices
Property Tax (L1)	0.892*** (0.0649)	-0.00758** (0.00356)	0.638*** (0.0693)	-0.0107** (0.00446)
Property Tax (L2)	-0.373*** (0.0502)	0.00226 (0.00300)		
House Prices (L1)	-0.364 (0.302)	1.195*** (0.0456)	0.192 (0.198)	0.754*** (0.0341)
House Prices (L2)	0.466* (0.255)	-0.570*** (0.0433)		
Observations	673	673	697	697
R-squared	0.552	0.779	0.471	0.684
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Series are HP filtered.

Table 7: House Prices, Unemployment and Public Saving

<b>Table A</b>	(1)	(2)	(3)
	Unemployment (2sls)	Investment (2sls)	Unemployment (2sls)
House Prices	-35.01*** (10.65)	35.85*** (11.12)	
Investment			-0.976*** (0.157)
Observations	523	523	523

<b>Table B</b>	(1)	(2)	(3)	(4)
	Unemployment (OLS)	Public Saving (OLS)	Public Spending (OLS)	Public Revenue (OLS)
Investment	-0.486*** (0.0439)			
Unemployment		-0.661*** (0.0584)	0.626*** (0.0823)	-0.103* (0.0552)
Observations	523	523	523	523
$R^2$	0.528	0.617	0.562	0.148

**Notes:** HAC robust standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). Country fixed-effects included. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. We develop the links between house prices and unemployment in Chapter 2.

Table 8: Falsification tests I

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Table A: Second-stage of the Instrumental Variable Strategy</b>						
	CA	CA	CA	CA	CA	CA
First-stage Tax	Property	Income	Social Secu.	Payroll	Goods/Services	Other
House Prices	-23.15*** (8.647)	52.37 (51.76)	21.59 (18.39)	-176 (331.1)	-1.558 (56.927)	1.278 (11.89)
Observations	769	769	769	769	769	769
<b>Table B: First-stage of the Instrumental Variable Strategy</b>						
	House	House	House	House	House	House
Tax	Property	Income	Social Secu.	Payroll	Goods/Services	Other
	-0.0196*** (0.00716)	0.00279 (0.00207)	-0.00582* (0.00299)	-0.00241 (0.00488)	7.41e-05 (0.00274)	-0.0156** (0.00758)
Observations	769	769	769	769	769	769

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and Year-fixed effects are included.

Table 9: Falsification tests II

	(1)	(2)	(3)	(4)
	House	House	House	House
	(2sls) 1st stage	(2sls) 1st stage	(2sls) 1st stage	(2sls) 1st stage
Tax	Property	Capital gains	Transactions	Inheritances
	-0.0184*** (0.00701)	0.0484*** (0.00913)	0.0696*** (0.00939)	0.0167 (0.0254)
Observations	734	734	734	734

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and Year-fixed effects are included.

Table 10: Examining exclusion restriction

	(1)	(2)	(3)	(4)
	Property (/total tax)	Property (/GDP)	Property (/GDP)	Total tax (/GDP)
	(OLS)	(OLS)	(OLS)	(OLS)
GDP	-0.00285 (0.00187)	-0.000419 (0.000572)		
Property (/total tax)			0.286*** (0.0167)	-0.555*** (0.170)
Observations	757	757	757	757
R <sup>2</sup>	0.008	0.005	0.785	0.037

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included. Series are HP filtered. "Property" denotes the property tax.

Table 11: Controlling by different measures of GDP

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	House	House	House	House	CA	CA	CA	CA
	(IV: 1st st.)	(IV: 1st st.)	(IV: 1st st.)	(IV: 1st st.)	(IV: 2nd st.)	(IV: 2nd st.)	(IV: 2nd st.)	(IV: 2nd st.)
Property tax	-3.038*** (0.917)	-3.219*** (0.981)	-3.474*** (1.047)	-1.954** (0.821)				
Relative income	1.547*** (0.201)				9.698 (12.07)			
GDP		0.00353*** (0.000434)				0.00457 (0.0241)		
GDP growth			0.0378** (0.0180)				0.701 (0.457)	
GDP per cap.				4.34e-05*** (5.95e-06)				0.000630 (0.000556)
House Prices					-20.82*** (6.482)	-19.66*** (5.898)	-20.95*** (5.608)	-26.45** (11.24)
Observations	665	593	592	593	593	593	592	593

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects are included in the regressions. Series are HP-filtered (except GDP growth).

Table 12: Other scaling variables

	(1)	(2)	(3)	(4)	(5)	(6)
Table A	House prices (1st st.)	House prices (1st st.)	House prices (1st st.)	CA (IV: GDP)	CA (IV: Invest.)	CA (IV: Cons.)
Property tax (/GDP)	-0.0910*** (0.0264)					
Property tax (/Invest.)		-2.713*** (0.404)				
Property tax (/Cons.)			-6.224*** (1.702)			
House Prices				-18.87*** (5.490)	-24.75*** (3.317)	-25.78*** (5.474)
Observations	766	766	766	766	766	766

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Table B	House (1st st.)	House (1st st.)	House (1st st.)	House (1st st.)	CA (IV:Tot.tax mean)	CA (IV:Tot.tax sm. 100)	CA (IV:Tot.tax sm. 10)	CA (IV:Property mean)
Property/(Tot. tax mean)	-0.0817*** (0.0250)							
Property/(Tot. tax sm.a)		-0.113** (0.0549)						
Property/(Tot. tax sm.b)			-0.245** (0.0982)					
Property/(Property mean)				-0.00308*** (0.000694)				
House Prices					-27.63*** (9.728)	-38.63** (18.07)	-21.00** (8.330)	-15.08*** (2.058)
Observations	719	719	719	719	719	719	719	719

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country-fixed effects are included. All series are HP-filtered. In Table A, the property tax variable is measured as a % of GDP, as a % of investment, as a % of consumption, etc. In Table B, "Tot. tax smo." indicates that total tax is smoothed with the trend component of a HP filter ("a","b" indicates a filter of 100 and 10 respectively). Total tax (mean) and Property (mean) are calculated as the moving average of Total tax and Property with a 10-year period.



Table 13: Share prices and current accounts?

	(1) CA (OLS)	(2) CA (OLS)	(3) Share Prices (OLS)	(4) CA (OLS)
Market cap.	0.00752 (0.0102)			
Share prices		-0.0216* (0.0118)		
House Prices			36.05*** (8.300)	
Res. Share				-0.0101 (0.0113)
Observations	517	517	517	517

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and Year-fixed effects are included. "Market cap." is market capitalization.

Table 14: Other HP filters

Smooth. parameter	(1) CA 1600	(2) CA 400	(3) CA 100	(4) CA 25	(5) CA 10
	<b>Table A: OLS</b>				
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices	-9.336*** (0.937)	-10.62*** (1.068)	-11.26*** (1.236)	-11.59*** (1.478)	-11.19*** (1.648)
Observations	833	833	833	833	833
	<b>Table B: IV</b>				
	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)
House Prices	-20.19*** (6.438)	-17.10*** (4.587)	-14.97*** (4.047)	-13.48*** (4.094)	-13.04*** (4.549)
Observations	769	769	769	769	769

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed-effects included.

Table 15: Country Groupings

	(1)	(2)	(3)	(4)	(5)
	CA	CA	CA	CA	CA
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices	-7.734*** (1.657)	-5.426** (2.190)	-10.29*** (2.579)	-5.283*** (1.475)	-11.35*** (2.617)
Public Surplus	0.0599 (0.0884)	0.0803 (0.0817)	0.0892 (0.106)	0.0600 (0.0629)	0.0615 (0.161)
Relative income	0.912 (10.18)	-1.087 (7.028)	2.536 (13.77)	-16.71** (7.597)	4.480 (16.66)
Relative income sq.	-35.78 (228.6)	-643.2*** (194.8)	232.2 (258.4)	-47.70 (257.6)	-190.0 (273.8)
Relative dependency ratio (Young)	-0.585** (0.244)	-0.695** (0.275)	-0.450 (0.357)	-0.710*** (0.202)	-0.976 (0.617)
Relative dependency ratio (Old)	0.792* (0.451)	1.328*** (0.458)	0.268 (0.847)	0.681 (0.558)	1.149* (0.634)
Financial deepening	0.0107 (0.00831)	0.0227*** (0.00601)	0.00113 (0.0124)	0.0179** (0.00744)	0.00754 (0.0127)
Oil Dummy	0.267 (1.059)		0.0153 (1.838)	0.278 (0.951)	1.381 (1.038)
Real interest rates	0.109 (0.170)	-0.199 (0.169)	0.396** (0.190)	0.115 (0.152)	0.275 (0.348)
Real exchange rates	-0.0381*** (0.0138)	-0.0643* (0.0331)	-0.0462*** (0.0152)	-0.0434** (0.0169)	-0.0622** (0.0289)
Observations	402	170	232	201	201
$R^2$	0.254	0.533	0.265	0.524	0.309
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Euro Countries		Yes	No		
High income Countries					Yes
Low income Countries				Yes	

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and Year-fixed effects are included. Series are detrended with a HP-filter. In our sample, Euro countries are Austria, Belgium, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Slovakia, Slovenia, Spain. High (low) income Countries are countries where GDP per capita is higher (lower) than the median of the sample.

Table 16: Consumer and firm credit constraints: more specifications

<b>Table A</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	CA	CA	CA	CA	CA	CA	Private Saving	Private Saving	Consumption	Consumption	CA	CA
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(2sls)	(2sls)
House Prices	-12.03*** (1.239)	-13.93*** (1.999)	-11.55*** (1.528)	-18.21** (7.571)	-12.07*** (1.560)	-11.18*** (1.684)	-6.066*** (1.273)	-6.358*** (1.289)	14.42*** (2.132)	18.73*** (2.544)	-17.20** (8.702)	-101.9 (314.3)
House*LTV				0.0666 (0.0860)								
Observations	833	416	417	604	500	333	367	273	384	409	416	353
$R^2$	0.258	0.261	0.340	0.280	0.365	0.281	0.277	0.436	0.469	0.492		
LTV		< 80%	> 80%				< 80%	> 80%	< 80%	> 80%	< 80%	> 80%
Extraction					No	Yes						

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and year fixed-effects are included. "Consumption" is indexed 2005=100 and in real terms.

<b>Table B</b>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	CA	CA	Invest.	Invest.	R Invest.	R Invest.	NR Invest.	NR Invest.	CA	Invest.	R Invest.	NR Invest.
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(2sls)	(2sls)	(2sls)	(2sls)
House Prices	-0.371 (2.089)	-1.593 (2.129)	7.983*** (2.554)	7.017*** (2.080)	5.579*** (1.379)	5.103*** (1.313)	2.370 (2.175)	1.935 (1.906)				
House/PCGDP	-938.7*** (209.3)	-931.6*** (191.1)	547.8** (218.0)	581.6*** (190.4)	-7.756 (87.33)	50.76 (86.90)	556.6*** (187.4)	529.3*** (174.9)	-1,913*** (710.3)	3,513*** (879.9)	123.9 (308.1)	3,371*** (928.0)
Observations	710	710	664	664	664	664	664	664	664	664	664	664
$R^2$	0.201	0.266	0.318	0.477	0.327	0.429	0.174	0.354				
Country FE	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

Table 17: Decomposition of the current account with Year Fixed Effects

	(1) OLS	(2) OLS,Y	(3) OLS	(4) OLS,Y	(5) OLS	(6) OLS,Y	(7) IV	(8) IV,Y	(9) IV	(10) IV,Y	(11) IV	(12) IV,Y
<b>Table A: Current Account = Savings - Investment</b>												
	CA	CA	Saving	Saving	Invest.	Invest.	CA	CA	Saving	Saving	Invest.	Invest.
House Prices	-10.35*** (1.136)	-12.07*** (1.397)	2.618*** (0.953)	1.613 (1.014)	14.07*** (1.154)	13.80*** (1.104)	-17.66*** (5.075)	-24.70*** (8.840)	17.78*** (6.195)	16.32* (8.377)	38.29*** (7.543)	42.17*** (10.40)
Observations	721	721	721	721	721	721	721	721	721	721	721	721
$R^2$	0.156	0.230	0.020	0.239	0.305	0.475						
<b>Table B: Savings = Private Savings + Public Savings</b>												
	Saving	Saving	Pr. Sav.	Pr. Sav.	Pu. Sav.	Pu. Sav.	Saving	Saving	Pr. Sav.	Pr. Sav.	Pu. Sav.	Pu. Sav.
House Prices	2.203*** (0.855)	1.187 (0.928)	-5.321*** (0.925)	-6.675*** (0.877)	8.375*** (1.332)	8.839*** (1.072)	27.16*** (9.791)	33.21* (18.90)	-17.01*** (6.383)	-13.07 (12.57)	46.38*** (14.38)	47.26** (24.05)
Observations	621	621	621	621	621	621	621	621	621	621	621	621
$R^2$	0.016	0.271	0.073	0.298	0.113	0.527						
<b>Table C: Investment = Residential + Non-residential Investment</b>												
	Invest.	Invest.	R Invest.	R Invest.	NR Invest.	NR Invest.	Invest.	Invest.	R Invest.	R Invest.	NR Invest.	NR Invest.
House Prices	11.49*** (1.046)	11.13*** (1.056)	4.605*** (0.378)	4.681*** (0.361)	6.829*** (0.923)	6.399*** (0.944)	33.68*** (9.154)	38.26** (16.29)	1.475 (2.825)	-4.443 (8.143)	32.17*** (9.417)	42.17** (21.06)
Observations	591	591	591	591	591	591	591	591	591	591	591	591
$R^2$	0.273	0.468	0.365	0.467	0.134	0.387						

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Year fixed-effects included for OLS, Y and IV, Y columns. All series are detrended using a HP-filter.

Table 18: OLS Regressions with controls and year fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	CA	CA,Y	CA	CA,Y	CA	CA,Y	CA	CA,Y	CA	CA,Y
<b>House Prices</b>	-10.61*** (1.068)	-12.03*** (1.239)			-8.986*** (1.396)	-10.27*** (1.815)			-7.453*** (1.225)	-7.728*** (1.657)
Public Surplus			-0.106* (0.0622)	-0.000113 (0.0862)	-0.0295 (0.0580)	0.0557 (0.0837)	-0.0516 (0.0733)	0.0273 (0.0901)	0.00266 (0.0704)	0.0591 (0.0885)
Relative income			-8.018 (8.111)	-12.73 (9.324)	1.861 (7.849)	0.855 (9.074)	-4.878 (8.810)	-8.489 (9.924)	2.271 (8.915)	0.940 (10.18)
Relative income sq.			-70.92 (201.1)	4.282 (217.0)	-9.645 (178.7)	39.57 (186.4)	-227.0 (262.0)	-110.4 (253.2)	-114.7 (239.1)	-36.34 (228.5)
Relative dependency ratio (Young)			-0.247 (0.253)	-0.274 (0.262)	-0.441* (0.240)	-0.371 (0.250)	-0.430* (0.260)	-0.494** (0.251)	-0.696*** (0.248)	-0.583** (0.244)
Relative dependency ratio (Old)			0.365 (0.444)	0.569 (0.465)	0.0109 (0.434)	0.141 (0.446)	1.003** (0.471)	1.390*** (0.455)	0.446 (0.468)	0.796* (0.451)
Financial deepening			0.00731 (0.00659)	0.00642 (0.00999)	0.00954 (0.00589)	0.00845 (0.00909)	0.00673 (0.00606)	0.0104 (0.00843)	0.00830 (0.00574)	0.0107 (0.00830)
Oil Dummy			-0.359 (0.828)	-0.490 (0.831)	-0.510 (0.787)	-0.602 (0.761)	0.218 (0.805)	0.0349 (0.776)	-0.0789 (0.782)	-0.206 (0.755)
Real interest rates							0.136 (0.161)	0.138 (0.173)	0.190 (0.154)	0.105 (0.171)
Real exchange rates							-0.0572*** (0.0177)	-0.0570*** (0.0153)	-0.0329** (0.0153)	-0.0380*** (0.0138)
Observations	833	833	473	473	473	473	402	402	402	402
$R^2$	0.181	0.258	0.044	0.122	0.170	0.232	0.086	0.194	0.168	0.254

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Year fixed-effects included in columns CA,Y.

Table 19: Instrumental strategy with controls and year fixed effects, First Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	House	House	House	House	House	House	House	House	House	House
	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)
<b>Property tax</b>	-3.697*** (0.881)	-1.956*** (0.716)	-3.389*** (0.942)	-1.800** (0.787)	-3.362*** (0.934)	-1.732** (0.757)	-3.195*** (0.971)	-1.658** (0.778)	-2.955*** (0.951)	-1.560** (0.793)
Rel. dependency ratio (young)			-0.0318*** (0.00728)	-0.0234*** (0.00630)	-0.0299*** (0.00772)	-0.0207*** (0.00686)	-0.0282*** (0.00714)	-0.0223*** (0.00659)	-0.0299*** (0.00759)	-0.0233*** (0.00675)
Rel. dependency ratio (old)			-0.0112 (0.0157)	-0.0283** (0.0141)	-0.00890 (0.0155)	-0.0239* (0.0138)	-0.0122 (0.0156)	-0.0234 (0.0148)	-0.0153 (0.0160)	-0.0319** (0.0144)
Oil Dummy			0.00248 (0.0288)	0.0228 (0.0202)	-0.0255 (0.0326)	-0.00828 (0.0269)	0.00249 (0.0292)	0.0197 (0.0193)	-0.0439 (0.0398)	0.0111 (0.0716)
Relative income					0.181*** (0.0639)	0.166*** (0.0596)				
Relative income sq.					3.133 (7.794)	2.398 (6.714)				
Real exchange rates							0.00345*** (0.000700)	0.00268*** (0.000599)		
Financial Deepening									0.00182*** (0.000405)	0.00115*** (0.000355)
Observations	769	769	591	599	591	599	567	575	545	553
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with band-pass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. All series are HP-filtered.

Table 20: Instrumental strategy with controls and year fixed effects, Second Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	CA	CA	CA	CA	CA	CA	CA	CA	CA	CA
	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)
<b>House Prices</b>	-17.10***	-23.15***	-18.77***	-26.89***	-19.09***	-27.82***	-22.25***	-32.48***	-22.62***	-34.35***
	(4.587)	(8.647)	(5.438)	(10.24)	(5.417)	(10.50)	(6.070)	(12.20)	(6.572)	(13.09)
Relative dependency ratio (young)			-0.292	-0.359	-0.277	-0.321	-0.438*	-0.569	-0.529**	-0.606
			(0.241)	(0.317)	(0.233)	(0.305)	(0.247)	(0.359)	(0.254)	(0.384)
Relative dependency ratio (old)			-0.205	-0.413	-0.183	-0.360	-0.378	-0.681	-0.0759	-0.577
			(0.325)	(0.488)	(0.327)	(0.472)	(0.362)	(0.525)	(0.370)	(0.617)
Oil Dummy			0.355	0.989	0.168	0.493	0.364	1.066	-1.784	-0.399
			(0.912)	(0.871)	(0.998)	(1.000)	(0.956)	(0.910)	(1.713)	(2.453)
Relative income					2.237	3.315				
					(2.480)	(2.944)				
Relative income sq.					-153.3	-65.61				
					(203.1)	(220.7)				
Real exchange rates							0.0206	0.0316		
							(0.0265)	(0.0390)		
Financial Deepening									-0.0188	-0.0182
									(0.0175)	(0.0197)
Observations	769	769	591	599	591	599	567	575	545	553
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with band-pass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. All series are HP-filtered.

Table 21: Instrumental strategy with controls, Investment, Second Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.	Inv.
	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)
<b>House Prices</b>	38.29***	42.17***	39.37***	46.95***	39.23***	47.69***	45.77***	58.12***	45.96***	58.88***
	(7.541)	(10.40)	(8.712)	(14.57)	(8.762)	(15.06)	(10.31)	(19.34)	(11.53)	(22.14)
Relative dependency ratio (young)			0.370	0.223	0.335	0.183	0.548	0.604	0.669	0.660
			(0.351)	(0.430)	(0.339)	(0.410)	(0.393)	(0.555)	(0.436)	(0.619)
Relative dependency ratio (old)			0.0603	1.001	0.0169	0.910	0.286	1.389*	0.268	1.563
			(0.503)	(0.673)	(0.495)	(0.647)	(0.590)	(0.833)	(0.636)	(1.013)
Oil Dummy			-0.239	-0.269	-0.170	-0.387	-0.264	-0.312	0.827	0.530
			(0.919)	(0.887)	(0.954)	(0.972)	(1.135)	(1.155)	(1.157)	(1.434)
Relative income					-3.116	-3.800				
					(2.559)	(3.525)				
Relative income sq.					-290.0	-172.9				
					(211.5)	(209.9)				
Real exchange rates							-0.121***	-0.105*		
							(0.0435)	(0.0553)		
Financial Deepening									-0.0521**	-0.0416
									(0.0255)	(0.0309)
Observations	721	721	590	590	590	590	566	566	544	544
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included in the regressions. All series are HP-filtered.



Table 22: Instrumental strategy with controls, Saving, Second Stage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Sav.	Sav.	Sav.	Sav.	Sav.	Sav.	Sav.	Sav.	Sav.	Sav.
	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)	(2sls)
<b>House Prices</b>	17.78***	16.32*	17.98**	16.30	17.66**	15.76	21.49***	22.25*	23.73***	25.97*
	(6.194)	(8.377)	(7.087)	(10.62)	(7.030)	(10.98)	(7.677)	(12.62)	(8.691)	(14.44)
Relative dependency ratio (young)			0.0852	-0.147	0.0810	-0.131	0.120	-0.00290	0.224	0.133
			(0.285)	(0.303)	(0.273)	(0.288)	(0.284)	(0.347)	(0.320)	(0.387)
Relative dependency ratio (old)			-0.469	0.0628	-0.471	0.0745	-0.437	0.0899	-0.0810	0.683
			(0.337)	(0.453)	(0.326)	(0.423)	(0.358)	(0.499)	(0.416)	(0.616)
Oil Dummy			0.184	0.191	0.492	0.419	0.170	0.167	-0.433	-0.695
			(0.675)	(0.633)	(0.700)	(0.662)	(0.781)	(0.719)	(0.868)	(0.928)
Relative income					0.367	1.423				
					(2.184)	(2.623)				
Relative income sq.					-253.0	-101.9				
					(163.7)	(132.0)				
Real exchange rates							-0.118***	-0.0942***		
							(0.0322)	(0.0347)		
Financial Deepening									-0.0596***	-0.0475**
									(0.0207)	(0.0213)
Observations	721	721	590	590	590	590	566	566	544	544
Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included in the regressions. All series are HP-filtered.

Table 23: Controlling with the Frequency of Cadastral Revisions

	(1) House (IV: 1st st.)	(2) House (IV: 1st st.)	(3) House (IV: 1st st.)	(4) CA (IV: 2nd st.)	(5) CA (IV: 2nd st.)	(6) CA (IV: 2nd st.)
Property tax	-3.697*** (0.881)	-3.434*** (1.193)	-3.896*** (1.281)			
House Prices				-17.10*** (4.588)	-17.37*** (6.404)	-16.92*** (6.366)
Observations	769	393	376	769	393	376
Revision		Yes	No		Yes	No

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included in the regressions. All series are HP-filtered. "Revision" points to countries where cadastral values are reassessed at least every five years (Australia, Canada, Denmark, Finland, Hungary, Japan, Netherlands, New Zealand, Portugal, South Africa, Sweden, Switzerland, United States). For a description of the frequency of revision of cadastral values, see Table 26.

Table 24: Decades

	(1) House (IV: 1st st.)	(2) House (IV: 1st st.)	(3) House (IV: 1st st.)	(4) CA (IV: 2nd st.)	(5) CA (IV: 2nd st.)	(6) CA (IV: 2nd st.)
Property tax	-2.473** (0.987)	-3.705*** (1.281)	-10.68*** (2.568)			
House Prices				-20.47* (11.90)	-20.58*** (6.647)	-13.60*** (4.491)
Observations	284	229	256	284	229	256
Decades	<1990	1990s	>2000	<1990	1990s	>2000

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included in the regressions. All series are HP-filtered.

Table 25: Real Exchange Rates

	(1) CA (IV)	(2) Real Exchange Rates (OLS)	(3) Real Exchange Rates (VAR)	(4) House (VAR)
House Prices	-19.73*** (5.017)	18.83*** (3.532)		
Real exchange rates	0.0293 (0.0189)			
Real Exchange Rates (L1)			0.461*** (0.0723)	-0.000404 (0.000341)
House Prices (L1)			11.33*** (3.155)	0.707*** (0.0623)
Observations	691	691	664	664
$R^2$		0.052	0.287	0.447

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects are included in the regressions. All series are HP-filtered.

## B Data

**Instrumental variable.** We focus on recurrent taxes as real estate capital gain taxes (non-recurrent taxes) are endogenously affected by house prices. Real-estate includes land, buildings, and other construction or "improvements" to land. Precise categorization of taxpayers is difficult in practice. We thus include both property taxes and dwellings taxes in the variable.<sup>27</sup> Data are built from the taxation series of the OECD.

**Data on LTV ratios.** As it is common in the literature (see: Andrews and Sánchez (2011) or Andrews et al. (2011)), we use the maximum LTV ratios. The maximum LTV accounts for the maximum access to financing that the mortgage market grants to households. High LTV ratios are associated with low downpayment requirements. Data are sourced from Chiuri and Jappelli (2003), Jappelli and Pagano (1994), Catte et al. (2004), Green and Wachter (2005), Drudi et al. (2009), Andrews et al. (2011).

**Home equity extraction dummy.** Home equity extraction exists when households may take up debt secured on the housing stock and use it for consumption spending. There are 9 countries in our sample where home equity extraction exists (Australia, Canada, Denmark, Finland, the Netherlands, Norway, Sweden, the United Kingdom, the United States). For a description see in particular table in Appendix 1 "Mortgage equity withdrawal" in Andrews (2010). Mortgage equity withdrawal appears to be less common in euro area housing markets (Drudi et al. (2009) and Catte et al. (2004)).

This Appendix details also the frequency of revision of cadastral values in Table 26, and the source for house price series in Table 27.

<sup>27</sup>For example in France, this variable is mainly composed of the "taxe d'habitation" (dwelling tax) and "taxe foncière" (property tax). Dwelling taxes also affect house prices as they reduce the (before-tax) rental income earned by owners, and so house prices.

Table 26: Recurrent Taxes on Property: Revision of Cadastral Values

Country	Level of administration of the Tax	Cadastral values	Sources
Australia	Local councils levy rates on the rental value of the property	Land valuations made every 3 to 4 years	Landgate (2012), Sidney (2011)
Austria	Federal rate multiplied by a municipal coefficient	From 1973 with no automatic update	ECB (2012)
Belgium	Regional and Local	From 1975, indexed to the CPI since 1991	ECB (2012)
Canada	Municipal governments	Market value in most provinces (with an annual reassessment)	Statistics Canada (2003)
China	Central, local	On historical cost. Market value for Shanghai and Chongqing since 2011	The Economist (2012)
Czech Republic	Local	Based upon floor-area	ECB (2012)
Denmark	Municipal tax and National tax	Updated every second year	ECB (2012)
Estonia	Municipality	From 2001	ECB (2012)
Finland	Municipality	From 2009	ECB (2012)
France	Local	From 1978	Sénat (2012)
Germany	Federal rate multiplied by a municipal coefficient	From 1964	ECB (2012)
Greece	National tax of 2011	Based upon floor-area	ECB (2012)
Hungary	Local	Fair market value	ECB (2012)
Ireland	National	Regular update for non-residential housing. New Property Tax in 2012	ECB (2012)
Italy	Local Tax	From 1988. Correction factor was increased by 60% in 2012	ECB (2012)
Korea	Local and national	From 2005	Kim (2008)
Japan	Central government	Adjusted every three years	The Japan Times (2012)
Luxemburg	Local	From 1941	ECB (2012)
Netherlands	Local	Updated annually by municipalities	ECB (2012)
New Zealand	Local	Official land valuation every three years	LINZ (2012)
Norway	Municipalities	Assessed value of the property (about 25% of the market value)	Global Property Guide (2012)
Portugal	Municipalities (min/max rates determined at the national level)	Adjusted every 3rd year. But some values have not been updated since 2003	ECB (2012)
Slovak Republic	National and municipalities	From 2004	ECB (2012)
Slovenia	Municipalities	Based upon floor-area. Market value since 2012.	ECB (2012)
South Africa	Local	Market value	Global Property Guide (2012)
Spain	Tax levied by municipalities	Partly updated in Jan. 1994	ECB (2012)
Sweden	Municipal tax	Fully updated every 6th year, with a minor revision in between	ECB (2012)
Switzerland	Cantons	Market value	Federal Tax Administration (2011)
United Kingdom	Local taxation (Council tax)	From April 1991	ECB (2012)
United States	Local government level (municipal or county level)	Nearly always at the fair market value. Values determined by local officials	Texas Basics, Tax Foundation Study

Table 27: Data Appendix: House Price Series

Country	Time coverage	Sources	Series
Australia	1970-present	BIS -Australian Treasury	Residential property prices, existing dwellings (8 Cities), nsa
Austria	1986-present	BIS	Residential Property Prices, all dwellings (Vienna and big cities), nsa
Belgium	1970-present	BIS-Statistics Belgium	Residential property prices, existing houses, nsa.
Canada	1970-present	BIS	Residential Property Prices, all dwellings
China	1998-present	BIS	Land prices, residential and commercial, nsa
Czech Republic	2004-present	BIS	Residential property prices, existing flats , nsa
Denmark	1970-present	Danmarks Nationalbank	Residential property prices, new and existing single-family house, nsa
Estonia	2002-present	BIS	Residential property prices, all flats, nsa
Finland	1970-present	BIS-Statistics Finland	Residential property prices, existing houses, nsa
France	1970-present	J. Friggit (Conseil Général à l'Environnement et au Développement Durable)	Residential property prices, existing dwellings, nsa
Germany	1975-present	BIS- Deutsche Bundesbank	Residential property prices, existing flats (West-G.), nsa
Greece	1992-present	BIS	Residential property prices, all flats (Athens-Thessaloniki), nsa
Hungary	2000-present	BIS	Residential property prices, existing dwellings (Budapest), nsa
Iceland	1999-present	BIS	Residential property prices, all dwellongs, nsa
Indonesia	2001-present	BIS	Residential property prices, new houses (big cities), nsa
Ireland	1970-present	BIS-Department of Environment	Residential Property Prices, all dwellings, nsa
Israel	2000-present	BIS	Residential property prices, owner-occupied dwellings, nsa
Italy	1970-present	BIS- Il Consulente Immobiliare	Residential Property prices, All dwellings, nsa.
Japan	1970-present	Stat Bureau, Ministry of Internal Affairs and Communications, Japan	Japan Residential land price index
Korea	1985-present	BIS	Residential Property Prices, all dwellings, nsa
Mexico	2004-present	BIS	Residential Property Prices, all dwellings, nsa
Netherlands	1975-present	BIS-The Dutch Land Registry Office (Kadaster)	Residential Property Prices, existing dwellings, nsa
New Zealand	1970-present	BIS-Reserve Bank of New Zealand	Residential Property Prices, all dwellings, nsa
Norway	1970-present	Norges Bank	Residential Property Prices, all dwellings, nsa
Poland	2001-present	BIS	Residential property prices, existing flats (big cities), nsa
Portugal	1987-present	BIS	Residential Property Prices, all dwellings, nsa
Slovak Republic	2004-present	BIS	Residential Property Prices, existing dwellings, nsa
Slovenia	2002-present	BIS	Residential Property Prices, existing dwellings, nsa
South Africa	1970-present	BIS-ABSA	Residential Property Prices, all middle-segment houses, nsa
Spain	1970-present	BIS-Ministerio de la Vivienda	Residential Property Prices, all dwellings, nsa
Sweden	1970-present	BIS-Statistics Sweden	Residential Property Prices, all owner-occupied dwellings, nsa
Switzerland	1970-present	Swiss National Bank	Residential Property Prices, all 1-family houses, nsa
United Kingdom	1970-present	Nationwide	Residential Property Prices, all dwellings, nsa
United States	1970-present	FHFA-Shiller	Residential Property Prices, existing 1-family houses, nsa

Variables	Abbreviation	Sources	Variable description
House Prices	House	See Table 27	Real house prices (base 1=2005)
Current account balance	CA	WDI	Current account balance (ratio of GDP)
Property Tax	Property Tax	OECD	Property tax (ratio of total taxation)
Income Taxes	Income Tax	OECD	Income tax (ratio of total taxation)
Taxes on capital gains	Capital gains	OECD	Taxes on capital gains (ratio of total taxation)
Taxes on inheritances	Inheritances	OECD	Taxes on inheritances (ratio of total taxation)
Taxes on capital and financial transactions	Transactions	OECD	Taxes on capital and financial transactions (ratio of total taxation)
Social security contributions	Social Secu.	OECD	Social security contributions (ratio of total taxation)
Payroll taxes	Payroll	OECD	Payroll taxes (ratio of total taxation)
Taxes on goods and services	Goods/Services	OECD	Taxes on goods and services (ratio of total taxation)
Other taxes	Other	OECD	Other taxes (ratio of total taxation)
CPI	CPI	OECD	Consumer Prices, Index 2005=100
Net Foreign Asset Position	NFA	WDI	Stock of net foreign assets, ratio to GDP
Young dependency ratio	Relative dependency ratio (Young)	WDI	Youth Population under 15/Population between 15 and 65
Old dependency ratio	Relative dependency ratio (Old)	WDI	Population over 65/Population between 15 and 65
Gross fixed capital Formation	Investment	OECD	Gross fixed capital Formation, total, ratio of GDP
Residential Investment	Res. Inv.	OECD	Gross fixed capital formation (housing), ratio of GDP
Non residential Investment	NR Invest.	OECD	Gross fixed capital formation (non-housing), ratio of GDP
Saving	Gross domestic savings	WDI	Gross domestic savings (ratio of GDP)
Gross Saving	Gross Savings	WDI	Gross savings (ratio of GDP)
Government net lending	Government surplus	OECD	Government net lending (+ indicates surplus, - indicates deficit), ratio of GDP
Net Capital Outlays	Net Capital Outlays	OECD	Net capital outlays of the government, ratio of GDP
Public Saving	Public Saving	OECD	Government net lending+ Net capital outlays, ratio of GDP
Private Saving	Private Saving	OECD	Gross Savings minus Government net lending minus Net capital outlays , ratio of GDP
Total General government expenditure	Public Spending	OECD	Total General government expenditure, ratio of GDP
Total General government revenue	Public Revenue	OECD	Total General government revenue, ratio of GDP
Household final consumption	Consumption	WDI	Household final consumption expenditure, etc. (ratio of GDP)
Share Prices	Share Prices	OECD	Share prices, Index 2005 = 100
Relative Income	Relative Income	WDI	Relative income is the the GDP per capita divided by the GDP per capita for the US
GDP	GDP	WDI	GDP (current US \$), Index 2005=100
GDP per capita	GDP per capita	WDI	GDP per capita, PPP (current international \$)
Market capitalization	Financial deepening	WDI	Market capitalization of listed companies (ratio of GDP)
Domestic credit to private sector	PCGDP, Financial. Deep.	WDI	Domestic credit to private sector (ratio of GDP)
Oil rents	Oil rents	WDI	Oil rents (ratio of GDP)
Oil dummy	Oil dummy		Norway, Russia
Real long term interest rates	Real Interest Rates	OECD	Real long-term interest rate on government bonds, ratio of GDP
Real effective exchange rate	Real exchange rates	WDI	Real effective exchange rate index (2005 = 100)
Unemployment	Unemployment	WDI	Unemployment, total (% of total labor force)
Loan-To-Value ratios	LTV ratios	See text	maximum LTV ratios

## C Stationarity

There are two types of test we can use to test the stationarity of the residuals. We can reject the joint hypothesis that all residuals contain a unit root quite easily using panel-data unit root tests. Results are displayed in Table 48. Because the sample must be a balanced panel in order to perform the existing panel test procedures, the sample is restricted to 30 years (1979 – 2009) and 15 countries. For example, the Levin-Lin-Chu bias-adjusted  $t$  statistic are significant at all the usual testing levels. Therefore, we reject the null hypothesis and conclude that these series are stationary. Note however that all these tests assume a common autoregressive parameter for all series, so this test does not allow for the possibility that some country residuals contain unit roots while other country residuals do not.

To test for whether just one country residuals contain a unit root is arguably harder to reject. However, for those countries for which we have a reasonable number of years (that is, higher than 10 years), we can reject the hypothesis that our series contain unit roots at the usual confidence levels (5%). Therefore, we do not have to worry about spurious regressions problems when using a smoothing parameter of 400.

Table 28: Test Statistics: Panel of series

	Residual
Levin-Lin-Chu	-12.2587***
Im-Pesaran-Shin	-4.2698***
Fisher-type tests (ADF)	68.3449***
Harris-Tzavalis	0.5663***

**Notes:** \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## D Comparability of house price indexes

It is important for the validity of our study that house price indexes be comparable across countries (Figure 4). Since we at times use prices in capital cities or commercial prices instead of plain residential countrywide house price indexes, we check that all prices are the same, be there residential or commercial, countrywide or limited to one big capital city. Intuitively, all this can be understood by an arbitrage argument: residential structures can be turned into office space and the reverse (and land prices joint determine both residential and commercial real estate prices), and residents in the country arbitrage between different cities. In contrast, there are very high costs to arbitrage between real estate markets of two different countries, such as language and culture, which drives a wedge between house prices in different countries.

Table 29: Test Statistics: Individual Tests for Residuals

	Obs.	Phillips-Perron	Dickey-Fuller
Australia	38	0.00133896	0.00057261
Austria	23	0.13036501	0.13946425
Belgium	7	0.38942575	0.35585806
Canada	34	3.87E-07	4.49E-07
Czech Republic	5	0.00964448	0.0295434
Denmark	34	0.00011012	0.00013367
Estonia	6	0.79614642	0.62502458
Finland	34	0.04314767	0.09078547
France	34	0.01521007	0.01261114
Germany	34	0.032882	0.03641409
Greece	16	0.18450038	0.20636683
Hungary	8	0.6829401	0.77173235
Iceland	9	0.02059045	0.0204428
Ireland	35	0.03074412	0.04414738
Israel	8	0.28900171	0.21027767
Italy	29	0.11187055	0.14829428
Japan	32	0.065605	0.10567722
Korea	23	0.02037664	0.02049362
Mexico	4	0.45424782	0.45656888
Netherlands	33	0.00970076	0.01244231
New Zealand	37	0.00021194	0.00025407
Norway	34	0.03045081	0.02397773
Poland	7	0.35994073	0.32838974
Portugal	21	0.01285676	0.01429522
Slovak Republic	4	0.59535082	0.56657353
Slovenia	6	0.07901901	0.08319547
Spain	34	0.03767954	0.05407641
Sweden	39	0.0011417	0.00111046
Switzerland	32	0.00365723	0.00272435
United Kingdom	39	0.0121957	0.01067992
United States	39	0.02724493	0.03492188

**Notes:** Augmented Dickey-Fuller and Phillips-Perron tests are reported for residuals of the regression of current-accounts on house prices with country and year-fixed effects.

## E The Spanish example: four policy shocks

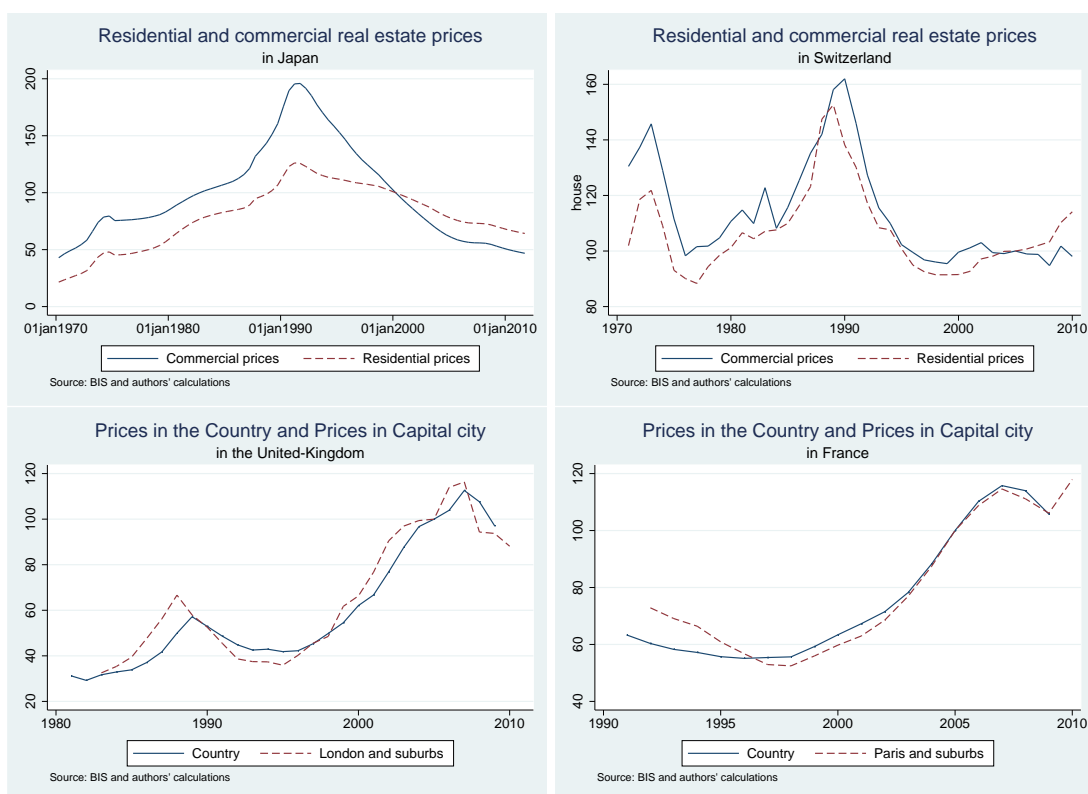
We develop four exogenous tax shocks which happened in Spain during the last thirty years. We show that all of them are not related to current accounts. Information about the history of property taxation in Spain are taken more specifically from Miranda Hita (2004).

### 1. 1979-1980: Decree Law of 1979

In 1979, a decree Law (11/1979) introduced an extensive package of measures for the reorganization of local treasuries, ranging from doubling the base of some property taxes (the Urban Land Tax) and the subsequent revision of all cadastral values. Property taxes were also converted into local taxes. Property taxes were increased in a context of structural deficits of local communities. Indeed, social demands had increased since 1972 (the arrival of democracy) and were materialized with central government deficit. The government responded to those demands by exporting deficit to the local authorities. The package of measures provided in the decree law of 1979 addressed the "chronic situation of structural deficit of Local Corporations". With this perspective, the decree law proposed to



Figure 4: Comparability of house prices indexes



**Note:** Because of data availability, we show 4 countries where data exist in BIS database. We restrict ourselves to data from BIS database to ensure data comparability so that covered area are strictly similar when we compare residential and commercial prices, or property types are strictly the same when we compare prices in the whole country and in the capital city.

adjust the taxable bases of land taxes and to update the cadastral value of urban estates. (The coefficients were different for each local corporation depending on which year the "cadastral system" of Law 41/1964 had been implemented.) The goal was the increase in cadastral income of rented housing and premises, the elimination of certain hypotheses established in Land Tax law, the annulment of certain exemptions and rebates and the reduction in the amount of others. The movement was followed by the law of 1983 (see next shock).

## 2. 1985: the sentence of the Constitutional Court on 19 December 1985

In 1983, a law (24/1983) contained a package of measures designed to reinforce the capacity of local self-finance: it authorized local authorities to establish a surcharge on Personal Income Tax and on property taxation. The surcharge was effectively applied, amidst fierce debate, by 528 local corporations that year. But this surcharge was later overturned by sentence of the Constitutional Court on 19 December 1985. It resulted in a decrease in property taxation.

## 3. 1991-1994: the law of 1987, first applied after the local elections of 1991.

There was an increase the rate of land taxes, which from then on could for example vary between 20 and 40 percent for urban land <sup>28</sup>. But it is only in 1991, after the municipal elections <sup>29</sup>, that the municipalities increased the rates of land taxes. Between 1991 and 1993 local corporations showed a high level of activity, increasing rates annually from 0.588 in 1990 to 0.664 in 1993. This explains that the increase in property taxation was gradual in this period. This activity is largely attributable to the absence of cadastral value revisions in this three-year period. When revisions were resumed effective 1 January 1994, we observe that the average rate went down that year to 0.658, and continued a downward trend.

#### 4. 2006 : the law of 2006

At the end of 2006, Spain got a new tax reform. More precisely, on 30th of November came Law 36/2006 with measures to prevent tax frauds. Through this law of November 29, the power to require the production of a cadastral declaration for new constructions was attributed to municipalities when granting the license authorizing the first occupation of buildings. Moreover, the Act modified the fiscal scheme, changing the regime for net taxable income for certain properties for the purposes of the local property tax. In practice, the law led to an increase of the local property tax (Impuesto de Bienes Inmuebles) <sup>30</sup>.

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<sup>28</sup>Law of local treasuries of 1988 reinforced the autonomy of municipalities by authorizing Local Corporations to establish two additional taxes (Tax on the Increase in Value of Urban Land and a Tax on Construction, Installations and Works)

<sup>29</sup>Municipal elections are every four year in Spain. So the first elections after 1987 were in 1991)

<sup>30</sup>This is a rate tax which varies depending on the municipality and the level of urbanisation and services relating to your property. It is based on the "valor catastral" (fiscal value), determined by the cadaster office in the provincial capitals. This yearly tax is 0,4% on residential property, but municipalities may increase this percentage in accordance with the number of inhabitants and the services given.



## Chapter 2

# House Price Effects on the Labour Market: a new Dutch Disease?

*This chapter was written with François Geerolf.*

### Abstract

We investigate the causal effect of house price movements on employment dynamics. Using a dataset of 34 countries over the last 40 years, we show the large and significant impact of house prices on unemployment fluctuations using property taxes as an instrument for house prices. A 10% (instrumented) depreciation in house prices yields to a 3% increase in the unemployment rate. These results are very robust to the inclusion of the variables commonly used to explain unemployment rate developments. Besides the effects on unemployment rates, house prices also impact labor reallocation between tradable and non-tradable sectors: rising (declining) house prices do not only lead to hiring (firing) of construction workers, it also leads to real exchange rate appreciations that affect manufacturing activity. Over the housing cycle, total effect of house prices on employment in the tradable sector is negative.

**Keywords:** Unemployment, Sectoral reallocation of labour, House prices.

**JEL classification:** J60, E29, R32

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## Introduction

Many commentators have noted a close link between house price busts and rising unemployment rates. The negative relationship between house prices and unemployment can however accommodate very different interpretations: house prices comove positively and unemployment negatively with the business cycle, so whatever drives the cycle could explain their comovement. Moreover, house prices could decrease when unemployment goes up in the case of reduced consumption on all goods, and on housing services in particular. However, in this chapter we investigate the opposite causal effect: the effects of house price movements on unemployment.

Following the Chapter 1, we use property taxes as an instrument for house prices. Our identification strategy relies on the fact that property tax changes are driven by local politics rather than macroeconomics, so that they are orthogonal to macroeconomic factors which might otherwise determine the business cycle. We show that house prices have a causal effect on unemployment: a 10% (instrumented) depreciation in house prices yields to a 3% increase in the unemployment rate. This is economically a very large effect as the standard deviation of house prices is 30.4% in the whole sample, while that of unemployment is 4.7% of active population. We treat very carefully the business cycle dimension of house price fluctuations. Our data is a country-year dataset spanning 34 countries and the period 1970-2010.

We investigate the mechanisms explaining this result. Effects of house prices on unemployment go well beyond the direct effect on employment in the construction sector. Interestingly, house prices do not only impact unemployment levels but also sectoral employment reallocation between tradable and non-tradable sectors<sup>1</sup> with a mechanism reminiscent of a Dutch disease phenomenon. This new "Dutch disease" affects employment in two ways. Housing booms increase the demand for labor, which cause production to shift toward the booming sector (construction), an effect called in the literature "direct-deindustrialization" (Corden and Neary (1982); Corden (1984)). A second effect occurs as a result of the real exchange appreciation caused by the housing boom. Real exchange rate appreciation affects manufacturing exports and activity in the tradable sector (indirect-deindustrialization). During housing busts, adjustments tend to be more painful in a monetary union as nominal exchange rate cannot adjust.

We finally compute the total effect of house prices over the housing cycle. If housing booms (resp. busts) tend to reduce (resp. increase) the unemployment rate, house price effect on employment over the housing cycle appears to be negative. This negative effect is particularly strong and robust in the tradable sector. This is a deindustrialization phenomenon over the housing cycle.

**Related literature.** We will not review here the very vast literature on unemployment dynamics. In particular a large number of articles have sought the source of differences

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<sup>1</sup>We define industry as the tradable sector. We separate construction from the rest of the non-tradable sector.

in labour market outcomes in differences in labour market institutions. Blanchard and Wolfers (2000) showed that the interaction between shocks and institutions is crucial to explaining unemployment patterns. Nickell et al. (2005) emphasized that broad movements in unemployment can be explained by shifts in labour market institutions. Bassanini and Duval (2006) looked at the existence of complementarities between labour market policies. The first contribution of this chapter is to show the strong explanatory power of house prices relative to these labour market institution variables to explain unemployment dynamics. A limited number of paper has started to look at the issue empirically. Bover and Jimeno (2008) presented for example evidence regarding the relationship between house prices and relative employment in construction on a sample of nine OECD countries over the period 1980-2003. They showed that countries with more building possibilities tend to display larger elasticities of labor demand in the construction sector with respect to house prices than countries with fewer building possibilities. Byun (2010) tried to estimate the impact on employment of the recent housing bubble in the US. Using input-output tables, the bubble is estimated to have contributed somewhere between 1.2 million and 1.7 million jobs in 2005, accounting for 0.8 percent to 1.2 percent of total U.S. employment. In this chapter, we investigate more fully house price effects on unemployment rates and we address the issue of causation between house prices and unemployment dynamics.

Moreover, we show that house prices also affect sectoral employment reallocation, in particular between tradable and non-tradable sectors. The theoretical mechanism behind this effect is close to a Dutch Disease. There is a voluminous literature on Dutch Diseases, in particular with empirical papers looking at the consequences of the discovery of natural resources. Other sources of real exchange rate appreciations have been analyzed in this literature. Recently, Rajan and Subramanian (2011) examined the effects of aid on the growth of manufacturing showing that aid inflows have adverse effects on a country's competitiveness. Theoretical analyses of Dutch disease effects of capital inflows in small open economies have been based largely on the dependent economy model, following in particular the seminal paper of Corden and Neary (1982). More recently, Lartey (2008) proposed a variant of this model within a real business cycle framework. Other papers have taken a more normative approach looking at the need to intervene to protect the export sector in the case of persistent real exchange rate appreciations. For example, Caballero and Lorenzoni (2007) presented a model of irreversible export destruction where financial constraints damage the export's sector ability to recover and may justify exchange rate interventions. In this chapter, we study another source of real exchange rate appreciations: housing booms. The analogy between housing booms and the Dutch Disease phenomenon was suggested previously. But to our knowledge, no academic paper has investigated this issue before this work. Bover and Jimeno (2008) raised the hypothesis that housing booms could have effects close to a Dutch disease but they did not investigate further this suggestion. In a speech at the JRC inaugural conference in Princeton, on April 19, 2012, Professor Garicano presented stylized facts about what he called the "Spanish Variant of the Dutch Disease" due to

the negative effects of the resource intensive construction growth. In this chapter, we investigate more fully the analogy with Dutch Diseases and the impacts of house price cycles on resource reallocation.

Note that if we study the macroeconomic consequences of house prices, we do not investigate specifically the effects of home-ownership rates on residential mobility. Following Oswald (1996) and more recently Blanchflower and Oswald (2013), a different strand of the literature has indeed looked at the role of home-ownership rates as a friction in the labour market. More theoretical papers have also address this question. Recently, Rupert and Wasmer (2012) presented a model where the interconnection between two frictional markets (housing and labor) can be used to understand differences in the functioning of labor markets. In this chapter, we do not focus specifically on the effects of housing on residential mobility<sup>2</sup>.

**Outline.** The rest of the chapter is organized as follows. In Section 1, we investigate house price effects on unemployment dynamics. We present our OLS and IV results, controlling for determinants which have been previously used in the literature, and using country fixed-effects. We show that house price effects go beyond effects on the construction sector and are asymmetric between booms and busts. In Section 2, we show that house prices do not only impact unemployment rates but have also reallocation effects with a mechanism close to a Dutch disease. House prices have in particular a negative effect on manufacturing activity. In Section 3, we then compute the total effect of house prices over the housing cycle: this total effect on employment is negative, with a particularly strong and negative effect on the tradable sector. Finally, in Section 4, we present our robustness checks.

## 1 House prices and Unemployment dynamics

### 1.1 Data and estimation technique

**Data.** House price data are taken from Chapter 1. We use annual data for 34 countries for the period 1970-2010<sup>3</sup>. To build this database, we notably used the property price statistics from the Bank for International Settlements which cover a large number of countries but only for a short period of time. We then completed this database with data from various national sources (central banks, national statistical agencies, etc.). Data for unemployment are taken from the OECD Labour Market statistics. Employment variables are built as a percentage of active population. In the robustness checks, we show also results with variables taken as percentage of working age population. Sectoral

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<sup>2</sup>In the robustness checks, we test the hypothesis that home-ownership could play as a friction in the labour market.

<sup>3</sup>We have 1143 observations in total for house prices. Our sample comprises Australia, Austria, Belgium, Canada, China, Czech republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, United Kingdom, the United States.

employment variables are in addition measured as a percentage of total employment. Other variables used in this article are described at the end of the chapter, in Appendix G.

**Stationarity problems and estimation technique.** Due to data limitation on house prices, most of the economies we consider are advanced economies. House prices have an upward trend in the period we consider. We detrend our data by using a HP-filter with a smoothing parameter of 400 to remove the very low frequencies. We show in the robustness checks that our results are robust to several specifications of the HP parameter (Table 18). Our results are also robust when taking first differences instead of a HP filter. Using augmented Dickey-Fuller and Phillips-Perron tests, we can then reject the hypothesis that our series contain a unit root. Moreover, after regressing unemployment on house prices, we can reject the null hypothesis that residuals contain a unit root at reasonable confidence intervals, for all series in which we have a sufficiently large sample (Appendix F). Since house prices and unemployment are serially correlated, we are careful to use robust estimation procedures to not overestimate the precision of our coefficients. In this chapter, we only present standard errors which are robust to heteroscedasticity and autocorrelation (HAC). We use the Bartlett kernel-based (or nonparametric) estimator, also known as the Newey and West (1987) estimator. We use a bandwidth of 2, which leads that to the inclusion of autocovariances up to 1 lag. Our results are robust to different choices, for example inclusion of 2 lags<sup>4</sup>.

## 1.2 OLS Results

The main specification of our paper is:

$$U_{it} = \alpha H_{it} + \beta X_{it} + \delta_i + \nu_t + u_{it}. \quad (1)$$

$U_{it}$  and  $H_{it}$  are unemployment and house prices of country  $i$  in year  $t$  respectively. More precisely,  $U_{it}$  denotes the share of unemployment over active population.  $H_{it}$  denotes an index of real house prices (that is, deflated by the CPI), in base 1 = 2005.  $X_{it}$  are controls for unemployment.  $\delta_i$  and  $\nu_t$  are country and year fixed-effects. Country fixed effects are included in all the regressions of this chapter, and enable us to identify the effect of house prices on unemployment from the time-series dimension<sup>5</sup>. We also add year fixed-effects in the robustness checks.

The baseline regression yields the estimates displayed in Table 1. According to the simplest specification (column (1)), an increase in house prices of 10% is associated with a decrease of the unemployment rate of 0.8%. The correlation is very significant and the explanatory power of this regression is high:  $R^2 = 30\%$  with house prices alone. Adding

<sup>4</sup>Automatic lag selection as in West (1994) is not available here since we use panel data. See Hayashi (2000) for more on GMM estimation with serial correlation.

<sup>5</sup>Country fixed effects also control for the fact that house price indices may not be comparable across countries, so that we are only left with interpreting the difference from the country-mean.



Table 1: House Prices and Unemployment. OLS regressions.

	(1)	(2)	(3)	(4)	(5)	(6)
	U	U	U	U	U	U
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices	-8.105***	-7.997***	-4.836***		-5.581***	-4.168***
	(0.766)	(1.000)	(1.260)		(1.353)	(1.490)
GDP		0.0104				0.0219**
		(0.00764)				(0.00968)
Min. vs. Av. wage				7.424	7.849	2.482
				(6.177)	(6.022)	(3.336)
LME (active)				1.719	0.655	-0.353
				(1.068)	(1.603)	(1.151)
Employment protection				-0.108	-0.579	-0.784
				(0.720)	(0.728)	(0.569)
Tax Wedge				-0.0385	-0.102**	-0.0484
				(0.0542)	(0.0469)	(0.0389)
Trade Union				0.187***	0.233***	0.140**
				(0.0621)	(0.0562)	(0.0547)
Replacement rate				6.491	3.714	4.984
				(5.400)	(4.350)	(3.307)
Output gap						-0.401***
						(0.0507)
Observations	671	554	194	194	194	191
$R^2$	0.299	0.243	0.237	0.237	0.337	0.558

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are detrended using a HP-filter. U denotes unemployment rate. LME denotes labour market expenditures.

our house price variable to usual determinants of unemployment dynamics increases the  $R^2$  by more than 10 percentage points (compare column (5) to column (4)).

In columns (4), (5), and (6) of Table 1, we follow the literature on unemployment to compare the explanatory power of house prices with other variables usually put forward in the literature (Blanchard and Wolfers (2000), Nickell et al. (2005), Bassanini and Duval (2006), Murtin and Robin (2013)). We add the following variables:

- (i) *Employment protection*. It tends to increase long-term unemployment as employers are more reluctant to hire highly protected workers. In the short term, it can reduce unemployment as workers are fired less easily.
- (ii) *Minimum versus average wage*. This is the minimum wage as a percentage of the median wage. High minimum wages tend to increase unemployment as they mean higher real labor costs but not necessarily higher productivity. But the literature does not find a significant effect of minimum wage on unemployment (Bassanini and Duval (2006)).
- (iii) *Labour market expenditures*. We take the active measures in favour of the labour market. They include notably training, employment incentives or direct job creation. Effects of these measures can be complex as they may entail substitution effects or programmes that are likely to pay off only in the long-run (training programmes). This explains that macro studies tend not to find significant effects of these expenditures on unemployment.
- (iv) *Tax wedge*. We define this variable as in Murtin and Robin (2013). It is the sum of the payroll, income, and consumption tax rates. Tax wedge is based on a full time

worker with no children. The impact of this variable on unemployment depends on who shoulders the burden of taxes, and so on the relative bargaining power of the parties. If for example taxes cannot be shifted onto wages, then labour demand is likely to be negatively affected and so, employment is likely to be negatively affected as well. High tax wedges on labor largely may reflect high levels of public expenditure and the important role played by wage-based contributions in financing the transfer system.

(v) *Trade Union*. Higher levels of unionization can give rise to less competition in labor markets. In particular, Nickell and others (2001) find that greater unionization tends to increase real labor costs.

(vi) *Replacement rate*. It captures the degree of generosity of the unemployment insurance system. More generous insurance systems may cause unemployment if they reduce the effectiveness of the search of jobs.

(vii) *Output gap*. It aims at controlling for the unemployment effects of aggregate demand fluctuations over the business cycle (Bassanini and Duval (2006)). The measure is however highly endogenous. Indeed, the output gap is measured by the OECD as the percentage difference between the levels of actual GDP and estimated potential GDP, both in real terms. But for most countries, potential output is estimated using data on potential employment, which in part depends on estimates of the structural rate of unemployment (NAIRU).

Interestingly, the six policy and institutional determinants of unemployment explain 24% of the variance (column (4)), as much as house prices alone (column (3)). Moreover, adding house prices to these institutional variables helps to explain 34% of the variance (column (5)). In column (6), we include also the output gap which increases even further the  $R^2$ . But as noticed before, this variable is highly endogenous. We control also by real GDP which is also endogenously affected by house prices (Table 13C). We show in the robustness checks that these results are also robust without filtering our variables but by taking instead house prices in delta-log (Tables 22 and 23).

### 1.3 Instrumental approach

There are several issues with the OLS regression which prevent an interpretation of this correlation in a causal sense, from house prices to unemployment. The first issue is reverse causality: it could be argued that house prices can decrease when unemployment goes up because of reduced consumption on all goods<sup>6</sup>, and on housing services in particular. Second, there is potentially an omitted variable problem, since many factors could drive both house price booms and unemployment patterns. For example, house prices could comove positively and unemployment negatively with the business cycle. Whatever drives the cycle could explain the comovement. Third, there is a clear problem of measurement errors in house prices.

<sup>6</sup>For example, in the precautionary savings literature, capital market imperfections and the presence of uninsured idiosyncratic risk lead agents to save more than they would if there were no uncertainty (notably Carroll et al. (1992), and more recently Mody et al. (2012)).

To answer these issues, we use an Instrumental Variable approach. As in Chapter 1, we use property taxes as an instrumental variable for house prices. Because of capitalization<sup>7</sup>, unexpected increases in property taxes are immediately translated into a decrease of house prices. A very important element in the choice of this tax is that it is not endogenously affected by house prices. Indeed, property taxation essentially uses fiscal values (as opposed to market values) which are rarely revised to reflect market values. Concerning the construction of our instrument, it is not possible to use marginal rates as property taxes are highly multidimensional, nonlinear, with several brackets, and exemptions below a certain threshold. We therefore use the share of revenues brought about by property taxation in total taxation of a country. This enables to capture variations in property taxation that keep total tax receipts constant, since changes in total tax could impact the business cycle. Data on property taxes come from OECD Revenue Statistics. We use recurrent taxes on immovable property, a category that covers taxes levied regularly in respect of the use or ownership of immovable property<sup>8</sup>.

Table 2: IV approach: first and second stage

	(1) House (IV: 1st st.)	(2) House (IV: 1st st.)	(3) House (IV: 1st st.)	(4) U (IV: 2nd st.)	(5) U (IV: 2nd st.)	(6) U (IV: 2nd st.)
Property tax	-3.607*** (1.043)	-2.709*** (0.969)	-4.573** (2.010)			
House Prices				-28.04*** (6.187)	-31.22*** (8.585)	-25.23** (10.36)
GDP		0.00316*** (0.000447)	0.00277*** (0.000546)		0.0851*** (0.0298)	0.0775** (0.0326)
Min. vs. Av. wage			-0.133 (0.331)			3.593 (7.834)
Employment protection			-0.0991** (0.0388)			-2.684* (1.389)
Tax Wedge			-0.0147*** (0.00417)			-0.335** (0.143)
Trade Union			0.00676** (0.00274)			0.276*** (0.0816)
Replacement rate			-0.529** (0.244)			-5.003 (8.611)
Observations	656	554	194	656	554	194
Cragg-Donald				16.35	11.76	11.48

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. House Prices are an indice of house prices, normalized at 1 in 2005. U denotes the Unemployment rate. Country fixed effects included in the regressions. All series are HP-filtered. A possible explanation of the positive sign before GDP in columns (5) and (6) could be that this variable is endogenously affected by house prices.

**First stage.** We use Two stage least squares (2SLS), with exogenous variation of real-estate property taxation ( $T_{it}$ ) as an instrumental variable for house prices in the first stage. We check in the first stage regression that this instrument is indeed related

<sup>7</sup>The mechanism of capitalization is described more fully in Chapter 1.

<sup>8</sup>According to OECD Revenue Statistics, "these taxes are levied on land and building, in the form of a percentage of an assessed property value based on a national rental income, sales price, or capitalised yield; or in terms of other characteristics of real property, such as size, location, and so on, from which are derived a presumed rent or capital value. Such taxes are included whether they are levied on proprietors, tenants, or both. Unlike taxes on net wealth, debts are not taken into account in their assessment."

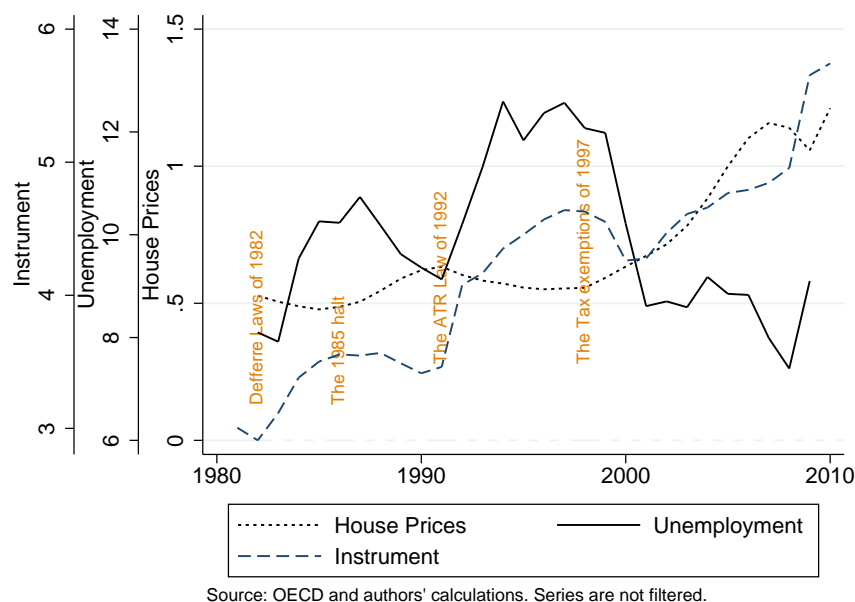
negatively to house prices ( $H_{it}$ ), estimating the equation by least squares:

$$H_{it} = \gamma T_{it} + \delta X_{it} + \delta_i + \nu_t + v_{it}. \quad (2)$$

In Table 2, a 1% increase in the share of property taxation leads to a decrease in house prices of about 3.7% (column (1)). This first stage is very robust when we include our controls (column (3)).

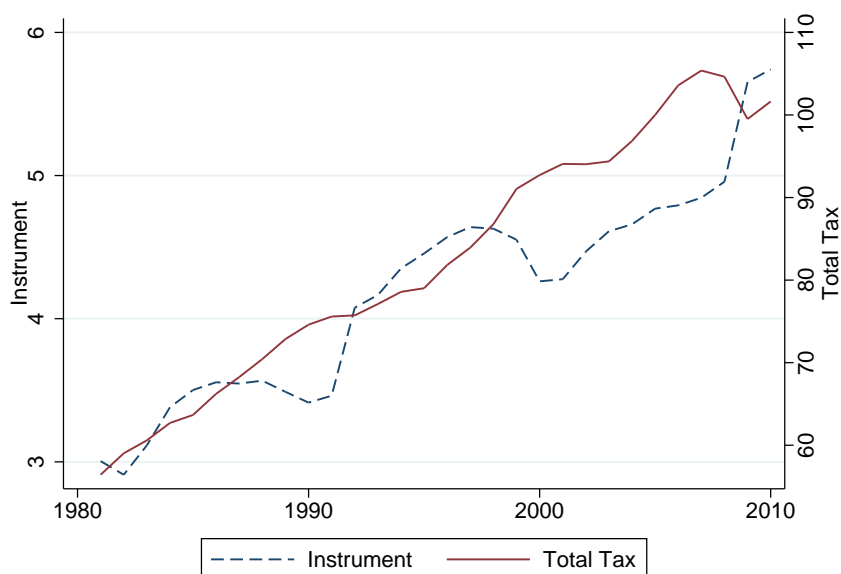
**Exclusion restriction.** Several arguments help to explain why our instrumental variable does not impact unemployment other than through house prices. Property tax changes must not result from an omitted third factor, like economic conditions. A major argument in favor of our instrument is that property taxes are usually set by local governments, and are not a tool used for macroeconomic policy. In the robustness checks, we verify that business cycle factors such as GDP do not correlate at all with our instrumental variable (Table 20). We show also that controlling for different measures of GDP does not alter our results in any way (Table 19). We verify also that variations of our instrument are not driven by changes in total taxes (Table 21). We show that smoothing our denominator does not alter the results in any way. In particular, we take an averaged value of total tax or we smooth total tax taking the trend component of a HP filter to remove business cycle frequencies. Moreover, we show that choosing other scaling variables for property taxes does not alter the results either<sup>9</sup>.

Figure 1: Instrument, house prices and unemployment in France



<sup>9</sup>In Chapter 1, we develop also the argument that variations of our instrument are not driven by changes in the value of other taxes. 95% of changes in our taxation measure come from an increase in the amount collected by property taxes, not from an increase in total taxes (in frequency terms).

Figure 2: Instrument and total taxation in France



Source: OECD and authors' calculations. Series are not filtered. Total tax is measured in real terms.

**A narrative approach: the example of France.** We take the example of France where it is possible to shed light on four different property tax shocks over the last thirty years (Figures 1 and 2). These shocks are consequences of decentralization policies, uncorrelated with unemployment dynamics or the business cycle. The first shock was the result of the Defferre Laws in 1982-1983 that initiated the policy of decentralization in France. Prior to these laws, French municipalities and departments enjoyed very limited autonomy. The laws gave territorial collectivities in France separate defined responsibilities and resources. In particular, the 1983 laws dating from 7 January and 22 July defined the responsibilities of new bodies (the "Régions") and how they would be financed. If local authorities could set property tax rates since 1981, it was the need of increasing resources due to the new responsibilities of local collectivities that explained the rise of property taxes between 1982 and 1985, whose consequence was a gradual decrease of house prices and an increase in the unemployment rate.

A second shock was the halt to the decentralization reforms in 1985. That year marked the end of the first phase of decentralization. This started a period of moderation of local taxation. If local authorities enjoyed more autonomy thanks to the decentralization reforms, they became also responsible to the electors, in particular of their budget management. Several local elections took place during this period (for the "départements" in 1985, for the regions in 1986, for the municipalities in 1989). This was a major factor explaining the fiscal moderation. During this period, new budgetary control rules were also put in place by local authorities and budgetary choices were rationalized. These efforts contributed to alleviating budgetary financing needs. This period of moderation of local taxation led to an increase of house prices and to a decrease of the unemployment rate.

The third policy shock was the result of the ATR law of 1992. Intercommunality was

the main cause of the increase of property taxes between 1993 and 2006 (Charlot et al. (2008)), whose consequence was a decrease of house prices and a rise of unemployment. Intercommunality really emerged in France with the ATR Law of the 6th February 1992 which created the "communautés de communes". The law was an immediate success with more than 1000 "communautés de communes" created during the first five years. Decentralization reforms had permitted transfers of responsibilities to local authorities. Increasing responsibilities implied a need for increasing resources which explained the increase of property taxes.

Finally, the fourth shock was the result of the tax exemptions of 1997 and the local elections of 1998. The increase of property taxes that had started in 1992 with the ATR law was temporarily halted in 1997-1998. Several property tax exemptions were voted in 1996-1997 (property tax exemptions for developed property during 5 years in urban free zones with the Law of the 14th November 1996; property taxes for undeveloped property are removed for the Régions and "départements" in 1996). In addition, local authorities started in 1997 a policy of tax moderation, notably because the parliament had secured the state grants to local governments with the Financial Stability Pact (integrated into the 1996 Finance Act). The local elections of 1998 (for the "départements" and régions) contributed also to this tax moderation, whose consequence was an increase of house prices and a decline of unemployment.

**IV results.** Looking at the column (4) of the second stage (Table 2), we get that a 10% increase in house prices yields to a decrease of the unemployment rate of 2.8%. This estimation by IV is not significantly different from that obtained by ordinary least squares. Comparing column (4) (2nd stage) in Table 2 with column (1) in Table 1, we interpret the increase in the coefficient with respect to OLS (in absolute value) by the fact that house prices are mismeasured and that OLS estimates are therefore biased towards 0. This suggests also that reverse causality is not at work in the data (higher unemployment does not generate lower house prices). Note that the lower coefficient in the OLS case could also be explained by the use of housing as a precautionary saving asset in times of uncertainty. For example during the recent crisis in France, increase in the demand for housing could partly be due to an increase in uncertainty (correlated with higher unemployment rate). Note that in Appendix D, we simulate unemployment patterns taking house price shocks as given. Predicted patterns of unemployment match actual ones reasonably well.

#### **1.4 House price effects go beyond impacts on construction**

House prices have a causal effect on the unemployment rate. To understand this effect, we decompose employment into the different sectors of the economy. It is in particular interesting to estimate the effects of house prices which go beyond the direct effect in the construction sector.

**The magnitude of the direct effect.** In average for our sample of 34 countries over the period 1970-2010, employment in the construction sector and in real estate activities represents around 8% of total employment<sup>10</sup> (7% for the construction sector only, with a standard deviation of 2%). In particular, employment in construction represented in 2005 around 6% of total employment in France or Germany, 7% in the United-Kingdom, 8% in the United States or 12% in Spain (Table 11 in Appendix A). In addition, the production of other sectors of the economy may be used as inputs for construction. In table 12 of Appendix A, we estimate the total share of employment devoted to housing in several countries. To do so, we add employment in the construction sector (column (2)) and in real estate activities (column (3)). We calculate also thanks to OECD Input-Output tables an estimation of the number of employees devoted to housing in sectors that are used as inputs of construction and real estate activities (column (1)). The sum of these 3 columns gives us an estimation of the size of employment in the housing sector. The housing sector represented 11.7% of total employment in the United States in 2005 (column (4)), 12% in the United Kingdom, 11.3% in France, almost 23% in Spain. It is interesting to notice the cases of Japan and Germany which had a housing boom in the nineties. If percentages in these countries are still high (13.4% in Japan, around 10% in Germany), they are lower than in the mid-nineties (respectively 16.1% and 14.2% )<sup>11</sup>.

Not only the housing sector represents a significant share of total employment, but employment in this sector is also one of the most volatile in the economy. If employment in the construction sector represents in average in our sample 8% of total employment, it explains 56% of the variance of total employment<sup>12</sup> (Table 24, column (1)). This helps to explain that house prices have such an impact on unemployment.

**Decomposition of Employment.** To measure the effects of house prices on the different sectors of the economy, we decompose employment into six sectors using ISIC Rev. 3 classification: (1) Agriculture, hunting and forestry, fishing ; (2) Industry, including energy ; (3) Construction ; (4) Wholesale and retail trade, repairs; hotels and restaurants; transport ; (5) Financial intermediation; real estate, renting and business activities ; (6) Other service activities. Each sectoral variable is measured as a percentage of active population.

We measure the effects of house prices on these different sectors. An increase of house prices of 10% leads to an increase of total employment of 0.8% (column (1) of Table 3). If we decompose this effect, employment increases by 0.3% in the construction sector (column (4)), and by around 0.2% in industry (column (3)), in retail services (column (5)), and in financial and business activities (column (6)). Employment variations in

<sup>10</sup>Estimations for non-filtered series.

<sup>11</sup>We calculate also in column (5) of Table 12 the share of employment devoted to housing in sectors which use construction as an input. If employment in these sectors is not directly impacted by a construction boom, it is influenced by changes in house prices (rising input prices impact employment in output sectors). For instance, almost 8% of employment in Spain (in 2005) was in sectors which directly use housing as an input (in the sense of an input-output table).

<sup>12</sup>Employment in industry that represents 18% of total employment explains 20% of the variance (column (3)). On the contrary, employment in retail service activities (hotels, restaurants, ..), that represents in average 24% of total employment, explains only 10% of the variance (column (4)).

Table 3: Employment Decomposition

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Employ. total (OLS)	Agri. (OLS)	Ind. (OLS)	Constru. (OLS)	Retail. Serv. (OLS)	Financial (OLS)	Other Serv. (OLS)
House Prices	8.100*** (1.110)	-0.0881 (0.200)	1.617*** (0.439)	3.482*** (0.389)	1.573*** (0.574)	1.610*** (0.258)	-0.00704 (0.371)
GDP growth	1.147** (0.531)	-0.0869 (0.128)	0.998*** (0.270)	-0.0476 (0.181)	0.374 (0.246)	-0.0564 (0.137)	0.000886 (0.202)
Observations	457	457	457	457	457	457	457
$R^2$	0.278	0.037	0.130	0.362	0.083	0.131	0.005

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. "Employ. total" denotes total employment. The six other columns represent the 6 sectors of ISIC Rev. 3 classification : Agri. denotes employment in agriculture; Ind. employment in industry; Constr. employment in construction; Retail Serv. employment in retail services; Financial employment in financial services; Other Serv. employment in other services. Employment variables are measured as a percentage of active population.

construction explain 43% of the variations of total employment following house price fluctuations. This implies that more than half of the variations comes from other sectors of the economy. In the robustness checks, we show that these results are also robust using the instrumental strategy (Table 25 B).

**Tradable and non-tradable sectors.** To clarify the understanding of the effects of house prices on the different sectors of the economy, we decompose the economy into tradable and non-tradable sectors. We define industry<sup>13</sup> as the tradable sector. For robustness, we show also the results restricting the tradable sector to manufacturing. To represent the non-tradable sector, we include market services<sup>14</sup> as in Freeman (2008). Note that we separate construction from the rest of the non-tradable sector. We control the classification of the tradable and non-tradable sectors by measuring the degree of trade openness in each sector<sup>15</sup>. Effects on tradable and non-tradable sectors tend to converge with the degree of trade openness. When house prices increase by 10%, employment increases by 0.2% of active population in the tradable sector and by 0.3% in the non-tradable sector (columns (2) and (3) of Table 4A). Looking at the IV estimate, we get that a 10% increase in house prices leads to an increase of 0.6% in the tradable sector and 0.9% in the non-tradable one (columns (5) and (6)). To take into account the relative size of each sector, we measure also in the robustness checks house price effects in elasticity terms<sup>16</sup>.

Interestingly, house prices have asymmetric effects on employment during booms

<sup>13</sup>According to the International Standard Industry Classification (ISIC Rev.3), industry includes: mining and quarrying; manufacturing; and electricity, gas and water supply.

<sup>14</sup>According to the ISIC Rev.3, market services include: Wholesale and retail trade, repairs; hotels and restaurants; transport ; Financial intermediation; real estate, renting and business activities ; Other service activities. Note that we include real estate activities in the non-tradable sector as employment variations in real estate services only explain 3% of employment variations in the non-tradable sector following house price fluctuations.

<sup>15</sup>We use OECD STAN database that enables to measure exports and imports of each specific sector.

<sup>16</sup>In table 26A, a 10% increase in house prices implies an increase of 0.8% in employment (1% in the tradable sector and 0.5% in the non-tradable sector).



Table 4: House prices and Employment in tradable and non-tradable sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table A</b>	Employ. (OLS)	Employ. T (OLS)	Employ. NT (OLS)	Employ. C (OLS)	Employ. T (IV)	Employ. NT (IV)	Employ. C (IV)
House Prices	8.033*** (1.114)	1.617*** (0.439)	3.175*** (0.808)	3.482*** (0.389)	6.109*** (2.203)	9.216*** (3.537)	4.015*** (1.557)
GDP growth	1.234** (0.532)	0.998*** (0.270)	0.318 (0.334)	-0.0476 (0.181)	0.296 (0.444)	-0.625 (0.643)	-0.131 (0.264)
Observations	457	457	457	457	457	457	457
$R^2$	0.277	0.130	0.131	0.362			
Cragg-Donald					17.02	17.02	17.02

	(1)	(2)	(3)	(4)
<b>Table B</b>	Employment (OLS)	Employment T. (OLS)	Employment NT (OLS)	Employment C. (OLS)
House(boom)	5.941*** (1.200)	0.686 (0.442)	2.316*** (0.867)	3.039*** (0.452)
House(bust)	12.52*** (1.656)	3.613*** (0.729)	5.018*** (1.203)	4.431*** (0.555)
GDP growth	1.103** (0.500)	0.939*** (0.249)	0.264 (0.326)	-0.0755 (0.181)
Observations	457	457	457	457
$R^2$	0.310	0.169	0.150	0.374

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included. Series are HP-filtered. House denotes house prices. Employ. denotes total employment. Employ T. denotes employment in the tradable sector; Employ. NT in the non-tradable sector; Employ. C employment in construction. Employment variables are constructed as a percentage of active population.

and busts<sup>17</sup>. In Table 4B, we show that the effect of house prices is much larger when house prices decrease (columns (1) to (4)). For example, if house prices increase by 10%, total employment increases by 0.6%, while for a decline of house prices of the same magnitude, total employment decreases by 1.3% (column (1)). Note that when house prices increase, there is no significant effect on employment in the tradable sector (column (2)). This result could be explained by the Dutch Disease mechanism we develop in Section 2. Contrary to the tradable sector, employment in the non-tradable sector increases during housing booms (column (3)). Concerning housing busts, when house price decrease by 10%, employment in the tradable sector falls by 0.4% (0.5% in the non-tradable sector) (columns (2) and (3)).

Note finally that in Appendix B, we test different channels to explain why house price effects go beyond the effects on the construction sector. In particular, house prices could affect labour demand through investment and consumption channels (Table 13A,B). We show also house price effects on GDP, and on activity in the tradable and non-tradable sectors (Table 13C).

<sup>17</sup>We measure booms as periods where house prices increase. Similarly, busts are defined as periods where house prices decrease.

Table 5: Reallocation during booms and busts

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP.C.(sh)	GDP T(sh)	GDP.NT(sh)	GDP.C.(sh)	GDP T(sh)	GDP.NT(sh)
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House(boom)				3.345***	-1.042*	-1.641***
				(0.347)	(0.560)	(0.486)
House(bust)				4.665***	-3.153***	-1.083
				(0.563)	(0.919)	(0.924)
House Prices	3.770***	-1.722***	-1.461***			
	(0.334)	(0.510)	(0.465)			
Observations	861	861	861	861	861	861
$R^2$	0.346	0.017	0.014	0.355	0.022	0.014

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series are HP-filtered. GDP T denotes GDP in the tradable sector; NT in the non-tradable sector; C in construction. Variables of GDP are measured as a share (sh) of total GDP.

## 2 House prices as a Dutch disease

If house prices have a causal impact on unemployment rates, they have also specific effects on activity reallocation in the economy. More precisely, house price fluctuations impact the tradable sector with a mechanism close to a "Dutch Disease" (Corden and Neary (1982) and Corden (1984)). The housing boom will increase the demand for labor, which will cause production to shift toward the booming sector (construction), an effect called in the literature "direct-deindustrialization" (2.1). A second effect occurs as a result of real exchange rate appreciations that follow housing booms and affect manufacturing exports ("indirect-deindustrialization") (2.2). Note that contrary to a traditional Dutch Disease, the booming sector is not a tradable sector.

### 2.1 Reallocation during booms and busts

House prices lead to a reallocation of employment and activity in favor of the construction sector. During booms, both the tradable and the non-tradable sectors suffer from a reallocation of activity towards construction (columns (1) to (3), Table 5). This is close to the resource movement effect described in Corden and Neary (1982)<sup>18</sup>. During busts, activity in the tradable sector increases relative to the rest of the economy (column (5)). This could be explained by the rise of exports following the housing bust (see subsection 2.2). In the robustness checks, we show that effects on employment reallocation are very close (Table 32). During booms, the share of employment in the tradable sector declines relative to total employment (column (1)).

<sup>18</sup>Making a parallel, we can make the assumption that house price booms raise profitability in construction and raise the demand for labour in construction at a given wage rate. This effect, which raises the wage rate (for a given real exchange rate) thus could cause labour to move out of both the manufacturing and services sectors. Employment in manufacturing therefore falls. This is called in Corden and Neary (1982) direct de-industrialisation.

Table 6: House prices and wages during dutch disease

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RER	LC	LC T	LC NT	ER	LC	LC T	LC NT	ER
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)	(IV)
House(boom)	21.15*** (4.206)	15.50*** (2.391)	17.03*** (2.398)	15.10*** (2.740)	14.05*** (3.055)				
House(bust)	26.20*** (6.700)	25.34*** (3.776)	28.47*** (3.176)	27.32*** (3.521)	20.52*** (4.718)				
House Prices						43.91*** (9.268)	62.14*** (15.83)	48.78*** (13.57)	26.21* (14.01)
Observations	775	594	555	555	861	540	540	540	856
$R^2$	0.071	0.333	0.274	0.304	0.065				
Cragg-Donald						14.56	14.56	14.56	25.84

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. RER denotes the real exchange rate, ER the nominal exchange rate. LC denotes real labour cost; T denotes the tradable sector; NT the non-tradable sector.

## 2.2 A loss of competitiveness of the tradable sector

We investigate house prices effects on real exchange rates, manufacturing exports and on local spending. We show that house price effects are more painful in a monetary union, probably because of the absence of nominal exchange rate adjustment.

**Real exchange rates appreciate during booms.** Housing booms are accompanied by real exchange rate appreciations (column (1) of Table 6). This can be explained by increases in wages in the economy (column (2)). If wages rise equally in the tradable and non-tradable sectors (columns (3) and (4)), increases in wages in construction tend to precede both increase in wages in the rest of the economy and real exchange rate appreciations (Table 33 in the robustness checks). Real exchange movements could also be explained by nominal exchange rate fluctuations (columns (5) and (9) of Table 6). These adjustments in the nominal exchange rate could be due to the capital inflows driven by house price booms<sup>19</sup>. We show later in this subsection that real exchange rate adjustments come mostly from changes in wages or prices in a monetary union whereas they can also be explained by adjustments in the nominal exchange rate in the other countries (Table 8). Housing booms tend to reduce margins in the tradable sector as labour costs increase more than manufacturing prices (probably because these prices tend to be fixed at international levels) (Table 35 in the robustness checks).

**A negative impact on manufacturing exports.** Housing booms negatively affect manufacturing exports, probably because of real exchange rate appreciations. Table 7 shows that manufacturing export volumes are negatively correlated with house prices (column (2)). Manufacturing exports decline also relatively to domestic manufacturing production (columns (3)). In the robustness checks (Table 36), we show also that they decline relatively to world manufacturing exports (column (1)), to world trade (column (2)) or to world manufacturing production (column (3)). These are symptoms of real losses

<sup>19</sup>We showed in chapter 1 that house prices drive current accounts.

Table 7: House price effects on the Tradable sector

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP(man) (OLS)	Exp(man) (OLS)	Exp.man/Prod.man (OLS)	Imp(man) (OLS)	LC(man) (OLS)	Cons. dura. (OLS)
House(boom)	13.76*** (3.381)	-3.165** (1.403)	-0.0476*** (0.0112)	2.952*** (1.082)	15.35*** (2.295)	44.49*** (5.951)
House(bust)	13.29** (5.378)	-7.747*** (2.161)	-0.0951*** (0.0207)	3.970** (1.889)	25.47*** (3.766)	56.59*** (10.78)
GDP	-0.0585 (0.0401)	-0.0748*** (0.0162)	-0.000923*** (0.000131)	-0.0401*** (0.0141)	0.0372 (0.0233)	-0.00834 (0.0537)
Observations	653	706	644	706	544	512
$R^2$	0.035	0.138	0.254	0.029	0.193	0.257

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. Exp(man) denotes exports in the manufacturing sector; Prod.man denotes production in manufacturing; Imp. means imports; LC labour cost; Cons. dura. consumption of durable goods.

of competitiveness. It is interesting to notice that terms of trade (exports value/imports) are negatively correlated with house prices (column (5) in Table 36).

**Local spending.** The negative impact of house prices on exports seems however to be compensated by local consumption effects (columns (1) and (3) of Table 7). In particular, consumption of durable goods increases during booms, and decreases during busts (column (6)). Local spending seems to mitigate negative effects due to loss of competitiveness during booms. Even if part of this increased spending is met out of rising imports (column (4)), total effect on manufacturing GDP is still positive (column (1)). These opposite effects on exports and local spending could explain that house prices have no significant effect on employment in the tradable sector during booms (Table 4B in Section 1). During busts, if exports recover, the effect of house prices on manufacturing activity is negative (column (1)), probably because local consumption decreases. Foreign demand seems too low to compensate (column (3)) this negative effect.

Note that concerning the effects of house prices on consumption, it is difficult to disentangle two different channels. New workers (or increase in wages) in the construction sector, thanks to the housing boom, could explain the increase in consumption<sup>20</sup>. The increase in consumption could also be explained by traditional wealth effects. In the robustness checks, we try to disentangle effects directly linked to construction (volume effect) and the more general effects of house price fluctuations (price effects) described in Appendix B. To do so, we compare the effects of construction and house prices on consumption. It is very difficult to disentangle these two effects as house prices and construction volumes are correlated (column (1) of Table 43). However, we can compare the size of estimated coefficients and  $R^2$  in the two cases. House price effects seem to be larger than construction effects (columns (2) and (3) of Table 43). House prices seem thus to have additional effects than construction volume variations. This issue would require further investigation.

<sup>20</sup>This effect is closer to the "spending effect" described in Corden and Neary (1982) where part of the extra income in the booming sector is spent directly by factor owners.

Finally, we show in the robustness checks that house price effects on the manufacturing sector are robust with IV estimates (Table 34). An instrumented increase in house prices leads to an increase of manufacturing GDP (column (1)), to a rise of consumption of durable goods (column (2)), to rising wages in the sector (column (3)), to real exchange rate appreciation (column (4)) and to a decrease of exports (column (5)).

**Adjustments in a monetary union.** We look more specifically in Table 8 at the adjustments in a monetary union, investigating the cases of the Euro area and the European Monetary System (EMS). We construct two dummy variables, one corresponding to the Euro area countries and period<sup>21</sup>, one adding to the previous observations those corresponding to the European Monetary System. Note that we only keep two periods (1979-1983 and 1987-1992) of the European Monetary System which were characterized by great stability of exchange rates<sup>22</sup>. Following house price movements, adjustments of the real exchange rates are larger in the non-Euro countries (columns (1) and (2) of Table 8A). The source of the adjustments is different in the two groups of country. In the monetary union, they come from large adjustments in wages (columns (3), (4), (9), (10) of Table 8A) whereas they can also be explained by nominal exchange rate movements in the non-Euro countries (columns (1), (2), (7), (8) in Table 8B). Changes in wages are accompanied by changes in prices in the monetary union (columns (3) to (6), and (9) to (12) in Table 8B).

Interestingly, if housing booms are negatively correlated with manufacturing exports in the two groups of countries, housing busts are only accompanied by a rise of exports in the countries no members of the monetary union (columns (3) and (4) of Table 8C). This could be explained by the fact that housing booms lead to real exchange rate appreciations in the two groups of countries, but real exchange rates only depreciate during busts in the non-member countries (columns (1) and (2) of Table 8C). In particular, nominal exchange rates do not adjust in the monetary union ((columns (1), (2), (7), (8) in Table 8B). We show also that house prices are negatively correlated with trade balances during booms and busts in the two groups of countries (columns (7) and (8) of Table 8C)<sup>23</sup>. During housing busts, the positive impact of house prices on the trade balances in the monetary union can be explained by a decline of imports (column (5) of Table 8C).

House price effects on manufacturing activity seem to be much larger during housing busts in the monetary union than in the other group of countries (columns (9) and (10) of Table 8C). This could be due to the absence of a positive adjustment of exports during busts in the monetary union (column (3)). However, we show that the negative impact of housing busts on manufacturing employment is lower in the monetary union than

<sup>21</sup>The Euro became the new official currency of 11 Member States in 1999. For these countries, we extend the period, starting in 1996, as there was great rigidity of exchange rates from this date.

<sup>22</sup>During the period 1979-1983, relatively few realignments occurred, and when these occurred few currencies were involved. The other period 1987-1992, called the "hard" EMS, was characterized by great stability if not rigidity of exchange rates (Englander and Egebo (1993)).

<sup>23</sup>In Chapter 1, we have shown that house prices drive current accounts. But we did not decompose house price effects into booms and busts. Furthermore, we have decomposed the current account into savings and investments, whereas we look now at trade balances.

in the other group of countries (columns (11) and (12)). A possible explanation for the lower employment adjustments in these countries could be that employment protection is higher in European countries.

Table 8: Houses prices and adjustments in Monetary unions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<b>Table A</b>	RER	RER	LC	LC	Exp(man)	Exp(man)	RER	RER	LC	LC	Exp(man)	Exp(man)
House Prices	7.769** (3.951)	25.43*** (4.496)	22.23*** (3.298)	17.10*** (2.447)	-9.698** (4.217)	-5.749*** (1.165)	11.73*** (4.497)	27.36*** (5.283)	19.44*** (2.524)	17.23*** (2.857)	-5.621** (2.482)	-6.198*** (1.338)
Observations	151	624	148	446	149	653	245	530	221	373	235	567
$R^2$	0.032	0.081	0.531	0.295	0.092	0.084	0.081	0.091	0.506	0.290	0.078	0.103
Euro	Yes	No	Yes	No	Yes	No						
Euro+EMS							Yes	No	Yes	No	Yes	No

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<b>Table B</b>	Nominal.ER	Nominal.ER	CPI	CPI	Prices(man)	Prices(man)	Nominal.ER	Nominal.ER	CPI	CPI	Prices(man)	Prices(man)
House(nominal)	1.159 (2.286)	18.15*** (3.672)	7.608*** (1.441)	0.196 (1.349)	10.30*** (2.632)	-0.339 (1.987)	3.812 (3.057)	19.30*** (4.085)	6.147*** (1.380)	-0.541 (1.491)	8.986*** (2.141)	-1.237 (2.122)
Observations	166	695	166	800	162	347	261	600	261	705	223	286
$R^2$	0.018	0.049	0.211	0.003	0.090	0.017	0.015	0.053	0.130	0.022	0.077	0.040
Euro	Yes	No	Yes	No	Yes	No						
Euro+EMS							Yes	No	Yes	No	Yes	No

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<b>Table C</b>	RER	RER	Exp(man)	Exp(man)	Imp(man)	Imp(man)	Trade Bal.	Trade Bal.	GDP(man)	GDP(man)	Employ.(man)	Employ.(man)
House(boom)	14.08*** (5.219)	24.83*** (5.726)	-6.001** (2.639)	-4.091*** (1.279)	0.0770 (1.768)	1.813* (0.926)	-7.464*** (1.131)	-8.927*** (1.561)	9.898** (4.874)	18.21*** (3.961)	0.442 (0.477)	1.771*** (0.451)
House(bust)	4.241 (6.631)	32.42*** (8.604)	-4.375 (4.402)	-10.82*** (2.495)	7.163** (3.250)	1.100 (1.771)	-11.95*** (2.328)	-15.56*** (3.013)	21.58** (10.68)	11.86** (5.009)	2.056** (0.926)	4.267*** (0.797)
Observations	245	530	235	567	235	567	245	556	231	483	182	330
$R^2$	0.087	0.092	0.079	0.121	0.125	0.049	0.278	0.174	0.149	0.106	0.134	0.234
Euro+EMS	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No

**Notes:** HAC robust standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . OLS regressions. Country fixed effects included. Series are HP-filtered. RER denotes real exchange rates; LC real labour costs; Nominal.ER nominal exchange rates; Exp(man). manufacturing exports; Imp(man) manufacturing imports; House(nominal) house prices in nominal terms; CPI consumer price index; Prices(man) manufacturing domestic producer prices; Trade Bal. is the trade balance of goods and services as a % of GDP; EMS the European Monetary system. We include two periods of the EMS: 1979-1983 (relatively few realignments, and when these occurred few currencies were involved) and 1987-1992 (the "hard" EMS characterized by great stability if not rigidity of exchange rates).

Table 9: Testing the Dutch Disease

	(1)	(2)	(3)	(4)
	Exp(man) (OLS)	Exp(man)/Prod(man) (OLS)	Employ(man) (OLS)	GDP(ind) (OLS)
House	-0.515 (1.254)	-0.0150 (0.0191)	2.812*** (0.749)	26.37*** (5.323)
House*Trade openness	-0.116*** (0.0421)	-0.00149** (0.000636)	-0.0440*** (0.0170)	-0.348** (0.160)
Trade openness	0.758*** (0.0310)	0.00360*** (0.000365)	0.0577*** (0.0119)	1.104*** (0.0954)
GDP	-0.00690 (0.00771)	-0.000562*** (0.000125)	-0.00161 (0.00271)	0.00710 (0.0354)
Observations	683	621	411	588
$R^2$	0.765	0.407	0.108	0.296

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Exp(man) denotes manufacturing exports; Prod(man) manufacturing production; Employ(man) manufacturing employment.

**Testing the Dutch Disease.** One way to check whether a channel is at work is to see whether industries that might be most affected by a channel grow differentially in countries where that channel is likely to be more operative (Rajan and Zingales (1998), Rajan and Subramanian (2011)). Effects of house prices on the manufacturing sector should depend on the degree of trade openness. If house prices reduce the competitiveness of the traded goods sector, it should be the case especially in more open countries. We show in Table 9 that countries more open to trade are more affected by house prices through declining exports. The interaction between house prices and trade openness is significant in explaining decreasing manufacturing exports following house price increases (columns (1) and (2)). The channel reduces also manufacturing employment and the activity of the traded good sector (columns (3) and (4)).

### 3 Effects over the housing cycle

Housing booms lead to a decrease in the unemployment rate, housing busts to a rise of unemployment. But what is the total effect of house prices over the housing cycle? Similarly, what is the total effect on the tradable sector over the housing cycle?

**Higher unemployment over the housing cycle.** In Table 10A, we compute the total effect of house prices on unemployment over the housing cycle. To do so, we compute the linear sum of the estimated coefficients over the duration of the housing cycle. We take different durations of the housing cycle. Bracke (2011) has calculated for OECD countries an average duration of housing cycle of 10 years with approximately 6 years of booms and 4 years of busts. For robustness, we test also with other durations. The statistic is very significant whatever the duration chosen (standards errors in columns (1) to (6))<sup>24</sup>. The total effect is positive : over the housing cycle, house prices lead to

<sup>24</sup>We test the null hypothesis that the coefficients when house prices increase are equal to the coefficient when house prices decrease. Series are taken in delta-log. In the robustness checks, we show that the



Table 10: House price effects over the housing cycle

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	U	U	U	U	U	U	U
<b>Table A: Unemployment</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	1.430***	1.422***	1.357***	1.324***	1.310***	1.383***	1.387***
Standard Errors	0.292	0.302	0.333	0.353	0.379	0.392	0.382
Observations	639	625	611	595	578	560	560
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	E. T	E. T.	E. T	E. T	E. T	E. T	E. T
<b>Table B: Employment T.</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	-0.193***	-0.169**	-0.139*	-0.0852	-0.142*	-0.160**	-0.170**
Standard Errors	0.0634	0.0684	0.0772	0.0789	0.0741	0.0714	0.0681
Observations	483	473	463	452	441	431	431
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	E. NT	E. NT	E. NT	E. NT	E. NT	E. NT	E. NT
<b>Table C: Employment NT</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	-0.00937	0.00259	-0.00401	-0.00389	-0.0322	-0.0316	-0.0375
Standard Errors	0.0259	0.0240	0.0281	0.0299	0.0251	0.0246	0.0252
Observations	507	496	485	473	461	450	450
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Exports	Exports	Exports	Exports	Exports	Exports	Exports
<b>Table D: Exports</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	-0.214**	-0.213*	-0.229*	-0.283**	-0.190	-0.233*	-0.247**
Standard Errors	0.103	0.117	0.126	0.132	0.124	0.127	0.122
Observations	720	703	686	665	645	625	625
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. For the duration of the housing cycle, "1/1" indicates a cycle with one-year boom and one-year bust. All series are taken in delta log (elasticity). U denotes the unemployment rate. E.T denotes employment in the manufacturing sector; E. NT employment in the non-tradable sector. Exports are measured as manufacturing exports over the mean value of world trade in manufacturing (exports+imports).

higher unemployment. This is line with our results that the effects of house prices are asymmetric between booms and busts.

**A deindustrialization phenomenon over the housing cycle.** In Table 10B, we show that the (dynamic) total effect of house prices on employment in the tradable sector is negative. This is desindustrialization phenomenon over the housing cycle. On the contrary, total effects on the non-tradable sector are not significant (Table 10C). In addition, we show in Table 10D that the share of manufacturing exports over world trade in manufacturing goods declines over the housing cycle. This is the consequence of the loss of competitiveness of the tradable sector.

results are also robust when filtering our series (Table 38A).

## 4 Robustness checks

For the sake of brevity, tables corresponding to robustness checks are at the end of the chapter, in Appendix C.

**Granger causality.** We check in this section that Granger causality tests confirm that house prices cause unemployment and not the other way around. Table 16A shows that fitting simple VAR with 2 lags<sup>25</sup> confirm this result: a positive shock to house prices does cause a decrease of unemployment in the period after (columns (2)) while unemployment (a negative shock to unemployment) does not cause increases in house prices as can be seen in columns (1), (3). We show also in Table 16B that Granger causality tests confirm that house prices cause GDP and not the other way round<sup>26</sup>. A positive shock to house prices does cause an increase of GDP in the period after (columns (1)) while GDP (a positive shock to GDP) does not cause increases in house prices as can be seen in columns (2). Similarly, we show in Table 17A that house prices do cause investment (column (1)), residential investment (column (3)) and non residential investment (column (5)) and not the other way around (columns (2), (4), (6)). We have not pursued this empirical strategy in the core of the chapter, even though it seems to yield the same conclusions qualitatively, because Granger causality is not strictly causality, and more importantly because the coefficients are impossible to interpret quantitatively.

**Choice of HP filter parameter.** Our results are robust to several specifications of the HP parameter. In Table 18, we show that any HP-filter parameter in the range 10-1600 yields the same results with very good confidence intervals both for OLS results (A) and IV results (B). There is some disagreement in the literature as to which filter to use for frequencies different from quarterly data. We have used 400, as in Tomz and Wright (2007). Our results are robust to other lower proposed values of 6.25 (Ravn and Uhlig (1997)), 100 in Backus (1992) or higher, such as 1600 (the value commonly use for quarterly data). The choice of the parameter is not so important in our case as we are more interested in first moments than second moments for which the choice of the parameter is essential (Ravn and Uhlig (1997)). We use 400 as we both want to focus on medium term patterns of the data and to remove the trend of our data for our series to be non-stationary.

**Controlling by different measures of GDP.** Our results do not depend on the measure of GDP used. In most tables, we control with real GDP. But our results are robust to other measures. In Table 19, we show that we could have controlled by relative income or GDP growth without changing the results of our instrumental strategy.

<sup>25</sup>To determine the number of lags, we use the Akaike Information Criterion (AIC) and the Schwarz' Bayesian Information Criterion (SIC/BIC/SBIC). For most countries, they indicate 2 lags.

<sup>26</sup>We show the instrumented effect of house prices on GDP in Table 13C (Appendix B). We show also the (instrumented) effects of house prices on investment (Table 13A) and consumption (Table 13B).

**Other scaling variables.** In Table 21, we show that using other scaling variables does not change our results. In particular, using as an instrumental variable the share of property taxation as a percentage of private consumption (column (1)) instead of using the share of this tax as a percentage of total taxes does not change the results. The results are also robust if we measure the property tax with other scaling variables, such as investment (column (2)) or GDP (column (3)). We show also that smoothing total tax does not alter the results. In particular, we smooth total tax using the trend component of a HP filter (column (4)). We use the parameter 6.25 that is recommended by Ravn and Uhlig (1997) to remove business cycle frequencies with yearly data. We smooth also total tax by taking an averaged value of total tax (column (5)).

**No filter.** In Tables 22 and 23, we show that house price effects on unemployment we computed in Table 1 are robust even without any filter. We take instead house prices in delta-log. In Table 22, we just measure the unemployment rate in log terms. In Table 23, we then measure the unemployment rate in delta-log. The effects of house prices on unemployment are very robust both for OLS and IV regressions, even controlling by the usual determinants of unemployment (columns (1) to (8)) as in Table 2. In Tables 25, we show that results of Table 3 "Employment decomposition" are robust in delta-log, both for OLS (Table A) and for IV (Table B). In Tables 26, we look at house price effects on employment (A) and GDP (B) in the tradable and non-tradable sectors. Results are robust in OLS and IV terms.

**Booms and Busts: more.** In Table 27, we show that house price effects on employment and GDP are still higher during busts than during boom periods when taking the variables in delta-log. Effects on the unemployment rate (column (1) of Table 27) are also higher than the effects on employment (column (2)). When house prices increase by 10%, unemployment decreases by 3.8% (column (1)) and employment increases by 0.4% (column (2)). Note that both for employment (column (3)) and GDP (column (7)), house prices are not correlated with activity in the tradable sector during boom periods. In Table 28, we show that correlations between house prices and employment are also robust when we both take our variables in first differences and we filter them. In particular, effects are still larger during housing busts. Finally, in Table 29, we run IV estimations to compute house price effects on employment during booms and busts. Effects are significant, and still asymmetric between booms and busts.

**Year Fixed effects.** We control that house price effects on employment and GDP are robust to the inclusion of year fixed-effects (Table 30). In particular, in Table 30A, an instrumented increase in house prices leads to an increase of employment in the tradable sector (column (5)), in the non-tradable sector (column (6)) and in construction (column (7)). Concerning GDP (Table 30B), house price (instrumented) effects are robust when looking at GDP in the non-tradable sector (6) and in construction (7), but not for the tradable sector (column (5)).

**Consumption and investment.** In Table 31, taking the variables in delta-log, we show that house price effects on consumption are higher during busts than during boom periods (column (1)). For a 10% increase in house prices, consumption increases by 1.1%. When house prices decrease by 10%, consumption decreases by 2.2%. Effects are also robust when looking at consumption of durable goods (column (2)) and consumption in hotels and restaurants (column (3)). When measuring the effects on investment, results in elasticity terms show higher coefficients for residential investment than for non-residential investment. For example, when house prices increase by 10%, residential investment increases by 4.6% (column (5)) and non-residential investment by 2% (column (6)).

**Dutch disease: more.** In Table 32, we look at employment reallocation effects during housing booms and busts. During booms, the share of employment in the tradable sector declines (column (1)) while the share in construction increases significantly (column (3)). During busts, adjustments in employment come from the non-tradable sector (column (2)). In Table 33, we show that wages in construction tend to granger cause wages in the tradable sector (column (1)), wages in the non-tradable sector (columns (3)), and real exchange rates (column (5)). In Table 34, we show that house price effects on the manufacturing sector are robust in IV. In particular, house prices drive manufacturing GDP (column (1)), consumption of durable goods (column (2)), labour costs in the sector (column (3)), real exchange rates (column (4)) and manufacturing exports (column (5)). In Table 35, we compute house price effects on manufacturing margins. Manufacturing margins are calculated as the ratio between producer price indexes (PPI) in the manufacturing sector and labour costs in the same sector. House prices are negatively correlated with manufacturing margins both in OLS and IV (columns (1) and (2)) because of their strong effect on labour costs (columns (6) and (7)). In Table 36, we show that when house prices increase manufacturing exports decline relatively to world manufacturing exports (column (1)), to world trade (column (2)) or to world manufacturing production (column (3)). It is also interesting to notice that terms of trade (exports value/imports) are negatively correlated with house prices (column (5)). This is true also in elasticity terms (Table 36B).

**Trade openness.** Definitions of the tradable and non-tradable sectors depend on the degree of trade openness. The tradable sector loses its specificity when trade openness decreases and effects on the two sectors tend to converge with the degree of trade openness (Table 37). When trade openness is at the very low level of 10% (close to the lower bound of 5.6%), effects of house prices on the tradable and non-tradable are very close (columns (2) and (3) of Table 37). Table 37B shows that the tradable sector suffers all the more during a bust than its economy is more closed. In a closed economy, the tradable sector cannot indeed benefit from the rise of exports linked to the real exchange rate depreciation. On the contrary, during housing booms, a country very open to trade will only marginally benefit from local consumption and will suffer

from the decrease of exports linked to the real exchange rate appreciation (column (2)). Concerning housing busts, another possible interpretation is that house price decreases lead to capital outflows (sudden stops) (Chapter 1). Trade openness is a way to reduce the negative effects linked to these outflows (Martin and Rey (2006)).

**Total effect over the housing cycle: more.** We show that our results are robust when filtering our series. In particular, house prices are positively correlated with unemployment over the housing cycle (Table 38A). House price cumulative effects are also robust when measuring unemployment in first difference (Table 38B). In addition, house price cumulative effect on the tradable sector is still negative (Table 39). We show also that our results are robust when looking at house price cumulative effect on employment reallocation effect between the tradable and non-tradable sectors (Table 40).

**Working age population.** Our results are robust when measuring employment variables as a percentage of working age population (Table 41). A 10% (instrumented) increase in house prices leads to a rise of employment of 1.5% (column (1) of Table 41B). As working age population is the sum of unemployed, employed and inactive persons, we can compute the house price effects on inactivity. We compare house price total effect (over the housing cycle) on employment and unemployment variables, measured as a share of working age population (Tables 42A and 42B). Results in the two cases are very close. This could imply that house prices have no effect on inactivity. People who exit employment following a house price shock tend to become unemployed and not inactive. This could be explained by the fact that construction is a "male-dominated" sector. This issue would require further investigation.

**Construction.** In Table 43, we compare the effects of house prices and the effects of construction volume variations. It is very difficult to disentangle price effects and volume effects as house prices are strongly correlated to construction (column (1)). In addition, we cannot use our instrument for construction. We show that the effects of house prices seem to be larger than the effects of construction (both for estimated coefficients and  $R^2$ ). It is the case for consumption (columns (3) and (4)), for investment ((5) and (6)), for employment in the tradable sector ((7) and (8)), for real exchange rate fluctuations ((9) and (10)) and for current account variations ((11) and (12)). This could indicate that price effects exist in addition to volume effects. We show also that the effect on consumption of the residual of the regression between house prices and construction (column (1)) is much lower than the effects of house prices (column (4)). This issue would require further investigation.

**Share prices.** Following Beaudry and Portier (2006), we use also share prices as a variable for capturing changes in agents expectations about future economic growth ("news shock"). These changes may drive business cycle fluctuations. In Table 44A, we show that our results both in OLS and in IV (columns (3) and (5)) are very robust when

we control by this variable. In Table 44B, we show that house prices granger cause share prices.

**Home-ownership: a friction in the labour market.** Home-ownership could play as a friction in the labour market. Following Oswald (1996), we measure if home-ownership is a constraint for employment, notably because of reduced mobility. We build an interaction variable between house prices and the home-ownership ratio to capture this friction. To investigate this friction, we look also at unemployment dynamics (Table 45). Panel data on unemployment dynamics are taken from Elsbey et al. (2013). House prices have a significant and positive effect on job findings (column (1)). Interestingly, the effect of house prices on job findings becomes negative when looking at the interaction variable between house prices and home-ownership (column (2) of Table 45): home-ownership seems a constraint in the process of finding a job. Concerning employment exits, house prices are negatively correlated to this variable (column (4)). Note that if home-ownership is not as friction for employment exits, employment protection tends to decrease employment exits (column (6)).

**Structural unemployment.** We control that our results are also valid in the case of structural unemployment (Table 46). We take as a measure of structural unemployment the NAIRU, that is, the rate of unemployment at which there is no tendency emanating from the labor market for inflation to change. A 10% (instrumented) increase in house prices leads to a decrease of unemployment of 2.8% (column (5)) and of structural unemployment of 0.7% (column (6)).

**Beveridge Curve.** In Table 47, we show that job vacancy is indeed negatively correlated with unemployment (column (1)). If house prices are negatively correlated with unemployment (column (2)), they are positively correlated with job vacancy (column (3)). Mismatches induced by sectoral reallocation could lead to a shift in Beveridge Curve. This issue would require further investigation.

## Conclusion

In this chapter, we establish that house prices have a large causal effect on unemployment dynamics. Our instrumental variable for house prices allows us to control for potential reverse causality or omitted variable problems. A 10% (instrumented) depreciation in house prices yields to a 3% increase in the unemployment rate. Our results suggest that house prices are a major factor determining unemployment patterns.

We investigate empirically which mechanisms are at the source of this causal relationship. House prices do not only impact employment in construction but also total employment. A possible explanation could be that house prices affect labour demand determinants through investment and consumption channels (Appendix B). We show also

that house price effects are asymmetric. If housing booms have positive consequences on employment, they are more than compensated by the severe consequences of housing busts. Interestingly, house prices impact also sectoral labour reallocation between tradable and non-tradable sectors. We show that housing booms lead to real exchange rate appreciations that affect manufacturing activity. Negative effects of house prices on employment in the tradable sector can notably be measured through their cumulative impact over the housing cycle. This negative impact can itself be explained by the negative effect of house prices on manufacturing exports over the housing cycle. Housing booms seem to lead to a desindustrialization phenomenon, reminiscent of a Dutch disease.

The policy implications of our results are potentially important. Negative effects of house prices on the tradable sector could be another motivation to manage housing booms. If the traditional policy approach to real estate booms has been one of 'benign neglect' (Bernanke and Gertler (2001), Greenspan (2002)), the financial crisis has showed the dangers of neglecting real estate booms. In particular, financial risks associated with housing bubbles seem to justify a more active policy agenda (Bernanke (2010), Crowe et al. (2011)). However, managing real estate booms through monetary policy or fiscal tools to curb house prices is not out-of-danger as objectives of macroeconomic and financial stability can conflict. A reduction in the risk of a real estate boom may come to the cost of a higher unemployment rate.

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## A Descriptive statistics

Table 11: Share of each sector in total employment

	(1)	(2)	(3)	(4)	(5)	(6)
	Agriculture	Industry	Construction	Retail Serv.	Financial	Other Serv.
France (2005)	3%	13%	6%	22%	17%	33%
Spain (2005)	5%	17%	12%	27%	11%	27%
United Kingdom(2005)	1.6%	11%	7%	28%	20%	32%
United States(2005)	15%	13%	8%	27%	17%	37%

**Notes:** Source: OECD. Authors' calculations. In percentage of total employment.

Table 12: Employment in Housing: an Input-Output table approach

		(1)	(2)	(3)	(4)	(5)
	Year	Inputs of construction	Construction	Real Estate	Total	Construction as input
France	1995	3.8%	6.2%	1.1%	11.1%	2.6%
	2005	4.2%	6.1%	1%	11.3%	3.3%
Germany	1995	4.8%	8.6%	0.8%	14.2%	4.7%
	2005	3.1%	5.6%	1.1%	9.8%	3.8%
Japan	1995	5.6%	10.5%	..	16.1%	2%
	2005	4.3%	9.1%	..	13.4%	1.8%
Spain	1995	6%	9.1%	0.6%	15.7%	4.3%
	2005	9.2%	12.5%	0.9%	22.6%	7.9%
United Kingdom	1995	3.2%	6.6%	0.9%	10.7%	3.8%
	2005	3.7%	7%	1.2%	11.9%	4.2%
United States	1995	3.2%	7.1%	..	10.3%	5.3%
	2005	3.9%	7.8%	..	11.7%	5%

**Notes:** Authors' calculations. Source: OECD Input Output table. "Inputs of construction" is an estimation of the number of employees devoted to housing in sectors that are used as inputs of construction and real estate activities. "Construction as input" is an estimation of the share of employment devoted to housing in sectors which use construction as an input. "Real estate" stands for real estate activities. Calculations are given in percentage of total employment. "Total" represents the share of employment devoted to housing (columns(1+2+3)).

## B Explaining house price effects on unemployment beyond construction

House prices do not only impact employment in the construction sector but also employment in the other sectors of the economy. This could be explained by house price effects on the business cycle. We investigate two main channels to explain these effects: the investment channel and the consumption channel. However, we cannot properly identify consumption and investment specific effects on employment following house price shocks. This issue would require further investigation. Finally, we compute house price effects on GDP.

**The investment channel.** The first channel we investigate is the investment channel. House prices could impact the business cycle and labour demand through their effects on investment. As we have shown in Chapter 1, house prices have a positive causal effect on investment (Table 13A). A rise of house prices of 10% leads to an increase of investment of 1.3% (column (1)). This effect is especially due to a rise of non-residential investment (+0.8% following a 10% increase of house prices against a rise of 0.5% of residential investment). Note that when looking at elasticity, i.e when we take into account the relative size of each part of investment, the effects of house prices on residential investment are much larger than the effects on non-residential investment (columns (5) and (6) of Table 31). In Table 14, we investigate whether house prices could impact investment through firm-financing mechanism. Our data allows us to look into whether the relaxation of borrowing constraints might have caused increasing investment, together with an increased value of housing collateral (for its collateral services). More precisely, we investigate whether rising housing values help relaxing financial constraints for firms. We use as a proxy for the potential tightness of credit constraints, the ratio of private credit to GDP. This is a standard measure of financial development in the finance-and-growth literature (Aghion et al. (2010)). We construct an interaction variable between house prices and the ratio of private credit to GDP. The simultaneous of the two variables is significant for explaining investment and unemployment (columns (1) and (4) of Table 14), which confirms that the effect goes through a relaxation of financing constraints for firms.

Through investment, house prices could impact unemployment. Investment is indeed negatively correlated with unemployment (column (5)). We cannot exclude that unemployment comoves with investment following house price shocks<sup>27</sup>.

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<sup>27</sup>To try to identify investment effect on unemployment following house price shocks, we can use regression in column (2) of Table 13 to estimate the (instrumented) predicted value of investment. This predicted value of investments is negatively correlated with unemployment (column (6)). We can show that the predicted value of investment tend to granger cause unemployment (columns (5) and (6) of Table 15). This could indicate a specific effect of investment on unemployment following a house price shock. Identifying properly house prices effects on labour demand channels would however require further investigation.

Table 13: Houses price effects on Investment, Consumption and GDP

	(1)	(2)	(3)	(4)	(5)	(6)		
<b>Table A: Investment</b>	Inv. (OLS)	Inv. (IV)	Res. Inv. (OLS)	NR. Inv. (OLS)	Unemp (OLS)	Unemp (OLS)		
House Prices	12.84*** (0.883)	40.14*** (9.223)	5.243*** (0.337)	7.671*** (0.801)				
GDP	0.0243*** (0.00904)	-0.0850** (0.0391)	0.00457 (0.00345)	0.0196** (0.00821)	0.0144*** (0.00526)	0.0128** (0.00618)		
Invest.					-0.413*** (0.0227)			
Invest.(Pred. IV)							-0.198*** (0.0171)	
Observations	700	700	700	700	527	527		
R <sup>2</sup>	0.296		0.304	0.163	0.391	0.210		

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Table B: Cons.</b>	Cons. (OLS)	Cons. (IV)	Unemp. (OLS)	Unemp. (OLS)	Unemp (OLS)	Unemp (OLS)	Unemp (OLS)	Unemp (OLS)
House Prices	19.34*** (0.850)	37.96*** (5.867)			-7.867*** (1.478)	-7.695*** (0.999)	-7.097*** (0.946)	-9.736*** (1.483)
Cons.			-0.324*** (0.0131)					
Cons.(Pred.IV)				-0.192*** (0.0123)				
Obs.	902	831	621	621	312	309	348	273
R <sup>2</sup>	0.365		0.495	0.282	0.254	0.354	0.271	0.314
Extraction LTV					< 80%	> 80%	No	Yes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>Table C: GDP</b>	GDP (OLS)	GDP T (OLS)	GDP NT (OLS)	GDP C (OLS)	GDP (IV)	GDP T (IV)	GDP NT (IV)	GDP C (IV)	Unemp (OLS)
House Prices	19.19*** (1.880)	15.15*** (2.579)	15.93*** (1.614)	61.80*** (5.282)	42.79*** (7.601)	44.96*** (16.77)	30.72*** (5.681)	106.8*** (17.18)	
GDP(Pred.IV)									-0.185*** (0.0200)
Observations	820	820	820	820	751	751	751	751	568
R <sup>2</sup>	0.280	0.064	0.277	0.375					0.282
Cragg-Donald					20.92	20.92	20.92	20.92	

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are HP-filtered. Inv. denotes investment; Res. Inv. residential investment; NR Inv. non-residential investment; Unemp. the unemployment rate; Cons. consumption; LTV loan-to-value ratios; Extraction housing extraction; GDP denotes total GDP; GDP T denotes GDP in the tradable sector; NT in the non-tradable sector; C in construction. Invest.(Pred.IV) is the instrumented predicted value of investment.

Table 14: Houses prices and Investment: the firm-financing mechanism

	(1)	(2)	(3)	(4)
	Investment (OLS)	Res. Inv. (OLS)	NR. Inv. (OLS)	Unemp. (OLS)
House Prices	7.542*** (1.640)	4.184*** (0.651)	3.458** (1.513)	-4.517*** (1.468)
House/PCGDP	528.1*** (132.9)	91.16* (52.56)	393.2*** (122.2)	-326.1** (129.1)
1/PCGDP	10.71 (10.86)	-1.877 (4.316)	4.723 (10.03)	-19.27 (12.65)
GDP	0.0180** (0.00882)	0.00406 (0.00358)	0.0157* (0.00832)	0.0130** (0.00636)
Observations	735	692	692	519
$R^2$	0.305	0.294	0.168	0.222

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. Inv. denotes investment; Res. Inv. residential investment; NR Inv. non-residential investment. Unemp. denotes unemployment rate.

Table 15: Granger causality: Predicted GDP and U

	(1)	(2)	(3)	(4)	(5)	(6)
	GDP(predict.)	U	Cons.(predict.)	U	Inv.(predict.)	U
GDP(predict.)(L1)	1.265*** (0.0611)	-0.362*** (0.0645)				
GDP(predict.)(L2)	-0.655*** (0.0649)	0.426*** (0.0690)				
U(L1)	0.0361 (0.0336)	1.133*** (0.0704)	0.0967 (0.0919)	1.132*** (0.0704)	0.0954 (0.0906)	1.132*** (0.0704)
U(L2)	-0.0709** (0.0337)	-0.545*** (0.0679)	-0.189** (0.0920)	-0.545*** (0.0679)	-0.186** (0.0907)	-0.545*** (0.0679)
Cons.(predict.)(L1)			1.267*** (0.0605)	-0.132*** (0.0231)		
Cons.(predict.)(L2)			-0.654*** (0.0638)	0.155*** (0.0247)		
Inv.(predict.)(L1)					1.267*** (0.0605)	-0.134*** (0.0234)
Inv.(predict.)(L2)					-0.654*** (0.0638)	0.157*** (0.0251)
Observations	500	500	506	506	506	506
$R^2$	0.706	0.696	0.707	0.696	0.709	0.696

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. "predict" denotes the instrumented predicted value of the variable. Cons. denotes consumption, Inv. denotes investment. U is the unemployment rate.

**The consumption channel.** House prices could impact the business cycle and labour demand through a consumption channel. We show in Table 13B that house prices have a causal positive impact on consumption (column (2)). A 10% increase in house prices leads to an increase of consumption of 3.8%. Through this effect on consumption, house prices could impact unemployment. Consumption is negatively correlated with unemployment (column (3)). As for investment, we cannot exclude that unemployment comoves with

consumption following house price shocks<sup>28</sup>. A possible mechanism to explain house price effects on consumption is the consumer-financing channel. Many commentators have noted that in the 2000s, US consumers saw the collateral value of their house increases which enabled them to borrow more. We investigate whether a relaxation of consumer-financing constraints may cause an increase in consumption. We use measured maximum Loan-to-Value (LTV) to measure these constraints. In Chapter 1, we have shown that the consumer-financing channel does not seem to be a feature of our data. In Table 13B, we show that the relationship between house prices and unemployment is indeed not higher in countries with high LTV ratios (columns (5) and (6)). Similarly, the availability of home-equity extraction does not increase significantly the correlation between these two variables (columns (7) and (8)). The consumer-financing channel does not seem to at work in our data. The much-commented "wealth effects" could explain house price effects on consumption (Case et al. (2013)).

**House prices and GDP.** Because of their effects on investment and consumption, house prices could impact also GDP. This would be in line with the paper of E. Leamer investigating the effects of housing on the business cycle in the United States ( "Housing is the business cycle", Leamer (2007)). In Table 13C, we show the effects of house prices on GDP. A 10% increase in house prices implies an increase of 1.9% of GDP (column (1)). As expected, effected are particularly large on activity on the construction sector (+10% in house prices, +6% in construction (column (4))). Looking at IV estimates, effects of house prices on activity are larger in the tradable sector than in the non-tradable sector (columns (6) and (7) of Table 13C): a 10% increase in house prices cause a 4.5% increase of GDP in the tradable sector and of 3.1% in the non-tradable sector. Predicted value of GDP is negatively correlated with unemployment (column (9))<sup>29</sup>. In the robustness checks, we show that these results are robust when looking at elasticity (columns (5) and (6) of Table 26B for tradable and non-tradable sectors). We show also that house prices tend to granger cause GDP (Table 16B).

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<sup>28</sup>As for investment, we can try to identify consumption effect on unemployment by using IV regression in column (2) of Table 13B to estimate the (instrumented) predicted value of consumption following house price shocks. This predicted value of consumption is negatively correlated with unemployment (column (4)). This predicted value of consumption tends to Granger cause unemployment (columns (3) and (4) of Table 15). This issue would require further investigation.

<sup>29</sup>We estimate thanks to column (5) (Table 13C) the instrumented value of GDP following house price shocks. We show that this variable tends also to Granger cause unemployment (columns (1) and (2) of Table 15).

## C Tables: Robustness checks

Table 16: Granger causality: House Prices, Unemployment and GDP

	(1)	(2)	(3)	(4)		(1)	(2)
<b>Table A</b>	House	Unemploy.	House	Employ.	<b>Table B</b>	GDP	House Prices
House Prices (L1)	1.264*** (0.0564)	-1,350** (613.1)	1.263*** (0.0572)	2,021** (836.0)	GDP (L1)	0.891*** (0.0636)	0.000104 (0.000403)
House Prices (L2)	-0.629*** (0.0578)	1,385** (612.1)	-0.629*** (0.0586)	-1,793** (810.1)	GDP (L2)	-0.414*** (0.0571)	-0.000190 (0.000395)
Unemploy. (L1)	4.41e-06 (5.80e-06)	1.087*** (0.145)			House (L1)	32.85*** (5.717)	1.260*** (0.0478)
Unemploy. (L2)	-2.27e-06 (5.21e-06)	-0.728*** (0.183)			House (L2)	-18.64*** (5.676)	-0.620*** (0.0464)
Employ. (L1)			-1.91e-06 (4.14e-06)	1.078*** (0.110)			
Employ. (L2)			1.48e-06 (3.58e-06)	-0.652*** (0.139)			
Observations	523	523	523	523	Observations	719	719
$R^2$	0.714	0.562	0.714	0.566	$R^2$	0.526	0.729

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. House Prices are an indice of house prices, normalized at 1 in 2005. Country fixed effects included in the regressions. All series are HP-filtered.

Table 17: Granger causality: House and Investment, Investment and U

	(1)	(2)	(3)	(4)	(5)	(6)
	Investment	House	Res. Invest.	House	NR. Invest.	House
Investment (L1)	0.614*** (0.0583)	0.000119 (0.00143)				
Investment (L2)	-0.234*** (0.0552)	0.000151 (0.00144)				
House (L1)	15.04*** (1.644)	1.283*** (0.0551)	2.538*** (0.542)	1.241*** (0.0556)	11.03*** (1.419)	1.294*** (0.0512)
House(L2)	-14.86*** (1.608)	-0.639*** (0.0509)	-2.785*** (0.565)	-0.597*** (0.0493)	-11.04*** (1.273)	-0.647*** (0.0486)
Res. Invest.(L1)			0.941*** (0.123)	0.00806 (0.00511)		
Res. Invest.(L2)			-0.385*** (0.0892)	-0.00655 (0.00434)		
NR. Invest.(L1)					0.565*** (0.0567)	-0.000825 (0.00153)
NR. Invest.(L2)					-0.227*** (0.0504)	0.000842 (0.00150)
Observations	716	716	714	714	714	714
$R^2$	0.508	0.742	0.587	0.745	0.413	0.743

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. All series are HP-filtered.



Table 18: Other HP filters

	(1)	(2)	(3)	(4)	(5)
	U	U	U	U	U
<b>Table A: OLS</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices	-7.312*** (0.785)	-8.084*** (0.792)	-8.558*** (0.773)	-8.498*** (0.790)	-7.973*** (0.802)
Observations	671	671	671	671	671
Smooth. parameter	1600	400	100	25	10

	(1)	(2)	(3)	(4)	(5)
	U	U	U	U	U
<b>Table B: IV</b>	(IV)	(IV)	(IV)	(IV)	(IV)
House Prices	-37.64*** (12.30)	-29.09*** (6.563)	-26.79*** (5.239)	-25.90*** (4.686)	-26.38*** (4.887)
Observations	656	656	656	656	656
Smooth. parameter	1600	400	100	25	10

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. U denotes the unemployment rate. Smooth. parameter is the HP smoothing parameter.

Table 19: Controlling by different measures of GDP

	(1)	(2)	(3)	(4)	(5)	(6)
	House	House	House	U	U	U
	(IV)	(IV)	(IV)	(IV)	(IV)	(IV)
Property tax	-3.069*** (0.901)	-3.190*** (0.947)	-3.345*** (1.008)			
Relative income	1.495*** (0.194)			10.92 (11.93)		
GDP		0.00359*** (0.000415)			0.0817*** (0.0287)	
GDP growth			0.0376** (0.0183)			2.728* (1.421)
House				-27.49*** (8.414)	-29.02*** (7.837)	-30.37*** (9.863)
Observations	688	616	615	507	507	506

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are HP filtered.

Table 20: Examining exclusion restriction

	(1)	(2)	(3)	(4)
	Property (/total tax)	Property (/GDP)	Property (/GDP)	Total tax (/GDP)
	(OLS)	(OLS)	(OLS)	(OLS)
GDP	-0.00285 (0.00187)	-0.000419 (0.000572)		
Property (/total tax)			0.286*** (0.0167)	-0.555*** (0.170)
Observations	757	757	757	757
$R^2$	0.008	0.005	0.785	0.037

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects are included. Series are HP filtered. "Property" denotes the property tax. This table is extracted from Chapter 1.

Table 21: Other Scaling variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	House	House	House	House	House	U	U	U	U	U
	(1st st.)	(1st st.)	(1st st.)	(1st st.)	(1st st.)	(IV:Cons.)	(IV:Inv.)	(IV:GDP)	(IV:Tot.tax sm.)	(IV:Tot.tax mean)
Property/Cons.	-0.0454*** (0.0146)									
Property/Invest.		-0.0905*** (0.0198)								
Property/GDP			-0.0606*** (0.0137)							
Property/(Tot. tax sm.)				-0.0399*** (0.0142)						
Property/(Tot. tax mean)					-0.0286*** (0.0104)					
House						-3.102*** (0.838)	-2.777*** (0.298)	-3.085*** (0.728)	-2.641*** (0.972)	-4.318** (2.168)
Observations	824	822	836	803	767	578	578	575	578	563

**Notes:** The property tax variable is measured as a % of GDP, as a % of investment, as a % of consumption. "Tot. tax smo." indicates that total tax is smoothed with the trend component of a HP filter. We use the parameter 6.25 that is commonly used to remove business cycle frequencies with yearly data (Ravn and Uhlig (1997)) Total tax (mean) is calculated as the moving average of Total tax with a 10-year period. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are taken in delta log (elasticity).

Table 22: House prices and Unemployment (OLS): No HP filter.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	U	U	U	U	U	U	U
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices	-0.743*** (0.188)	-0.554** (0.225)	-0.814*** (0.242)	-0.826*** (0.223)	-0.832*** (0.221)	-0.872*** (0.225)	-0.880*** (0.223)
GDP		-0.871*** (0.179)	-0.407*** (0.142)	-0.319** (0.131)	-0.338*** (0.131)	-0.299** (0.128)	-0.122 (0.132)
Employment protection			-0.00377 (0.0531)	-0.0726 (0.0524)	-0.0455 (0.0506)	0.00254 (0.0508)	0.0146 (0.0532)
Trade Union				0.0255*** (0.00392)	0.0281*** (0.00403)	0.0282*** (0.00419)	0.0242*** (0.00372)
Tax Wedge					-0.0150* (0.00822)	-0.0143* (0.00834)	-0.0126 (0.00824)
Replacement rate						0.0143 (0.364)	-0.175 (0.428)
LME (active)							0.293*** (0.0994)
Observations	657	547	428	427	415	395	384

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . U denotes the unemployment rate (in log). House prices and GDP are taken in delta-log. Note that series are not HP filtered.

Table 23: House prices and Unemployment: No HP filter, Delta-log

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	U	U	U	U	U	U	U	U
	(OLS)	(OLS)	(OLS)	(OLS)	(IV)	(IV)	(IV)	(IV)
House Prices	-1.028*** (0.111)	-1.020*** (0.110)	-0.943*** (0.125)	-0.931*** (0.130)	-3.186*** (0.692)	-4.505** (1.843)	-3.461** (1.357)	-4.001** (1.644)
GDP		-0.263*** (0.0881)	-0.0983 (0.117)	0.0291 (0.0803)		0.421 (0.383)	0.267 (0.242)	0.443* (0.262)
Employment protection			0.0135 (0.0200)	0.0136 (0.0218)			-0.0438 (0.0522)	-0.0548 (0.0650)
Trade Union			0.00187 (0.00159)	0.00334** (0.00164)			0.00311 (0.00332)	0.00475 (0.00432)
Tax Wedge			0.00542 (0.00357)	0.00382 (0.00322)			-1.82e-05 (0.00684)	-0.000861 (0.00778)
Replacement rate				0.101 (0.164)				-0.365 (0.524)
LME (active)				-0.0554 (0.0441)				-0.0314 (0.0781)
Observations	639	530	406	376	609	515	401	372

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . U denotes the unemployment rate. Unemployment, House prices and GDP are taken in delta-log. Note that series are not HP filtered.

Table 24: Volatility of Employment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Employ. (OLS)	Employ. (OLS)	Employ. (OLS)	Employ. (OLS)	Employ. (OLS)	Employ. (OLS)	Employ (OLS)
E.Construction	1.936*** (0.0736)						1.936*** (0.00908)
E.Agriculture		0.807*** (0.220)					0.974*** (0.0182)
E.Industry			1.167*** (0.101)				1.201*** (0.00921)
E.Retail Services				1.031*** (0.128)			1.010*** (0.0111)
E.Financial					0.725*** (0.202)		0.699*** (0.0167)
E.Other Services						0.938*** (0.155)	0.981*** (0.0131)
Observations	536	536	536	536	536	536	536
$R^2$	0.563	0.025	0.200	0.108	0.023	0.064	0.993

**Notes:** \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. All series are HP-filtered. For each sector, to abstract from the effect of the other sectors, we take the residuals of the regressions between the given sector and the sectors described in the previous lines. (For example, "Industry" is calculated as the residual of the regression  $Industry = \alpha * Construction + \beta * Agriculture + \gamma$ ). "Employ." denotes total employment. "E." represents employment in the 6 sectors of ISIC Rev. 3 classification.

Table 25: Employment Decomposition (Elasticity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Table A: OLS</b>	U (OLS)	E (OLS)	Agri (OLS)	Ind (OLS)	Constru (OLS)	Retail (OLS)	Fin (OLS)	Other (OLS)
House	-1.020*** (0.110)	0.0661*** (0.00908)	-0.0139 (0.0258)	0.0674*** (0.0184)	0.350*** (0.0410)	0.0659*** (0.0146)	0.113*** (0.0200)	-0.00638 (0.0113)
GDP	-0.263*** (0.0881)	0.0184*** (0.00634)	-0.00619 (0.0261)	0.0570*** (0.0150)	0.0864*** (0.0250)	0.0193** (0.00835)	0.0187 (0.0141)	-0.00494 (0.00877)
Observations	530	504	440	440	440	440	440	440
$R^2$	0.278	0.235	0.060	0.187	0.366	0.158	0.259	0.168

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<b>Table B: IV</b>	U (IV)	E (IV)	Agri (IV)	Ind (IV)	Constru (IV)	Retail (IV)	Fin (IV)	Other (IV)
House	-4.505** (1.843)	0.365*** (0.141)	0.134 (0.173)	0.538** (0.210)	0.990*** (0.314)	0.337*** (0.120)	0.474*** (0.182)	0.116 (0.119)
GDP	0.421 (0.383)	-0.0301 (0.0257)	-0.0290 (0.0518)	-0.0271 (0.0403)	-0.0191 (0.0627)	-0.0266 (0.0250)	-0.0472 (0.0385)	-0.0260 (0.0223)
Observations	515	489	425	425	425	425	425	425

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are taken in delta log (elasticity). E denotes total employment. Agri. denotes employment in agriculture; Ind. employment in industry; Constru. employment in construction; Retail employment in retail services; Fin employment in financial services; Other Serv. employment in other services. Employment variables are measured as a percentage of active population.

Table 26: House price effects on the tradable and non-tradable sectors (Elasticity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table A: Employ.</b>	Employ (OLS)	Employ T (OLS)	Employ NT (OLS)	Employ C (OLS)	EmployT (IV)	Employ NT (IV)	Employ C (IV)
House	0.0803*** (0.00898)	0.101*** (0.0189)	0.0547*** (0.00768)	0.354*** (0.0467)	0.415*** (0.109)	0.166*** (0.0498)	0.766*** (0.168)
Observations	609	507	507	507	480	480	480
$R^2$	0.297	0.169	0.280	0.307			
Cragg-Donald					21.35	21.35	21.35

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table B: GDP</b>	GDP (OLS)	GDP T (OLS)	GDP NT (OLS)	GDP C (OLS)	GDP T (IV)	GDP NT (IV)	GDP C (IV)
House Prices	0.195*** (0.0194)	0.153*** (0.0331)	0.175*** (0.0158)	0.580*** (0.0529)	0.417** (0.173)	0.327*** (0.0785)	0.984*** (0.194)
Observations	863	789	808	808	700	719	719
$R^2$	0.358	0.145	0.433	0.398			
Cragg-Donald					19.19	19.51	19.51

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included. Series are taken in delta log. House denotes house prices. Employ. denotes total employment. Employ T. denotes employment in the tradable sector; Employ. NT in the non-tradable sector; Employ. C employment in construction. Employment variables are constructed as a percentage of active population.

Table 27: Booms and busts (Elasticity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	U (OLS)	E (OLS)	E.T (OLS)	E.NT (OLS)	E.C. (OLS)	GDP (OLS)	GDP.T (OLS)	GDP.NT (OLS)	GDP.C (OLS)
House(boom)	-0.398** (0.155)	0.0258** (0.0115)	-0.0189 (0.0275)	0.0201* (0.0111)	0.245*** (0.0481)	0.109*** (0.0244)	0.0511 (0.0476)	0.117*** (0.0216)	0.425*** (0.0699)
House(bust)	-1.892*** (0.276)	0.122*** (0.0223)	0.179*** (0.0427)	0.0686*** (0.0211)	0.486*** (0.0921)	0.320*** (0.0400)	0.304*** (0.0776)	0.260*** (0.0326)	0.810*** (0.122)
GDP	-0.227*** (0.0789)	0.0163*** (0.00578)	0.0534*** (0.0140)	0.00681 (0.00533)	0.0819*** (0.0237)				
Observations	530	504	440	440	440	863	789	808	808
$R^2$	0.313	0.265	0.214	0.230	0.376	0.379	0.155	0.446	0.411

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series are taken in delta log. U. denotes the unemployment, E. is employment. T denotes the tradable sector; NT the non-tradable sector. C. construction.

Table 28: Booms and Busts (1st difference)

	(1)	(2)	(3)	(4)	(5)
	U.(d) (OLS)	E.(d) (OLS)	Employ. T.(d) (OLS)	Employ. NT.(d) (OLS)	Employ. C.(d) (OLS)
House(boom)(d)	-5.905*** (0.908)	5.307*** (0.996)	1.386*** (0.387)	2.772*** (0.493)	1.561*** (0.516)
House(bust)(d)	-9.390*** (1.257)	9.331*** (1.392)	2.849*** (0.604)	3.972*** (0.610)	3.074*** (0.672)
Observations	639	507	507	507	507
$R^2$	0.281	0.271	0.135	0.184	0.216

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series are HP filtered and in first difference.

Table 29: Booms and Busts (IV)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	E. (IV)	E. (IV)	E.T (IV)	E.T (IV)	E.NT (IV)	E.NT (IV)	E.C (IV)	E.C (IV)
House Prices	12.65*** (3.959)	34.33*** (12.24)	6.192*** (1.918)	6.526** (2.979)	7.853*** (2.275)	17.06*** (6.550)	3.021*** (1.066)	8.755*** (2.983)
Observations	284	240	284	240	524	240	284	240
Boom	Yes		Yes		Yes		Yes	
Bust		Yes		Yes		Yes		Yes

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are HP-filtered. E denotes employment.

Table 30: Year fixed-effects (Elasticity)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table: Employ.</b>	Employ. (OLS)	Employ. T (OLS)	Employ. NT (OLS)	Employ. C. (OLS)	Employ. T (IV)	Employ. NT (IV)	Employ. C. (IV)
House Prices	0.0678*** (0.00778)	0.0780*** (0.0168)	0.0547*** (0.00768)	0.318*** (0.0454)	0.325*** (0.125)	0.160** (0.0794)	0.815*** (0.268)
Observations	609	507	507	507	480	480	480
R <sup>2</sup>	0.536	0.454	0.280	0.413			

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table: GDP</b>	GDP (OLS)	GDP T (OLS)	GDP NT (OLS)	GDP C (OLS)	GDP T (IV)	GDP NT (IV)	GDP C (IV)
House Prices	0.147*** (0.0188)	0.0774** (0.0305)	0.146*** (0.0155)	0.523*** (0.0526)	0.0957 (0.172)	0.257*** (0.0943)	0.846*** (0.250)
Observations	863	789	808	808	700	719	719
R <sup>2</sup>	0.553	0.418	0.589	0.485			

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country and Year fixed effects included. Series are taken in delta log.

Table 31: House prices, Consumption and Investment (Elasticity)

	(1)	(2)	(3)	(4)	(5)	(6)
	Cons. (OLS)	C. dura. (OLS)	C. Hotels/Rest. (OLS)	I (OLS)	Res. I (OLS)	NR. I (OLS)
House(boom)	0.115*** (0.0208)	0.239*** (0.0870)	0.128*** (0.0235)	0.273*** (0.0687)	0.461*** (0.0785)	0.201** (0.0845)
House(bust)	0.229*** (0.0369)	0.861*** (0.165)	0.151*** (0.0420)	0.694*** (0.108)	1.030*** (0.149)	0.581*** (0.126)
GDP	0.0683*** (0.0104)	0.230*** (0.0499)	0.0602*** (0.0127)	0.142*** (0.0279)	0.142*** (0.0426)	0.151*** (0.0369)
Observations	723	489	489	720	691	679
R <sup>2</sup>	0.448	0.375	0.437	0.287	0.317	0.170

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. House Prices are an indice of house prices, normalized at 1 in 2005. Country fixed effects included in the regressions. Series are taken in delta log (Elasticity). Cons. denotes consumption; C. dura consumption of durable goods; C.Hotels/Rest. consumption in hotels and restaurants. I denotes investment ; Res. I is residential investment; NR. I non-residential investment.

Table 32: Employment reallocation during booms and busts

	(1)	(2)	(3)
	Employ. T (sh.)	Employ. NT (sh.)	Employ. C. (sh.)
	(OLS)	(OLS)	(OLS)
House(boom)	-0.0359** (0.0179)	-0.00716 (0.00739)	0.232*** (0.0358)
House(bust)	0.0545** (0.0250)	-0.0612*** (0.0116)	0.346*** (0.0589)
GDP	0.0332*** (0.00849)	-0.00613* (0.00334)	0.0681*** (0.0163)
Observations	503	503	503
$R^2$	0.179	0.293	0.389

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included. Series are taken in delta log. Sectoral employment variables are measured as a share (sh.) of total employment.

Table 33: Granger causality : Wages in Construction

	(1)	(2)	(3)	(4)	(5)	(6)
	LC T.	LC C.	LC NT.	LC C.	RER	LC C.
LC T.(L1)	0.814*** (0.0643)	0.0946 (0.116)				
LC T.(L2)	-0.404*** (0.0540)	-0.118 (0.107)				
LC C.(L1)	0.117*** (0.0300)	1.210*** (0.124)	0.173*** (0.0351)	1.164*** (0.127)	0.137** (0.0614)	1.289*** (0.0603)
LC C.(L2)	-0.172*** (0.0293)	-0.701*** (0.0880)	-0.141*** (0.0379)	-0.620*** (0.0877)	-0.0972* (0.0509)	-0.665*** (0.0628)
LC NT.(L1)			0.839*** (0.0805)	0.224 (0.162)		
LC NT.(L2)			-0.459*** (0.0722)	-0.371** (0.180)		
RER(L1)					0.782*** (0.0615)	0.0375 (0.0326)
RER(L2)					-0.394*** (0.0444)	0.0190 (0.0345)
Observations	503	503	503	503	451	451
$R^2$	0.606	0.714	0.686	0.718	0.444	0.734

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. All series are HP-filtered.

Table 34: Effects on manufacturing (IV).

	(1)	(2)	(3)	(4)	(5)
	GDP(man)	Cons. dura.	Labour Cost(man)	RER	Exports(man)
	(IV)	(IV)	(IV)	(IV)	(IV)
House Prices	0.693** (0.287)	1.236*** (0.405)	0.632*** (0.151)	0.511*** (0.191)	-0.429*** (0.159)
Observations	662	543	553	678	684
Cragg-Donald	13.59	11.82	17.42	15.07	12.94

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are taken in delta-log. Exports(man) are calculated as a ratio over GDP(man).

Table 35: House prices and manufacturing margins.

	(1) Margin(man.) (OLS)	(2) Margin(man.) (IV)	(3) Margin(man.) (OLS)	(4) Prices(man.) (OLS)	(5) Prices(man.) (OLS)	(6) LC T (OLS)	(7) LC T (OLS)
House(boom)			-0.148*** (0.0431)		3.197* (1.860)		17.83*** (4.282)
House(bust)			-0.294*** (0.0571)		7.122*** (2.258)		34.87*** (4.679)
House	-0.217*** (0.0392)	-1.496** (0.604)		5.067*** (1.517)		25.95*** (3.783)	
Observations	401	397	401	401	401	401	401
$R^2$	0.083		0.092	0.026	0.030	0.305	0.334

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. Series are taken in nominal terms. Manufacturing margins are calculated as the ratio between producer price indexes (PPI) in the manufacturing sector and labour costs in the tradable sector.

Table 36: House prices and manufacturing exports

	(1) Exp./W. exp (OLS)	(2) Exp./(Exp+Imp)(w.m.) (OLS)	(3) Exp/Prod.(w.m.) (OLS)	(4) Exp/Imp(w.m.) (OLS)	(5) TOT (OLS)
<b>Table A: Filtered</b>					
House	-0.00735*** (0.00281)	-0.0612*** (0.0223)	-0.0756* (0.0413)	-0.171*** (0.0504)	-0.450*** (0.0745)
GDP	3.23e-05 (2.20e-05)	0.000549*** (0.000202)	0.00128*** (0.000385)	0.000907** (0.000435)	-0.00138*** (0.000513)
Observations	638	638	638	638	638
$R^2$	0.014	0.021	0.022	0.025	0.182

	(1) Exp/W. exp (OLS)	(2) Exp/(Exp+Imp)(w.m.) (Vol.)(OLS)	(3) Exp/Prod.(w. m.) (Vol.)(OLS)	(4) Exp/Imp(w.m.) (Vol.)(OLS)	(5) TOT (OLS)
<b>Table B: Elasticity</b>					
House	-0.109** (0.0464)	-0.104*** (0.0369)	-0.0921*** (0.0353)	-0.116*** (0.0409)	-0.303*** (0.0477)
GDP	0.0980*** (0.0315)	0.177*** (0.0229)	0.213*** (0.0219)	0.139*** (0.0254)	-0.116*** (0.0328)
Observations	692	692	692	692	697
$R^2$	0.080	0.149	0.185	0.104	0.150

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series in Table A are HP-filtered. Series in Table B are taken in delta-log. All variables contain only data for the manufacturing sector. W.exp. denotes world exports in manufacturing. (w.m) denotes the mean value at the world level. TOT denotes terms of trade.



Table 37: Employment and Trade openness

	(1)	(2)	(3)	(4)
<b>Table A</b>	Employ. (OLS)	Employ. Tradable (OLS)	Employ. Non Tradable (OLS)	Employ. Constru. (OLS)
House Prices	12.02*** (1.973)	0.276 (0.745)	6.790*** (1.214)	5.219*** (0.851)
House/Trade openness	-53.37 (33.19)	33.84** (15.30)	-47.47** (22.90)	-40.20** (15.84)
1/Trade Openness	-23.38** (9.626)	-10.48** (4.356)	-6.406 (4.998)	-2.329 (3.532)
GDP	-0.0213** (0.00833)	-0.00435 (0.00304)	-0.0218*** (0.00465)	0.00244 (0.00263)
Observations	432	432	432	432
$R^2$	0.311	0.072	0.259	0.439

	(1)	(2)	(3)	(4)
<b>Table B</b>	Employ. (OLS)	Employ. Tradable (OLS)	Employ. Non Tradable (OLS)	Employ. Constru. (OLS)
House(boom)	11.16*** (2.084)	-0.196 (0.797)	6.314*** (1.298)	4.956*** (0.932)
House(bust)	17.78*** (3.278)	1.731 (1.349)	9.206*** (2.421)	5.831*** (1.165)
House(boom)/Trade openness	-75.56** (32.53)	32.03** (16.21)	-54.04** (24.67)	-41.97** (17.77)
House(bust)/Trade openness	-42.93 (63.24)	55.77** (22.05)	-46.84 (47.52)	-28.16 (23.51)
1/Trade Openness	-12.86 (10.30)	-7.279 (4.662)	-3.418 (5.286)	-1.939 (3.919)
GDP	-0.0411*** (0.00843)	-0.0110*** (0.00336)	-0.0294*** (0.00487)	6.04e-05 (0.00302)
Observations	396	396	396	396
$R^2$	0.397	0.136	0.310	0.502

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered.

Table 38: Effects of house prices on Unemployment over the housing cycle (Filtered)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	U	U	U	U	U	U	U
<b>Table A</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	5.814***	5.457***	5.389***	4.434**	3.783*	4.351*	5.148**
Standard Errors	1.338	1.469	1.713	1.851	2.241	2.620	2.503
Observations	671	657	643	627	610	592	574
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	U(d)	U(d)	U(d)	U(d)	U(d)	U(d)	U(d)
<b>Table B: 1st diff.</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	3.490***	2.635***	2.926**	3.155**	2.737*	2.833*	2.943*
Standard Errors	0.817	0.745	1.155	1.273	1.450	1.693	1.581
Observations	639	625	611	595	578	560	545
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. For the duration of the housing cycle, "1/1" indicates a cycle with one-year boom and one-year bust. In Table A, series are HP filtered. In Table B, series are HP filtered and in first difference.

Table 39: Effect of house prices on the tradable sector over the Housing cycle (Filtered)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	E. T.	E. T.	E. T.	E. T.	E. T.	E. T.	E. T.
<b>Filtered: Ind.</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House Prices (cumulative effect)	-2.112***	-2.582***	-3.275***	-2.454**	-3.008***	-3.805***	-2.940**
Standard Errors	0.645	0.660	0.827	0.970	1.114	1.206	1.241
Observations	536	525	514	502	490	478	467
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. For the duration of the housing cycle, "1/1" indicates a cycle with one-year boom and one-year bust. Series are HP filtered.

Table 40: Reallocation effects over the Housing cycle

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	E.man (sh)	E.man(sh)	E.man(sh)	E.man(sh)	E.man(sh)	E.man(sh)	E.man(sh)
<b>Table A: E. T</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House (cum. effect)	-1.165*	-1.705***	-2.089***	-1.531*	-1.935**	-2.214**	-1.897*
Standard Errors	0.656	0.653	0.781	0.899	0.973	1.048	1.058
Observations	564	552	540	526	512	498	484
Dura. of the Hous. cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	E. NT.(sh)	E. NT.(sh)	E. NT.(sh)	E. NT.(sh)	E. NT.(sh)	E. NT.(sh)	E. NT.(sh)
<b>Table B: E. NT</b>	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
House (cum. effect)	2.408***	2.565***	1.945**	1.567	1.830*	1.475	1.180
Standard Errors	0.710	0.747	0.878	0.968	1.038	1.234	1.262
Observations	610	597	584	570	556	542	529
Dura. of the Hous. cycle	1/1	2/2	3/3	4/4	5/5	6/6	6/4

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. For the duration of the housing cycle, "1/1" indicates a cycle with 1-year boom and 1-year bust. Series are HP filtered. E.man (sh) denotes employment in manufacturing as a share (sh) of total employment; E. NT employment in the non-tradable sector. House(cum. effect) is the cumulative effect of house prices over the housing cycle. Dura. of the Hous. cycle is the duration of the housing cycle.

Table 41: Other scaling variable: Employment in % of working age population

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table A: OLS</b>	Employ.(wa) (OLS)	Agri.(wa) (OLS)	Ind.(wa) (OLS)	Constru.(wa) (OLS)	Retail(wa) (OLS)	Fin.(wa) (OLS)	Other Serv.(wa) (OLS)
House	4.837*** (0.813)	-0.216** (0.0920)	1.082*** (0.239)	1.958*** (0.274)	1.152*** (0.284)	0.827*** (0.217)	0.274 (0.211)
GDP	0.0257*** (0.00720)	0.000421 (0.000814)	0.00681*** (0.00211)	0.00946*** (0.00243)	0.00742*** (0.00251)	0.00342* (0.00192)	-0.00395** (0.00186)
Observations	252	252	252	252	252	252	252
$R^2$	0.231	0.047	0.169	0.297	0.137	0.098	0.024

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<b>Table B: IV</b>	Employ./wa (IV)	Agri./wa (IV)	Ind./wa (IV)	Constru./wa (IV)	Retail/wa (IV)	Fin./wa (IV)	Other Serv./wa (IV)
House	14.55*** (4.193)	0.703 (0.448)	5.178*** (1.448)	3.815*** (1.229)	4.529*** (1.461)	3.598*** (1.148)	-2.716** (1.164)
GDP	-0.00377 (0.0153)	-0.00237 (0.00163)	-0.00562 (0.00528)	0.00383 (0.00448)	-0.00283 (0.00532)	-0.00498 (0.00418)	0.00512 (0.00424)
Observations	252	252	252	252	252	252	252

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Variables of employment are measured as a percentage of the working age population ("wa").

Table 42: Total effect of house prices on Employment rate and on Unemp. over working age population

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Table A: E/wa</b>	E(wa) (OLS)	E(wa) (OLS)	E(wa) (OLS)	E(wa) (OLS)	E(wa) (OLS)	E(wa) (OLS)
House Prices (cumulative effect)	-6.714**	-5.397**	-6.619***	-5.812**	-6.516**	-6.819**
Standard Errors	2.955	2.169	2.449	2.662	2.801	2.992
Observations	361	353	345	336	327	319
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6

	(1)	(2)	(3)	(4)	(5)	(6)
<b>Table B: U/wa</b>	U(wa) (OLS)	U(wa) (OLS)	U(wa) (OLS)	U(wa) (OLS)	U(wa) (OLS)	U(wa) (OLS)
House Prices (cumulative effect)	6.444***	5.741***	6.398***	5.705**	7.391***	8.097***
Standard Errors	2.029	1.955	2.196	2.352	2.218	2.672
Observations	369	361	353	344	334	324
Duration of the Housing cycle	1/1	2/2	3/3	4/4	5/5	6/6

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. For the duration of the housing cycle, "1/1" indicates a cycle with one-year boom and one-year bust. House prices are measured in delta log. Employment over working age population and unemployment over working age population are taken in first difference.

Table 43: House Prices and Construction

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Dw. start.	Dura. cons.	Dura. cons.	Dura. cons.	Inv.	Inv.	E.T	E.T	RER	RER	CA	CA
House Prices	1.111*** (0.157)	0.542*** (0.0768)			0.517*** (0.0494)		0.101*** (0.0189)		0.168*** (0.0352)		-2.544*** (0.911)	
Dwell. start.			0.207*** (0.0222)			0.179*** (0.0213)		0.0467*** (0.0167)		0.0519** (0.0233)		-0.232 (0.377)
Dwell. start.(res.)				0.155*** (0.0310)								
Observations	381	608	238	238	780	363	507	227	746	349	291	114
$R^2$	0.236	0.279	0.249	0.121	0.233	0.208	0.169	0.172	0.066	0.032	0.046	0.019

**Notes:** OLS regressions. HAC robust standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are HP filtered. Dw. start. denotes dwellings started. Consumption denotes the consumption of durable goods. Inv. denotes investment. We denote "Dwell.start.(res.)" the residual of regression in column (1).

Table 44: Share Prices, House Prices and Unemployment

	(1)	(2)	(3)	(4)	(5)	(1)	(2)
<b>Table A</b>	Unemploy. (OLS)	Unemploy. (OLS)	Unemploy. (OLS)	Share Prices (OLS)	Unemploy. (IV)	Share Prices (OLS)	House Prices (OLS)
House Prices	-7.711*** (0.601)	-8.157*** (0.638)	-7.204*** (0.644)	80.80*** (11.80)	-40.49** (16.50)	Share Prices (L1) 0.896*** (0.0656)	0.000107 (0.000136)
GDP		0.0120** (0.00593)	0.0120** (0.00577)		0.111** (0.0511)	Share Prices (L2) -0.500*** (0.0534)	-0.000114 (0.000129)
Share Prices			-0.0118*** (0.00215)		0.0183 (0.0158)	House Prices (L1) 25.61** (11.88)	1.274*** (0.0468)
						House Prices (L2) -49.21*** (12.83)	-0.627*** (0.0457)
Observations	525	525	525	525	525	Observations	688
$R^2$	0.245	0.251	0.291	0.090		$R^2$	0.526
							0.743

**Notes:** HAC robust standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Country fixed effects included in the regressions. Series are HP filtered.

Table 45: Home-ownership: a friction in the labour market

	(1)	(2)	(3)	(4)	(5)	(6)
	Job Finding (OLS)	Job Finding (OLS)	Job Finding (OLS)	Employ. Exit (OLS)	Employ. Exit (OLS)	Employ. Exit (OLS)
House Prices	0.148*** (0.0387)	0.527*** (0.201)	0.576** (0.268)	-0.00407*** (0.00155)	-0.0110 (0.0119)	-0.0120 (0.0140)
House*Homeowner		-0.00562** (0.00280)	-0.00734** (0.00340)		9.12e-05 (0.000166)	0.000178 (0.000199)
House*Job protection			0.0341 (0.0309)			-0.00261** (0.00107)
GDP	-0.000630* (0.000329)	-0.000452 (0.000302)	-0.000613* (0.000324)	4.68e-06 (1.53e-05)	6.77e-06 (1.43e-05)	1.84e-05 (1.46e-05)
Observations	360	311	242	360	311	242
$R^2$	0.052	0.067	0.101	0.037	0.065	0.102

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. All series are HP-filtered. Variables are defined in Appendix G.

Table 46: House Prices and structural unemployment

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Unemploy. (OLS)	NAIRU (OLS)	Unempl. (OLS)	Res. Unemp. (OLS)	Unemploy. (IV)	NAIRU (IV)	Res. Unemp. (IV)
House Prices	-8.105*** (0.479)	-2.156*** (0.169)		-2.779*** (0.332)	-28.44*** (5.931)	-6.542*** (1.539)	-12.27*** (3.152)
NAIRU			2.472*** (0.0720)				
Observations	671	659	659	659	654	654	654
$R^2$	0.299	0.198	0.642	0.096			

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series are HP filtered.

Table 47: Beveridge Curve: Unemployment and Vacancy

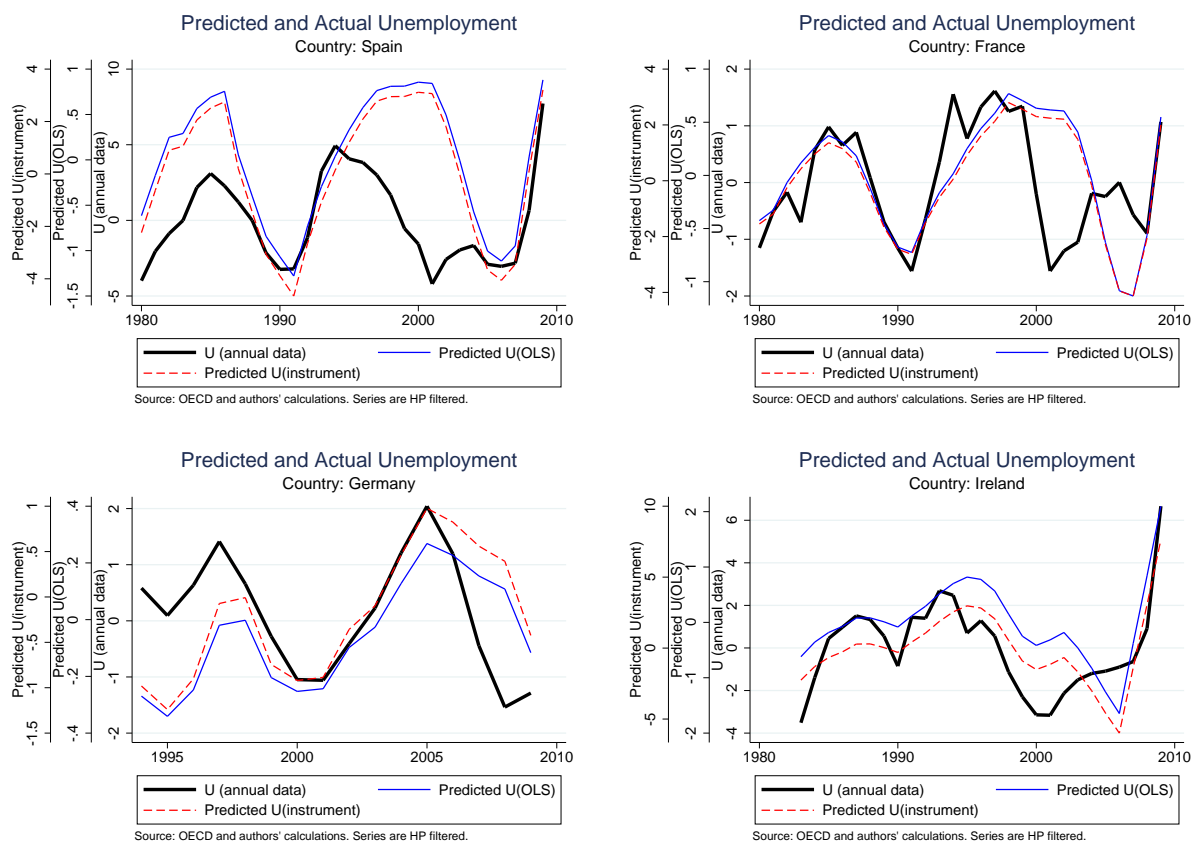
	(1)	(2)	(3)
	Unemploy. (OLS)	Unemploy. (OLS)	Job Vacancy (OLS)
Job Vacancy	-3.504*** (0.298)		
House Prices		-6.932*** (0.745)	1.106*** (0.118)
Observations	312	312	312
$R^2$	0.307	0.217	0.221

**Notes:** HAC robust (Heteroscedasticity and AutoCorrelation robust) standard errors are in parentheses (we use Bartlett kernel-based filter with bandpass parameter 2). \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . Country fixed effects included in the regressions. Series are HP filtered.

## D Simulating unemployment

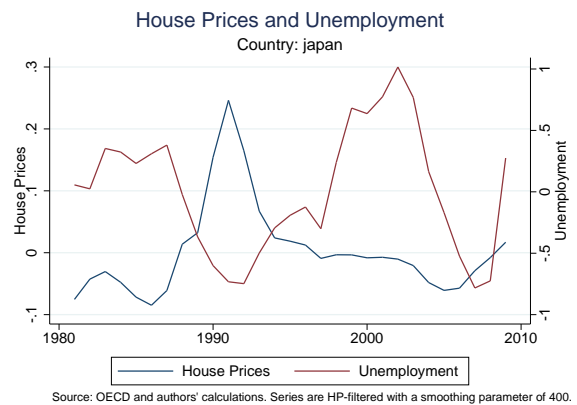
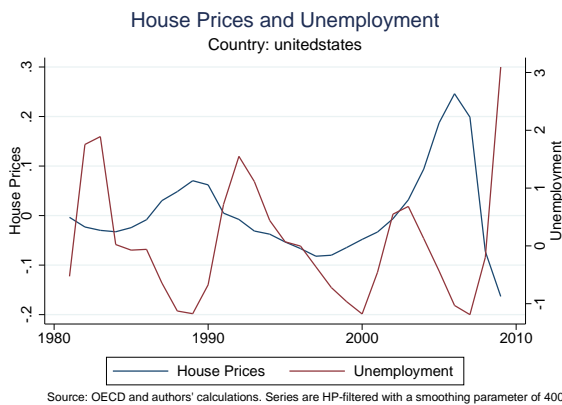
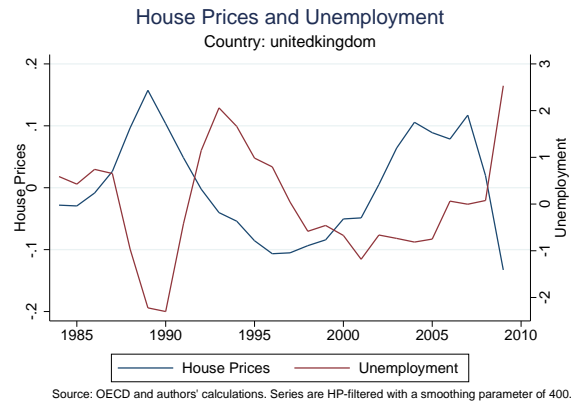
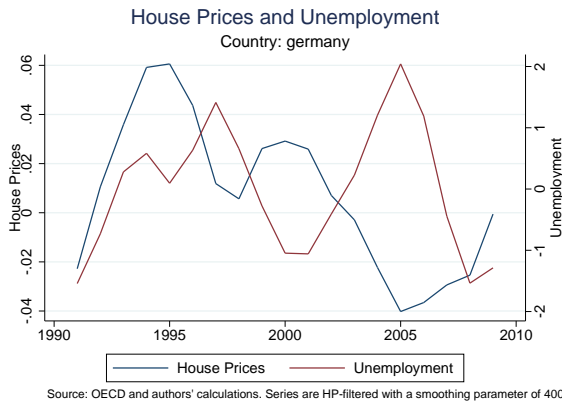
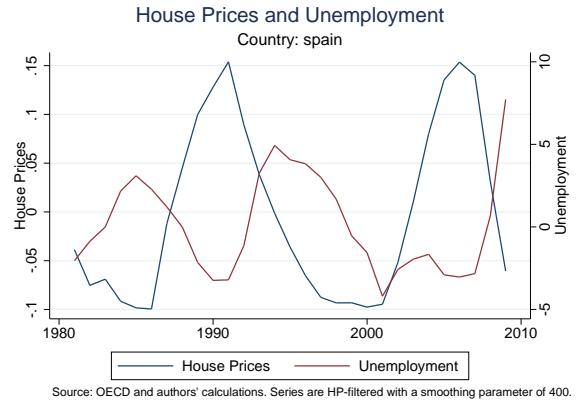
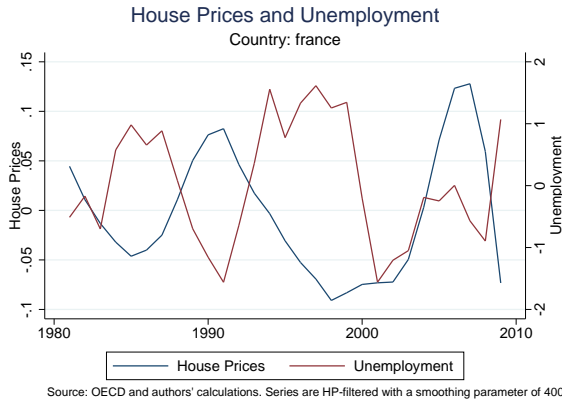
Taking house price movements as given, we can recover the unemployment patterns which would be generated by our very parsimonious linear model. An argument in favor of considering house prices as the source of exogenous shocks is that taking Ordinary Least Squares or Instrumental Variable estimates yields very comparable estimates. The results of this simulation exercise are summarized in Figure 3. We show the results for Euro area countries (Spain, France, Germany, Ireland) as they have been at the center of very important policy debates recently. Predicted patterns of unemployment match actual ones reasonably well.

Figure 3: Simulated unemployment fluctuations and actual ones



## E Graphs

Figure 4: House prices and Unemployment



## F Stationarity

We can reject the joint hypothesis that all residuals contain a unit root quite easily using panel-data unit root tests. Results are displayed in Table 48. Tests are reported for residuals of the regression of unemployment rate on house prices with country and year-fixed effects. Because the sample must be a balanced panel in order to perform the existing panel test procedures, the sample is restricted to 26 years (1983 – 2009) and 11 countries. For example, the Levin-Lin-Chu bias-adjusted  $t$  statistic are significant at all the usual testing levels. Therefore, we reject the null hypothesis and conclude that these series are stationary. Note however that all these tests assume a common autoregressive parameter for all series, so this test does not allow for the possibility that some country residuals contain unit roots while other country residuals do not.

Table 48: Test Statistics: Panel of series

	Residual
Levin-Lin-Chu	-5.6984***
Im-Pesaran-Shin	-2.3457***
Fisher-type tests (ADF)	36.9888**
Harris-Tzavalis	-4.3883***
<b>Notes:</b> *** $p < 0.01$ , ** $p < 0.05$ , * $p < 0.1$ .	

## G Data



Variables	Abbreviation	Sources	Variable description
House Prices	House	Chapter 1	Real house prices (base 1=2005)
Property Tax	Property Tax	OECD	Property tax (ratio of total taxation)
CPI	CPI	OECD	Consumer Prices, Index 2005=100
Employment	E.	OECD	Employed population(ETO)/Active population(PEANC), (%)
Employment Agriculture	E. Agri.	OECD	Employed persons agriculture(ETOAB)/Active population(PEANC), (%)
Employment Industry	E. Ind.	OECD	Employed persons industry(with energy)(ETOCE)/Active population, (%)
Employment Manufacturing	E.Manuf.	OECD	Employed persons manufacturing(ETOD)/Active population(PEANC), (%)
Employment Construction	E.Constru.	OECD	Employed persons Construction(ETOF)/Active population(PEANC), (%)
Employment Retail services	E. Retail.	OECD	Employed persons Retail services(ETOGI)/Active population(PEANC), (%)
Employment Other services	E. Other	OECD	Employed persons other services(ETOLP)/Active population(PEANC), (%)
Employment Financial	E. Financial	OECD	Employed persons financial (ETOJK)/Active population(PEANC), (%)
Employment X(share)	E.X(share)	OECD	Employed population in X/Active population(ETO), (%)
Employment X(working age)	E.X(wa)	OECD	Employed population in X/Working age population, (%)
Unemployment	U	OECD	Unemployed population/Active population(PEANC), (%)
Active population	active population	OECD	Active population(PEANC), persons
Working age population	wa	OECD	Working age population, all persons
Real labour cost	LC	OECD	Real total labour cost (quantity series), Index 2005=100
Employment Exit	Employ. Exit	Elsby et al. (2013)	Rate of inflow to unemployment
Job finding	Job Finding	Elsby et al. (2013)	Rate of outflow from unemployment
Job vacancy rate	Vacancy	OECD	Job vacancies(total stock)/Active population(PEANC)
Employment protection	Job protection	OECD	Strictness of employment protection
Minimum versus average wage	Min. vs. Av. wage	OECD	Minimum relative to median wages of full-time workers
Labour market expenditures	LME	OECD	Public expenditure (active measures) as a percentage of GDP (EXPPCT)
Tax wedge	Tax wedge	OECD	Average tax wedge (%), Single person at 100% of average earnings, no child
Trade Union	Trade Union	OECD	Trade Union density
Replacement rate	Replacement rate	Van Vliet and Caminada (2012)	Net Unemployment Replacement Rate for an Average Production Worker, Single Person
Output gap	Output gap	OECD	Unemployment rate with non-accelerating inflation rate
Gross fixed capital Formation	Investment	OECD	Gross fixed capital Formation, total, ratio of GDP
Residential Investment	Res. Inv.	OECD	Gross fixed capital formation (housing), ratio of GDP
Non residential Investment	NR Invest.	OECD	Gross fixed capital formation (non-housing), ratio of GDP
Household final consumption	Consumption	WDI	Household final consumption expenditure, etc. (ratio of GDP)
Consumption durable goods	Cons. dura.	OECD	Consumption of durable goods, Index 2005= 100, real terms
Share Prices	Share Prices	OECD	Share prices, Index 2005 = 100
Relative Income	Relative Income	WDI	Relative income is the the GDP per capita divided by the GDP per capita for the US
GDP	GDP	WDI	Real GDP, Index 2005=100
GDP growth	GDP growth	WDI	Real GDP growth
GDP per capita	GDP per capita	WDI	GDP per capita, PPP (current international \$)
Sectoral GDP	GDP in Sector X	OECD	Real GDP in sector X, Index 2005 = 100
Market capitalization	Financial deepening	WDI	Market capitalization of listed companies (ratio of GDP)
Domestic credit to private sector	PCGDP, Financial. Deep.	WDI	Domestic credit to private sector (ratio of GDP)
Real effective exchange rate	RER	WDI	Real effective exchange rate index (2005 = 100)
Nominal effective exchange rate	Nominal ER	OECD	Nominal effective exchange rate, index (2005 = 100)
Trade balance	Trade balance	WDI	Trade balance of goods and services (% GDP)
Manufacturing exports	Exp(man)	OECD	Manufacturing exports (% GDP)
Manufacturing imports	Imp(man)	OECD	Manufacturing imports (% GDP)
Loan-To-Value ratios	LTV ratios	Chapter 1	maximum LTV ratios

## Chapter 3

# Does Modern Banking lead to Money Privatization?

### Abstract

Money privatization is seen as one of the main features of modern banking. The development of private payment arrangements and the globalization of banking have indeed led to a growing questioning of central banks' monopoly on the provision of money. This chapter analyzes empirically the reality of money privatization and renews the attention on the role of central banks in money creation mechanisms. To determine the weight of private money in modern banking, I calculate the percentage of total transactions that are directly settled in central bank money with a precise estimate in the US case, and by giving orders of magnitude for a sample of 15 countries. Central bank money represents more than 95% of the value of transactions in 12 countries. I analyze the nature of the assets used for the remaining share of transactions by studying exhaustively all the arrangements and systems in my sample of countries where settlement potentially involves private money. Empirical evidence questions the existence of a privatization of money and tends to show the monopoly of central bank money as settlement asset in modern banking.

**Keywords:** money, private money, payment interdependencies, monetary policy

**JEL classification:** E42, E52, E58

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## Introduction

Central banks' efforts to support market liquidity during the financial crisis through conventional and unconventional policies have renewed attention on money creation mechanisms and on the special role of central banks. Yet, the money created by central banks is seen as more and more marginal in modern economies. More than ever, notably with technological development, the process of money creation seems to take place primarily in private banks (Federal Reserve Bank of Chicago (1994)).

In particular, the last fifteen years have seen a growing questioning of the central bank's role and of the power and efficiency of monetary policy. Both theoretical monetary economists and central bankers have started to discuss the consequences of a "world without money"<sup>1</sup> for the future of central banking. This concern has been raised in particular by a widely discussed article by Friedman (1999):

"It is something of a puzzle that central banks are able to control the pace of spending in large economies by controlling the supply of "base money" when this monetary base is itself so small in value relative to the size of those economies [. . .] This disparity of scale has grown more extreme in the past quarter century as a result of institutional changes that have eroded the role of base money in transactions, and that advances in information technology are likely to carry those trends still farther in the next few decades".

Several phenomena explain the reconsidering of the role of central banks in monetary policy: the development of information technology, the increasing use of electronic money, the rise of private intermediaries, or the globalization of banking. It is the monopoly of central banks on the provision of money which is questioned through these phenomena. Competition between public and private issuers of money is seen as especially strong today in modern banking, notably with the development of private arrangements. It is probably in payment systems that these changes are the most spectacular. For example, Kahn (2008) argues that "recent developments in private payments arrangements, particularly at the wholesale level, challenge central banks' longstanding monopoly on the provision of the ultimate means of settlement for financial transactions". Bank activity increasingly takes place through private settlement arrangements, such as CHIPS, the private large-value payment system in the United-States. Some private systems are even described as having no connection—legal or regulatory—to central banks. It is the case for example in Hong Kong, where banks have set up entirely private settlement arrangements for making payments in US dollars with no apparent connection to the Federal Reserve. Similarly, an increasing proportion of economic activity is paid through "on-us" transactions within a bank's accounts (intrabank transactions) which strongly reduce their dependency on central banks. All these transformations

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<sup>1</sup>This expression comes from Woodford (2000), "Monetary policy in a world without money". He argues that even if "the demand for base money for use in facilitating transactions is largely or even completely eliminated", macroeconomic stabilization would continue to be possible, in particular through the use of a channel system. The Berentsen Monnet model (2008) can be regarded as a formalization of the ideas of Woodford about conducting monetary policy in a world with no outside money. See also King (1999).

suggest a privatization of money, and strong competition between public and private issuers of money, which challenge the role of central banks and the efficiency of monetary policies.

These transformations renew the attention on a controversial debate in monetary theory: money creation mechanisms. Two conceptions of modern banking conflict. To explain the creation of money by the banking system, modern theories of money and banking use often a parallel with the goldsmiths, a network of bankers of 17th century London<sup>2</sup>. The story of modern banking does indeed seem to have started with these bankers accepting deposits for safe keeping; then their liabilities began circulating; then they began making loans. According to Encyclopedia Britannica, "the direct ancestors of modern banks were, neither the merchants nor the scrivenors but the goldsmiths. At first the goldsmiths accepted deposits merely for safe keeping; but early in the 17th century their deposit receipts were circulating in place of money and so became the first English bank notes". Banks are seen as institutions whose liabilities may substitute for money, or potentially complement money as a means of payments. This system is deeply linked to money privatization. In the goldsmiths system, it is indeed because banks issue private money that they can create money<sup>3</sup>. But such a conception is still questioned. An opposing view point considers on the contrary that the banking system only ensures the circulation of central bank money, i.e. that there is no private money creation. In this alternative view, the understanding of modern banking is very different from the goldsmiths conception and it is more difficult to consider money privatization as a feature of modern banking. It is important to notice that no private money creation does not imply a full-reserve banking system à la Fisher (1935) or Friedman (1948).

This debate has important policy implications, especially in the context of the current crisis. The existence of a privatization of money is not neutral both in terms of risk propagation and for the power of central banks in modern banking. Money is an asset necessary for all transactions. It is thus of particular interest to understand how shocks spread in a system and which institutions are able to limit the risk. If different assets are used as money, as is the case when public and private monies coexist, one can assume that the propagation of a shock would be limited to the compartment where each asset is used. Similarly, one can expect that the power of central banks and the transmission channels of monetary policy will be dependent on the assets used as money in modern banking. For example, if the world is segmented between public and private monies, the transmission channels of monetary policy would be limited to the markets where central bank money is used. Discussing the existence of competition in the supply of money can thus be important to understanding risk propagation and the power of central banks in

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<sup>2</sup>The origins of modern banking are still a discussed question in the literature. Some authors refer to the "Merchant banks", or to the bills of exchange in the Middle Ages ( De Roover (2007)). Other references, such as the Federal Reserve Bank of Chicago in its well-known workbook "Money Creation Mechanics" (1994), assert instead that the goldsmiths can be considered as the ancestors of modern banking. Similarly, Quinn (1997) describes the goldsmiths as at the "cornerstone of the Financial Revolution that occurred in England from 1660 to 1720". See also Kim (2011).

<sup>3</sup>The famous mechanism to explain money creation by the banking system, "loans make deposits", is based on this hypothesis.

modern banking.

This chapter analyzes empirically the reality of this privatization of money in modern banking. I answer the following questions. Does modern banking and in particular the development of private arrangements imply a privatization of money, and does it lead to a marginalization of central bank money? If the goldsmiths system was based on the issuance of private money, is this model still a good framework for modern banking? The objective of this chapter is to settle between the two conflicting views of modern banking. A precise investigation of the assets used as money in modern banking is necessary to answer these questions.

To discuss the conditions for a privatization of money, it is essential to define the characteristics of the asset called money to distinguish it from other assets which can seem close but are used in practice very differently. The definition of money, and the characteristics of environments in which money is useful, have been widely discussed in recent years (Holthausen and Monnet (2003); Kocherlakota (1998)). However, one criterion seems widely accepted, even by the most recent literature. “Money is an asset that serves as a medium of exchange” (Lagos (2006))<sup>4</sup>. One criterion is closely linked to this characteristic of money. Money should have the property that it is “used for the final settlements of debts, private or public. This rules out for instance checks, as private means of payment as their mere transfer does not represent a final settlement of debts” (Holthausen and Monnet (2003)). So in this chapter, *an asset will be called money only if it serves as a medium of exchange and as a settlement asset*. These characteristics of money are essential to exclude a *contrario* what is not money. A private bank or system can issue collateral to finance itself. This collateral will not be called money because it is neither the asset used as a medium of exchange, nor can it be used for the final settlement of debts. For example, commercial banks can use bonds (or other assets) to finance themselves. But these bonds are not used as a medium of exchange. They are not money, but a way to get money<sup>5</sup>.

To discuss the conditions for a privatization of money, it is also necessary to define private money. Does the development of private systems mean a development of private money? Is the use of an asset defined as money in private systems sufficient to call it private money? Private money is not precisely defined in the literature. Often, liabilities of private banks are called private money (BIS (2003c)). This definition is not precise enough as it does not allow for discriminating between two very different cases. In this definition, banknotes deposited in a bank account will be considered as private money as they represent bank liabilities. This reality is very different from the case where a private bank issues its own banknotes, which are not perfect substitutes for central bank money. In this case, the private issuer will be the ultimate issuer of money. Policy implications are very different if private money is simply the liabilities of private banks

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<sup>4</sup>The definition of money as a medium of exchange is not new and has been used notably in overlapping-generations models following Samuelson (1958) and spatial-separation models following Townsend (1980).

<sup>5</sup>The fact that banks rely increasingly on the bond market to fund their business (and not only on deposits) does not mean that they create money or liquidity (Hale and Santos (2010)). Indeed, banks issue bonds in order to receive money. They create “collateral” against money. I will show that the settlement asset is central bank money.

or if it implies that the private entity is the ultimate issuer of this asset.

To define private money, another characteristic must thus be added. It is closely linked to the double-entry accounting principle, i.e. the fact that an entity cannot add a credit without accounting for a debit. I will say that an entity can issue private money if it can credit an account with this private money without debiting another account with this asset. The possibility to credit without debiting means that the entity is the ultimate creator of money<sup>6</sup>. Similarly, only the central bank can credit an account with central bank money without debiting another account with the same asset. For example, the Federal Reserve can credit without debiting an account with US dollars. So, *it is only if the ultimate creator of money is a private entity that the asset will then be called private money*<sup>7</sup>. Similarly, *an asset will be defined as central bank money if the ultimate issuer of this fund is a central bank*. The only exception to this definition is when the central bank itself is a private entity. In this case, the asset will still be called central bank money, and not private money, as this asset is still used as the legal money in the country<sup>8</sup>. The distinction between central bank money and private money implies that if a bank needs to debit an account with central bank money in order to credit a private account, it is just changing the physical aspects of central bank money without adding additional liquidity to the economy<sup>9</sup>.

This chapter is organized as follow. I first describe the two conflicting conceptions of modern banking and their different policy implications (Section 1). The objective in the rest of the chapter is then to try to settle between these two conceptions. More precisely, I study empirically the reality of the privatization of money in modern banking. Even if it is considered as one of the main features of modern banking, such analysis has surprisingly not been made yet. According to the Bank for International Settlements, “while data are scarce, if the different components of payment chains are aggregated it is quite possible that in many cases the value of payments settling in commercial bank money exceeds that settled in central bank money” (BIS (2003c)). This chapter investigates the reality of this hypothesis. I construct a variable for the share of transactions settled with central bank money over the total value of transactions. Thanks to BIS data, I first give some orders of magnitude in a sample of 15 countries. To investigate the evolution of this variable, I then focus on the United States, and construct new datasets on the total value of transactions in retail and large-value payment systems over the last 40 years, which have not previously been calculated as far as I know. Thanks to this dataset, I get a precise estimate of the share of transactions settled in central bank money (over the total

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<sup>6</sup>“When banks issue notes that are backed by accumulated reserves, they are just changing the physical aspects of the means of payments, without necessarily adding additional liquidity to the economy” (Cavalcanti et al. (2005)).

<sup>7</sup>For example, Amazon can issue *Amazon coins* just by crediting the account of one of its customer without debiting another account.

<sup>8</sup>I develop these definitions in subsection 2.1.

<sup>9</sup>The possibility to add a credit without accounting for a debit is implicitly the characteristic of what is called *inside money*: “If only outside money is used, then the purchasing capability of a banker depends on the banker’s previous trades; if inside money is used, that purchasing capability need not be dependent on previous trades because the banker may be able to issue additional inside money at any time” (Cavalcanti and Wallace (1999)).

value of transactions) in the US. Contrary to what could have been expected with technological development and the rise of private systems, a growing share of the total value of transactions is directly processed by the Federal Reserve (Section 2). The remaining transactions are those which are potentially made with private money. I thus study characteristics of all the private systems classified by the Bank for International Settlements, i.e. I analyze exhaustively all the arrangements and systems where settlement potentially involves private money<sup>10</sup>. Results of the analysis show that the conditions for a privatization of money are not fulfilled today. This implies the monopoly<sup>11</sup> of central bank money as settlement asset in modern banking (Section 3).

## 1 Exploring two conceptions of modern banking

Privatization of money is often seen as one of the main features of modern banking. This analysis can be understood in a specific framework, the goldsmiths view. It is based on a world where banks issue private money. The Bank for International Settlements (2003c) summarizes well this "goldsmiths view"<sup>12</sup> of modern banking:

“The central bank issues its own liabilities for use as money (central bank money). But the central bank is not the only issuer of money in an economy. [...] Commercial banks are the other primary issuers, their liabilities (ie commercial bank money) representing in fact most of the stock of money [...] Thus central bank and commercial bank money coexist in a modern economy. Confidence in commercial bank money lies in the ability of commercial banks to convert their sight liabilities into the money of another commercial bank and/or into central bank money upon demand of their clients”.

In this view, banks can create money as each commercial bank issues its own specific commercial bank money that has to be convertible into the money issued by another bank or into central bank money. The opposing view point considers on the contrary that

<sup>10</sup>It is especially the recent developments in private payment arrangements that are seen as leading to privatization of money (Kahn (2008)). In addition, as transactions in payment systems represent a very large share of the total value of transactions, studying the nature of the settlement assets used for these transactions is essential to investigate the reality of money privatization in modern banking. The BIS classifies the payment systems and arrangements in different categories according to their settlement methods. This classification enables to determine the settlement assets used by these private systems.

<sup>11</sup>I can speak about a *monopoly* of central bank money as what can be considered as strictly private currencies are still very marginal phenomena (*Bitcoins, Amazon coins, Ithaca Hours*). For example, in October 2013, the value of the money supply of the Bitcoin network stands at over \$1.6 billion USD (Foley and Alloway (2013)). For a study on virtual currencies, see ECB (2012).

<sup>12</sup>See also Federal Reserve Bank of Chicago (1994): “The actual process of money creation takes place primarily in banks.’ [...] In the absence of legal reserve requirements, banks can build up deposits by increasing loans and investments so long as they keep enough currency on hand to redeem whatever amounts the holders of deposits want to convert into currency. This unique attribute of the banking business was discovered many centuries ago. It started with goldsmiths. [...] [These] bankers discovered that they could make loans merely by giving their promises to pay, or bank notes, to borrowers. In this way, banks began to create money. More notes could be issued than the gold and coin on hand because only a portion of the notes outstanding would be presented for payment at any one time [...] It was a small step from printing notes to making book entries crediting deposits of borrowers, which the borrowers in turn could “spend” by writing checks, thereby “printing” their own money” .

the banking system only ensures the circulation of central bank money as the only asset used for settlement is central bank money. Note that I model these two conceptions in Chapter 4.

**The goldsmiths view.** The understanding of modern banking and policy implications for central banks are very different on the two conflicting views. Figure 1 represents this goldsmiths view. Banks can create money as they issue private money ( $M_A$  or  $M_B$ ). It is because each bank issues its own private money than it can credit an account with this asset without having to debit an account with the same asset. There is no balance-sheet constraint on bank lending. For instance, Bank A can credit an account with 1000  $M_A$  without having to debit an account with the same amount. The transactions in this economy are settled with private money ( $M_A$  or  $M_B$  and not central bank money or USD). Starting from a small amount of gold (or central bank money in modern banking), this system enables many more transactions than the original amount thanks to the development of private money.

As banks can issue different amounts of money, the value of private monies are different. For example, because it is private money, bank A can decide to create ex nihilo  $M_A$  1000, whereas Bank B only creates  $M_B$  90. The value of  $M_A$  would not be the same as the value of  $M_B$  because the Bank A has issued much more money with the same amount of Gold (through the mechanism loans make deposits). The result will be a depreciation of bank A's money. The only constraint in the system is the convertibility between private money ( $M_A$  or  $M_B$ ) and gold<sup>13</sup>.

**Is it still a good framework for modern banking?** This conception can describe the US banking system pre-Federal Reserve. Till the creation of the Federal Reserve, private monies were used in the United-States. We were then in a goldsmiths system where the liabilities of banks circulated as means of payments. The asset of settlement was at that time private money. In that system, because banks issued their own private money, they could create money through the mechanism "loans make deposits"<sup>14</sup>. Because of the coexistence of private monies, domestic exchange rates existed. Notes of different banks were exchanged in the market at varying relative prices and were used as medium of exchange<sup>15</sup>:

"The typical bank note contract in 19th century U.S. banking involved a promise by the issuing bank to pay the bearer on demand a specified sum of "lawful money."

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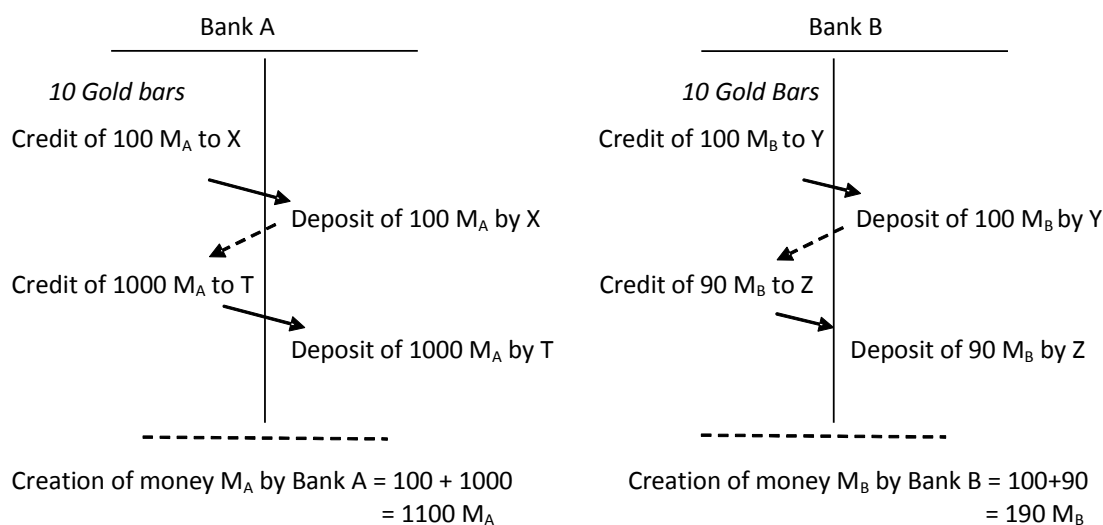
<sup>13</sup>X can use its  $M_A$  100 to pay Y, a client of bank B. Y will bring its  $M_A$  100 to Bank B. Bank B can ask Bank A to convert the  $M_A$  100 into Gold. This world is very close to the situation during the Bretton Woods era. At that time, the quantity of dollars issued by the Federal Reserve was linked to the quantity of gold at the rate of \$35 per ounce of gold. In the goldsmiths view, the same link applies today between private monies and central bank money:  $Q_A = \alpha \cdot Q_R$  with  $Q_A \neq .Q_R$ . Private money ( $Q_A$ ) can be converted into central bank money (reserves,  $Q_R$ ). More money can be issued than the reserves on hand.

<sup>14</sup>This famous mechanism was formulated probably for the first time by Withers (1909): "every loan creates a deposit."

<sup>15</sup>Newspapers provided information concerning the price of bank notes (Hasan and Dwyer, 1994).



Figure 1: The creation of private money in a “goldsmiths world”



Note: lines represent flows of funds inside the bank, but they do not mean for instance that X decides to loan his money to T.

Lawful money consisted of specie (gold or silver). [...] Notes were placed into circulation when banks made loans. [...] The bank note market of the 19th century essentially functioned as a floating exchange-rate system, with each note convertible into a dominant money (specie) at a rate (discount) determined by transportation costs, the perceived riskiness of the operating bank, and the costs of authenticating the note's validity. If the market was efficient, the size of the discount on a particular bank's notes provided some information concerning the "quality" of the note in terms of its purchasing power. Thus, a bank which pursued a systematic policy of depreciating the value of its notes (via overissue) would find that the market "revealed" the bank's strategy via a larger discount on its notes" (Mullineaux (1987))<sup>16</sup>.

The same mechanism existed with London goldsmiths in the 17th century: "Only the issuing bankers knew the true volume of their outstanding notes and the true nature of supporting assets. Under such asymmetric information, goldsmiths issued notes, checks,

<sup>16</sup>See also Phillips and Cutler (1998): "one feature of the pre-Federal Reserve financial system that has not been widely researched: the domestic exchanges, which existed for more than one hundred years from the early nineteenth century to shortly after the creation of the Federal Reserve System. The domestic exchanges were regional markets for bank drafts. Movements in the exchange rates reflected changes in the relative value of medium of exchange across regions in the United States. [...] In 1918 the Fed began operating a leased telegraph system (the Fed Wire), which was available to member and par-list banks. In effect, the Fed eliminated the float on interregional payment settlements, and thus the fluctuations in domestic exchange rates through the Federal Reserve System were zero. The Fed thus ended the private market in domestic exchange because the Fed did not charge for the use of its clearance and exchange facilities."

and deposits payable on demand which used the threat of runs to discipline bankers” (Quinn (1997)).

**An alternative view.** An opposing view point considers on the contrary that the banking system only ensures the circulation of central bank money. In this conception, the only asset used for settlement in modern banking is central bank money. Banks cannot create money by crediting an account *ex nihilo* as private monies are not accepted as a medium of exchange and a settlement asset. If an asset cannot be created *ex nihilo*, it must come from somewhere else. That is the reason why each time a bank credits an account it has to debit an account with the same amount (the double entry accounting hypothesis). This argument was notably expressed by Tobin (1963). He rejected the idea that “banks make a loan by ‘writing up’ deposit liabilities”:

« Neither individually nor collectively do commercial banks possess a widow’s cruse [...] Bankers cannot create means of payment to finance their own purchases of goods and services. Bank-created « money » is a liability, which must be matched on the other side of the balance sheet ».

In this world instead of creating money, the banking system just ensures the circulation of central bank money. This case is described in Figure 2. Starting from an initial amount of reserves of \$100, private banks cannot create *ex nihilo* additional units of the settlement asset as their private monies will not be accepted as a medium of exchange<sup>17</sup>. In my example, after the different operations, the quantity of money in the economy is thus unchanged (\$100). There is no creation of money by the banking system because a bank cannot add a credit without accounting for a debit. This means that there is a balance-sheet constraint on bank lending. In this system, loans do not make deposits. Instead, we have another mechanism: reserves make loans which make deposits<sup>18</sup>, i.e. to credit an account with \$100, banks need to debit these dollars from another account. If banks cannot create money (i.e. additional units of the settlement asset), the banking system ensures the high speed circulation of central bank money. In my example with a 10% reserve system, the circulation of the \$100 (as the circulation of coins in the real economy) permits  $100+90+81 = \$271$  of operations (in value terms). But, contrary to the goldsmiths world, the sum of the claims on the bank cannot be considered as the money created by the banking system. Because banks only ensure the circulation of central bank money, the number of operations (i.e. the size of the monetary aggregates) is instead an indicator of the risk taken by the banking system. Indeed, as it is always the same \$100 which circulate into the bank, the deposit of X is used to make a credit to Y, then to Z, etc. If the bank can lend several times the same dollars, each time it credits an account with \$100, it needs an equivalent amount of the settlement asset. In

<sup>17</sup>This argument is developed in the model of Chapter 4.

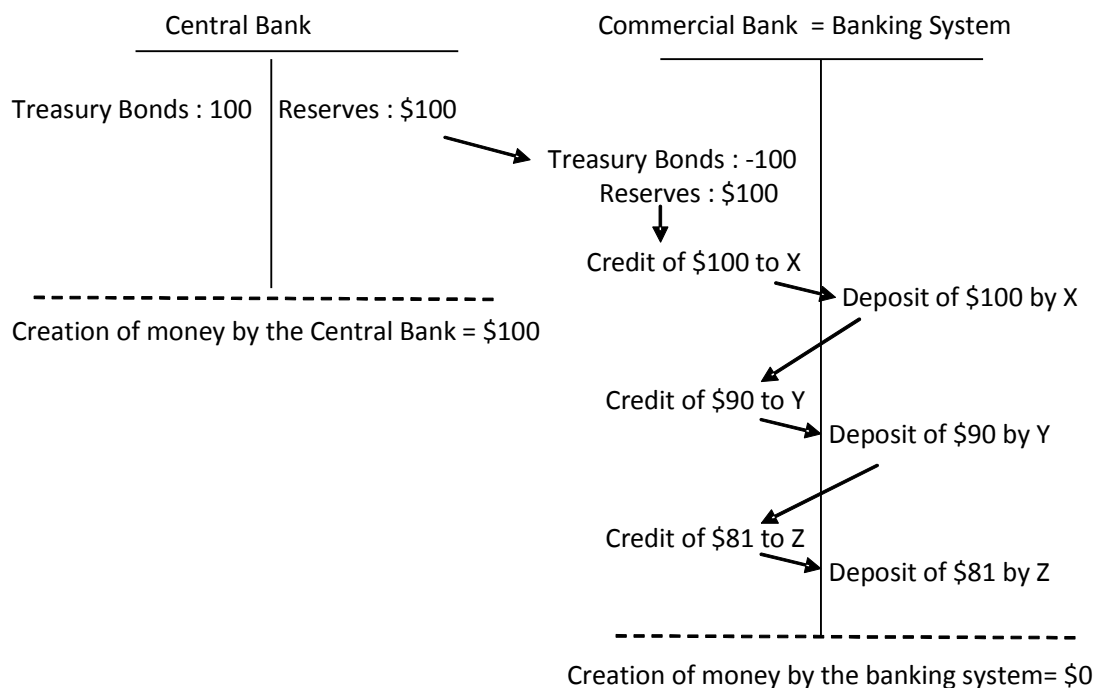
<sup>18</sup>The hypothesis that money is not created by banks through the mechanism “loans make deposits” is not contradictory with the fact that central banks are accommodating, i.e. that they will always make available the quantity of reserves required by banks in order to support their lending. But it does not mean that banks create money. Lending something that you do not have yet on your disposal does not mean that you created this thing.

this system it is only because of the law of large numbers that X can expect to get back his money. Finally, transactions in this economy are not settled with private monies but with central bank money (USD).

It is important to notice that the existence of a balance-sheet constraint on bank lending says nothing about the reserve requirements in the system. It is in particular possible to have no private money creation in a 0% reserve system. This just implies that a bank can lend all its customers' deposits. But the bank cannot lend more than what it has (or more than what it can borrow from another bank or from the central bank).

To summarize, in the goldsmiths world, banks can create money by crediting *ex nihilo* an account as the money credited is private. This system is only possible because transactions are settled with private monies. In the conflicting view, the banking system just ensures the circulation of central bank money as the only asset used for settlement is central bank money.

Figure 2: The circulation of Central Bank money in a world without private money



Note: example taken for a 10% reserve system.

**Policy implications.** I model these two conceptions and their policy implications in Chapter 4. It is not the object of the current chapter. One can expect that both risk propagation and the power of central banks could be dependent on the assets used

as money in modern banking. In the goldsmiths view, i.e. in a world where different private monies coexist, risk could be segmented to the compartment where each asset is used. With the alternative view, the risk could not be segmented and shocks could spread through the settlement asset in the entire banking system<sup>19</sup>. Similarly, these two cases should have also different policy implications for central banks. Transmission channels of monetary policy are dependent on the asset used as money in modern banking. For example, in the alternative view, as we have a monopoly of central bank money, only central banks can provide the liquidity needed to limit the risk, which can have significant impacts notably in payment systems<sup>20</sup>. These institutions could thus be reinforced in modern banking as they are the provider of the only asset used for settlement. In the goldsmiths view, i.e. in the case of a privatization of money, both public and private issuers of liquidity are able to limit the risk and we could have a marginalization of central bank monetary policy.

Two conceptions of modern banking conflict. For the goldsmiths view, widespread in modern theories of banking and in institutional publications, money creation takes place primarily in private banks. It is because banks issue private money that they can create money. Money privatization is seen as one the main features of modern banking. The opposing view point considers on the contrary that the banking system only ensures the circulation of central bank money as the only asset used for settlement is central bank money. The rest of this chapter tries to settle between these two conceptions.

## 2 Private money in modern banking

I study empirically the reality of the privatization of money in modern banking. Even if it is considered as one of the main features of modern banking, such analysis has surprisingly not been made yet. Measuring the share of private money in a system requires calculations of the total value of transactions (the denominator of this ratio) in a given country, and thus an exhaustive analysis of its different payment components. That is why my main estimates focus on the US. The empirical novelty of this chapter is that I calculate an estimate of the total value of transactions in the US, and then the share of these transactions that are directly processed by the Federal Reserve (i.e. the share of the transactions that are directly settled in central bank money). Thanks to BIS data, it is also possible to calculate orders of magnitude of the share of central bank

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<sup>19</sup>In Chapter 4, to understand this settlement risk or funding risk, I draw a parallel with the use of different settlement assets at the world level. One can expect existing compartments between central bank monies to gradually diminish with the globalization of banking, and in particular with the dollarization of European banks. Indeed, this globalization of banking leads to the use of the same settlement asset (the US dollar) for transactions at the world level. If banks use the same settlement asset, shocks could thus spread in a systemic way through this settlement asset as shown during the current crisis by the consequences of the scarcity of dollar funding available internationally to financial institutions.

<sup>20</sup>In these systems, creditors rely heavily on the inflows from debtors to fund outflows. A delay (or a default) of a debtor can affect an entire payment system, making normal settlement impossible. The marginal provision of liquidity by the central bank enables significant risk reduction.

money in a selected number of countries where data are available<sup>21</sup>. This enables me (by contrast) to determine the potential share of private money<sup>22</sup>. Results of these estimates appear to be comparable to those obtained in the analysis of the US case.

## 2.1 Central bank money: a definition through the settlement method

Before entering into the details of the estimations, it is necessary to define more precisely central bank money. I use BIS definitions to define systems where settlement involves central bank money. The Bank for International Settlements classifies settlement methods in five categories. Only the two first settlement methods can be considered as using directly central bank money. Since all the details of the settlement method are important, let me quote the Bank for International Settlements (BIS 2003c, p.102).

“C1 = settles in central bank money by the central bank simultaneously debiting/crediting the settlement accounts of the debtors/creditors (either individual payments in real-time in an RTGS system or the net positions periodically in net and other systems).

C2 = settles in central bank money by debtors first paying funds (eg by making an RTGS payment) to a special account at the central bank used solely for this purpose (eg in the name of the settlement agent for the system) and then the settlement agent paying funds from that account to the creditors. (NB Contrast this to P4. In C2, the settlement agent is NOT the settlement institution - the settlement agent does not provide accounts.)

P4 = settles on accounts held by direct participants at a (private sector) settlement institution - but, as a routine part of the normal settlement procedures, the settlement institution defunds those accounts (on the same day) to those with creditor positions using central bank money (eg CLS).

P5 = settles on accounts held by direct participants at the (private sector) settlement institution - and early enough in the RTGS operating day for those with positive balances to defund their accounts on the same day if they want (ie any overnight balances with the settlement institution are voluntary).

P6 = settles on accounts held by direct participants at the (private sector) settlement institution - but sufficiently late in the operating day to prevent those with positive balances at the settlement institution from defunding their accounts on the same day (ie overnight balances with the settlement institution are unavoidable)”.

In my estimations in this Section, the value of transactions settled in central bank money takes only into account transactions settled with C1 and C2 methods, i.e. transactions directly processed by central banks. Transactions settled with P4, P5 and P6 methods potentially involve private money. To say it differently, I call temporarily private money, transactions that are not settled with central bank money. So, at first sight, “central bank money” is only defined by the transactions that are directly processed by central banks. Similarly, transactions settled on accounts held by participants at a private settlement institution are made apparently using private money. However, I will show later in this

<sup>21</sup>Contrary to the methodology used for the US, I do not have a precise estimation of the total value of transactions in the 15 countries of my sample. I use as an approximation the value of the transactions settled in the different payment systems enumerated by the Bank for International Settlements.

<sup>22</sup>In this section, to simplify my notations, I call transactions not settled in central bank money “private money”. It is not strictly the case as we will see in Section 3. It is a first step to have an order of magnitude of what “private money” could represent. I will then show that these systems with private money are in fact closer to systems with only central bank money than to strictly private systems (i.e. to systems without any link with central banks) where we can really observe a privatization of money.

chapter that even transactions that are not directly processed by central banks cannot be considered as using private money. Indeed, because of the double-entry accounting principle, a bank cannot credit the account of one of its clients without debiting another account. It is only if a bank debits an account with private money that it can credit an account with the same private asset<sup>23</sup>. If a bank needs to debit an account with central bank money in order to credit a private account, it just ensures the circulation of the central bank money (for a discussion see Section 3 and Chapter 4).

Moreover, it is important to notice that the fact that the central bank of a given country is private (or not state-owned) does not imply that the transactions processed by this institution are defined as private money. For example, the Bank for International Settlements considers that the transactions in Swiss payment systems are settled with central bank money (C1), even if Swiss National Bank (SNB) is owned partly by private institutions (Table C in BIS (2003c)). In this definition, transactions settled by the SNB are considered as using central bank money, and not private money, because of the legal status of this asset. Similarly, the fact that banks use as settlement asset central bank money does not imply that these banks are state-owned. The nature of the settlement asset used by a given institution gives no particular information on the status (public or private) of this institution.

## 2.2 Private money in selected countries

Thanks to the BIS report (2003c) on the role of central bank money in payment systems, I estimate the relative share of transactions made in central bank money in the 15 countries described by the report. I divide the value of transactions settled in central bank money (i.e. the value of transactions in systems where the settlement method is either C1 or C2) by the total value of transactions in the payment arrangements existing in the country considered<sup>24</sup>. To my knowledge, the data are the latest that generate an order of magnitude of the share of central bank money at the “world” level. These percentages are still accurate as they mostly depend on the type of system. In the period considered, the settlement method has not change significantly. These estimations give orders of magnitude. I construct in the next subsection a more precise estimation of the US case. Note that I do not include in my analysis transactions settled with virtual currencies such as *Bitcoins* or *Amazon coins* as these private currencies are still quite marginal phenomena<sup>25</sup>.

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<sup>23</sup>Similarly, a bank can only credit an account with US dollars if it debits an account where it has these US dollars. For example, during the current crisis, the ECB could only lend US dollars to European banks because it had these dollars thanks to SWAP agreements with the Federal Reserve. To say it differently, as the ECB cannot create USD, it can only credit an account with USD if it has an equivalent amount of USD.

<sup>24</sup>The value of transactions settled in central bank money is calculated according to BIS classification (see previous subsection). Systems where settlement occurs in central bank money are explicitly enumerated, with the value of transactions in each system.

<sup>25</sup>For example, in October 2013, the value of the money supply of the Bitcoin network stands at over \$1.6 billion USD (Foley and Alloway (2013)).

**Methodology.** Contrary to the methodology used in next subsection for the US, I do not have a precise estimation of the total value of transactions in the 15 countries of my sample. I use as an approximation the value of the transactions settled in the different payment systems enumerated by the Bank for International Settlements (see Table C in BIS (2003c)). The interest of this approach is that it enables to take into account the private systems described in the literature as leading to a privatization of money (these private systems are then studied precisely in Section 3). Indeed, it is especially the recent developments in private payment arrangements that are seen as implying a privatization of money (Kahn (2008)). It is for example the case of the system in Hong Kong where banks have set up entirely private settlement arrangements for making payments in US dollars with *no apparent* connection to the Federal Reserve<sup>26</sup>. It is also important to notice that as transactions in payment systems represent a very large share of the total value of transactions in a given country (more than 90% in the US, see Appendix A), studying the nature of the settlement assets used for these transactions is essential to investigate the (potential) privatization of money in modern banking.

The transactions settled with central bank money are defined as the transactions operating with the settlement methods C1 and/or C2. Data are based on the payment and settlement systems existing at the level of each country<sup>27</sup>. For example, for the Eurosystem, only the systems operating at the Eurozone level (such as Target2) are taken into account. It is not an average of the results of the different European countries.

**Results.** In my sample of 15 countries, central bank money does not represent more than 95% of the value of transactions settled only in three systems (Belgium, US, CLS) (Table 1). The US is an interesting case as half of the transactions are not settled in central bank money. But it is important to notice it is also a specific case at the world level<sup>28</sup>. Except in these three cases, if private money exists, it represents a very small share of the value of transactions settled. The estimations calculated represent the upper bound of what private money could represent at the world level (if it is indeed private, see Section 3).

### 2.3 Private money in a long-run perspective

I study now more precisely the evolution of the percentage of transactions that are settled in central bank money. It is only by studying this evolution that one can answer the

<sup>26</sup>This system classified as P5 potentially involves private money as transactions are settled on accounts held by participants at the private institution.

<sup>27</sup>Payment and settlement systems can coexist at different levels in the same area as they do not cover the same type of financial transactions. For example, at the Euro level, wholesale payments can take place whereas some particular financial operations will use institutions existing at the national level such as Euroclear in Belgium. Operations in this national system do not coincide with operations using Euro-level institutions. For instance, large-value payments made by Belgian banks will be registered at the Euro level (Target2), and not in this specific institution based in Belgium.

<sup>28</sup>Belgium is also a special case because it is on this country that is based one of the two International Central Securities Depositories in the world (Euroclear).

Table 1: Potential share of private money in selected countries

	Share of transactions made in central bank money (end 2002)	Does private money exist <i>potentially</i> in these systems?	Central bank money represents more than 95% of the value of transactions
Belgium	22%	Yes	No
Canada	95%	Yes	Yes
Eurosystem	100%	No	Yes
France	100%	No	Yes
Germany	100%	No	Yes
Hong Kong	98%	Yes	Yes
Italy	100%	No	Yes
Japan	99.9%	Yes	Yes
Netherlands	100%	No	Yes
Singapore	98%	Yes	Yes
Sweden	100%	No	Yes
Switzerland	100%	No	Yes
United Kingdom	100%	No	Yes
United States	57%	Yes	No
CLS	-	Yes	No
“World” level (without Germany and CLS)	78%	Yes	No

Author's calculations, source: BIS (2003c).

following questions. Does modern banking imply a privatization of money? Are we going towards a “world without money”, i.e. a world without central bank money? I focus on the US system, which is the biggest in the world but also a special case at the world level as I showed in previous subsection that the potential share of private money is higher in this country. To investigate money privatization in the US, it is first necessary to describe briefly the main components of US payment and settlement systems and the pivotal role of the Federal Reserve in this organization. I use then a specific methodology to estimate the percentage of total transactions that are directly processed by the central bank (and settled in central bank money), or similarly, the potential weight of private money in the US economy. To do so, I divide the value of payments processed by the Federal Reserve by the total value of transactions. I first calculate the value of payments processed by the central bank. I then construct datasets on the total value of transactions in retail and large-value payments in the United-States, which did not exist to my knowledge. To avoid double-counting, I subtract transactions made with central money as they are already counted on the value of payments processed by the Federal Reserve.



Figure 3: The Federal Reserve in the US payment system

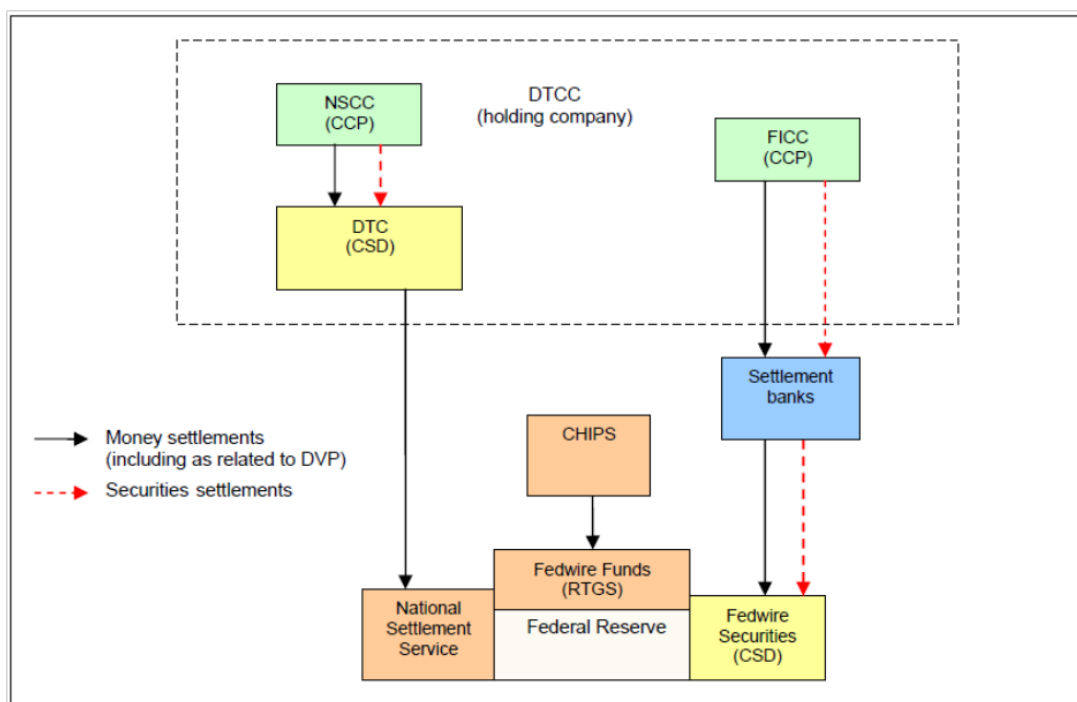


Diagram extracted from BIS (2008)

### 2.3.1 The pivotal role of the Federal Reserve in large-value payment systems and securities settlement systems.

The U.S payment and settlement systems are composed of large-value payment systems and securities settlement systems. The Federal Reserve plays a pivotal role in these systems.

**Large-value payment systems.** Generally, these payment systems are used by financial institutions and their customers to make large-dollar, time-critical transfers. There are two major large-value payment transfer systems in the United States:

- The first, Fedwire Funds Service<sup>29</sup>, is operated by the Federal Reserve Banks, and is an important participant in providing interbank payment services. The Federal Reserve Banks provide the Fedwire Funds Service, a real-time gross settlement system (RTGS) that enables participants to initiate funds transfer that are immediate, final, and irrevocable once processed. Depository institutions and certain other financial institutions that hold an account with a Federal Reserve Bank are eligible to participate in the Fedwire Funds Services. In 2008, approximately 7,300 participants made Fedwire funds transfers. The Fedwire Funds Service is a credit transfer service. Participants originate funds transfers by instructing a Federal Reserve Bank to debit funds from its own account and credit funds to the account of another participant.

<sup>29</sup>For a description of the different services provided by the Federal Reserve, see: <http://www.federalreserve.gov/paymentsystems>

- The Clearing House Interbank Payments Company operates the second, the Clearing House Interbank Payments System (CHIPS). Historically, CHIPS specialized in settling the dollar portion of foreign exchange transactions, and CHIPS estimates that it handles 95 percent of all U.S. dollar payments moving between countries.

**Securities Settlement Systems.** The major securities markets in the United States include the government securities market, the corporate equities and bond market, the market for money market instruments, and the municipal bond market. The mechanisms for clearing and settling securities transactions vary by market and type of instrument, and generally involve two types of specialized financial intermediaries: clearing corporations and securities depositories. Clearing corporations provide trade confirmation and comparison services, and multilateral netting of trade obligations; while, securities depositories transfer securities ownership on a gross or net basis against payment via book-entry transfers. In the United-States, Securities Settlements Systems have different components<sup>30</sup> :

- The Fedwire Securities Service, owned and operated by the Federal Reserve Banks, is a securities settlement system that enables participants to hold, maintain, and transfer Fedwire-eligible securities. It is a “Delivery versus payment” (DVP) system (where securities and funds both settle on a gross basis) settling in central bank money. Both securities and money settlement are conducted by the Fedwire Securities Service. Depository institutions and certain other governmental or financial institutions that hold a funds account and a securities account with a Federal Reserve Bank are eligible to participate in the Fedwire Securities Service .
- The Depository Trust & Clearing Corporation (DTCC) is the world’s largest post-trade financial services company. Today, DTCC provides clearance and settlement services for virtually all trades done on the New York Stock Exchange and NASDAQ as well as on all regional exchanges and electronic communications networks (ECNs) in the US. DTCC subsidiaries clear and settle nearly all US market trades in equities, corporate and municipal bonds, US government securities and mortgage-backed securities, money market instruments and over-the-counter (OTC) derivatives<sup>31</sup>.

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<sup>30</sup>For a description of these different systems, see also: Wholesale Payment Systems Booklet, July 2004.

<sup>31</sup>There are 3 subsidiaries. The Fixed Income Clearing Corporation (FICC), composed of the Government Securities Division (GSD) and the Mortgage-Backed Securities Division (MBSD), compares and nets trades of U.S. Treasury securities, agency debt securities, and mortgage-backed securities. The National Securities Clearing Corporation (NSCC) provides clearing and settlement services for the vast majority of corporate equity and municipal bond transactions in the United States. It handles all aspects of the clearance and settlement of trades between brokers and dealers in securities traded on the New York Stock Exchange, the American Stock Exchange, certain regional exchanges and in the over-the-counter market; it also provides clearing services to issuers of mutual funds. The Depository Trust Company (DTC), the central securities depository for corporate equities and bonds, municipal government securities, and money market instruments, provides safekeeping and transfer of these securities (Source: DTCC annual reports, Various issues, <http://www.dtcc.com/about/annuals/2009/index.php>).

**The other components of the services provided by the Federal Reserve.** In addition of playing a central role in Large-value payment systems and in Securities Settlement Systems, the Federal Reserve offers two other services.

- With the National Settlement Service (NSS), the Federal Reserve allows participants in private clearing arrangements to settle transactions on a net basis using account balances held at the Federal Reserve. The National Settlement Service is available to settlement arrangements clearing retail payments such as check, automated clearinghouse, credit card, point-of-service, and Automated Teller Machine transactions, as well as those exchanging wholesale payments, securities or other financial instruments. NSS was implemented in March 1999.
- Finally, the Federal Reserve processes retail payments (Automated Clearinghouse Services, check collection services, Currency and Coin Services).

### 2.3.2 Estimation of the total value of transactions.

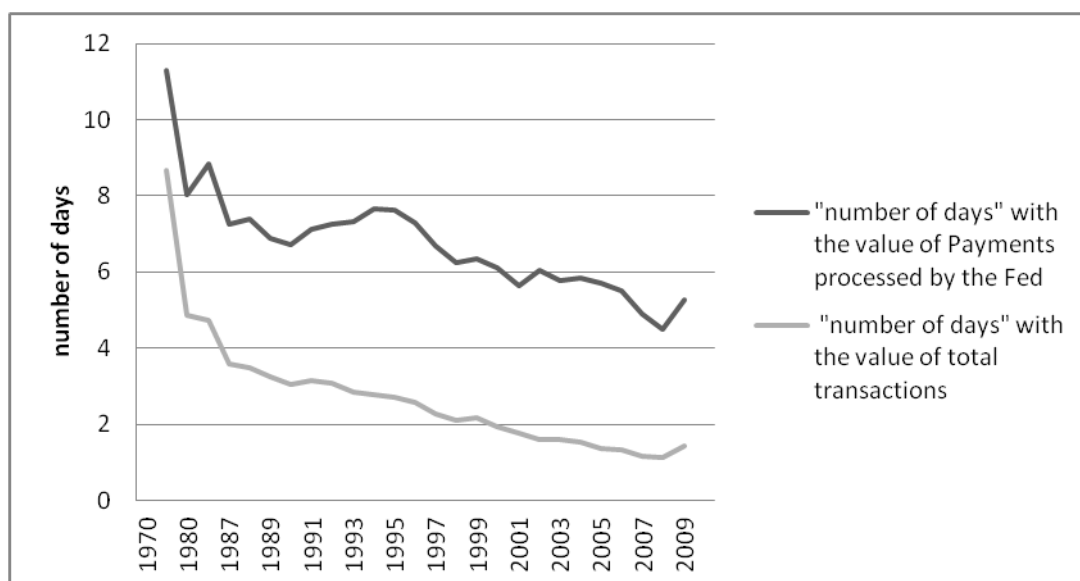
I construct datasets on the value of total transactions in retail and large-value payments in the United-States, which have not previously been calculated as far as I know. The objective is to determine the relative share of private money. Measuring the value of total transactions in the US economy is complicated because of the complexity of the different systems of payments, both public and private. Data about private institutions are difficult to obtain. It is also important to distinguish between large-value payments, retail payments and securities settlement systems that have their own characteristics. A significant part of transactions are internal payments or “on-us” transactions, i.e. payments that remain within a single financial institution that are difficult to estimate<sup>32</sup>. Similarly, each major bank has hundreds of correspondent –domestic and foreign – banks that keep accounts with it.

**The total value of transactions.** To have a first estimation of the total value of transactions in the U.S, I add to the estimation of the value of payments processed by the Federal Reserve the value of transactions in CHIPS, plus the total value of securities settled through DTCC (which includes DTC, NSCC and FICC transactions), plus the value of retail payments. For example for 2009, I add: the value of Payments processed by the Federal Reserve<sup>33</sup> (\$682 Trillion); CHIPS Total dollar amount of transactions (\$364

<sup>32</sup>In Appendix A, I give estimations of the value of internal payments.

<sup>33</sup>To have an estimation of the value of payments processed by the Federal Reserve, I add: the value of transfers in the Fedwire Funds Service (\$631 trillion in 2009); the value of transfers in the Fedwire Securities Service (\$296 trillion in 2009); the value of total settlement in the National Settlement Service (\$16.5 trillion in 2009); the retail payments processed by the Fed (\$34 Trillion in 2009). So the total value of payments processed by the Federal Reserve was around \$682 Trillion in 2009. The average daily value of transactions was around \$2.7 Trillion. The value of less than five days of transactions processed by the Fed is equivalent to the value of the U.S GDP! 36 days were “necessary” in 1960. Recent data about the payments processed by the Federal Reserve are extracted from the Federal Reserve website: <http://www.federalreserve.gov/paymentsystems>. Historical data are extracted from FRASER St Louis Fed: Banking and monetary statistics 1914-1941, 1941-1970, Volume of operations in principal departments of Federal Reserve Banks 1938-1984, 1984-2000.

Figure 4: How many days of daily transactions are "necessary" to get the U.S GDP?



Author's calculations, sources: Federal Reserve, BIS, CHIPS, DTCC, NACHA

Trillion)<sup>34</sup>; the value of securities settled through DTCC (\$1480 Trillion)<sup>35</sup>; total retail Payments<sup>36</sup> (\$87 Trillion). So the value of total transactions is around \$2580 trillion in 2009. The average daily value of transactions in 2009 is around \$10 trillion. To say it differently, the value of 2 days of total transactions is equivalent to the value of the U.S GDP!

**A net estimation.** I then calculate net estimations (i.e. without double-counting) of the total value of transactions in the United-States, by subtracting gradually transactions made with central money. Indeed, these transactions in central bank money are already counted on the value of payments processed by the Federal Reserve. I exclude also the funding values of clearing systems which are made directly with central bank money. Finally, I exclude systems where money settlements occur, even indirectly, on the books of the central bank (and which are not considered even by institution such as BIS as commercial bank money<sup>37</sup>).

To have a net estimation of the total value of transactions, I add:

- The value of Payments processed by the Federal Reserve (\$682 Trillion in 2009).
- I calculate the value of transactions in CHIPS. CHIPS total dollar amount of transactions was around \$364 Trillion in 2009. I then subtract:

<sup>34</sup>The Clearing House (CHIPS) provides data about the value of transactions since 1970 (CHIPS, 2011) (<http://www.chips.org/docs/000652.pdf>).

<sup>35</sup>There is no database for the transaction statistics of the different elements of the Depository Trust & Clearing Corporation (DTCC). It is thus necessary to look at each DTCC annual report to get some data about the value of securities settled through DTCC, NSCC transactions settled, DTC Book entry Deliveries, etc. (DTCC annual reports, Various issues, <http://www.dtcc.com/about/annuals/2009/index.php>).

<sup>36</sup>I describe precisely calculations for total retail payments in Appendix A.

<sup>37</sup>BIS (2008), pp.66-67

- The average daily CHIPS funding in central bank money. I take into account the average initial prefunding, the supplemental funding and the final funding<sup>38</sup>. The refined value of CHIPS total dollar amount of transactions was around \$349 Trillion in 2009.
  - The non-netting part of the transactions of the Clearing House (“individual messages”<sup>39</sup>), which almost occur on the books of the central bank (individual messages are an indirect claim on the central bank). It is the real-time gross settlement part of CHIPS. Individual messages (No netting) represent 37% of the value of payments (and 90% of the number of payments). 41% are multilateral netting, 22% bilateral netting (CHIPS, 2007). So the value of CHIPS net dollar amount without individual messages (since 2001) is around \$232 Trillion in 2009.
- Total Retail Payments (non-cash payments): \$87 Trillion (calculations in Appendix A).
  - Finally, to get the net estimation of the total value of transactions, I exclude Securities Settlement Systems. Indeed, settlements in these systems occur directly or indirectly on the books of the Federal Reserve. So they are made with central bank money. It is the case of DTCC transactions<sup>40</sup>. Cash settlements in DTCC subsidiaries occur directly or indirectly on the books of the Federal Reserve. For example, DTC is a direct participant in the Federal Reserve’s National Settlement Service, which provides multilateral net settlement in central bank money. Similarly, for the National Securities Clearing Corporation (NSCC), settlement in central bank money occurs indirectly through an account held by the Depository Trust Company (DTC) with the Federal Reserve (BIS (2008)).

So the value of the net estimation of total transactions is around \$915 trillion (2009). The average daily value is \$3.6 Trillion.

### **2.3.3 What is the share of private money in the US? Exploring a long-run dynamic.**

The share of transactions settled in central bank money is described in Figure 6. I divide the value of payments processed by the Federal Reserve by the net estimation of

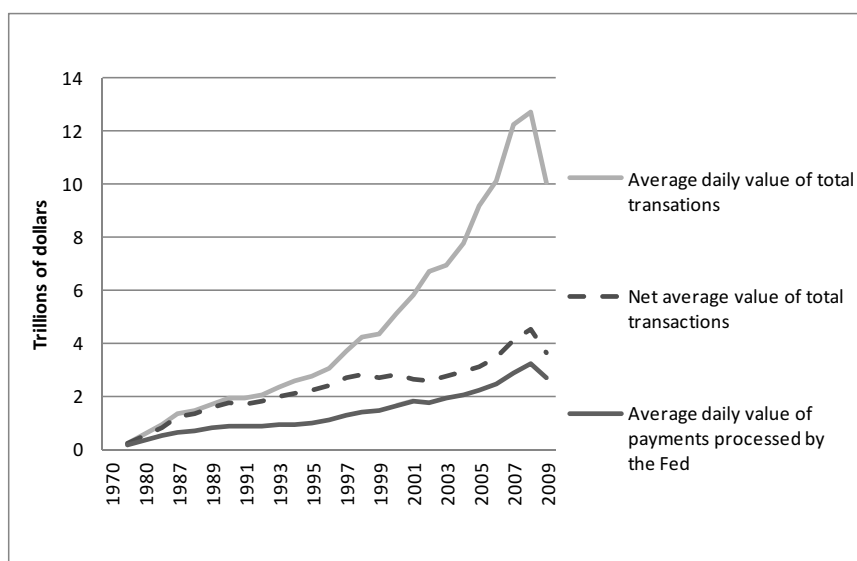
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<sup>38</sup>The data on CHIPS funding are taken from Kuo et al. (2009). The data on the average daily funding are multiplied by the number of business days to have an annual value. Some missing data are calculated thanks to CHIPS Turnover ratio and by making the hypothesis that this turnover ratio has been increasing for thirty years.

<sup>39</sup>“If a payment message is released individually, it is simultaneously settled and the sending participant’s obligation is paid by decreasing the current position of the sending participant and increasing the current position of the receiving participant in the amount of the payment message” (CHIPS, 2009).

<sup>40</sup>DTCC is the world’s largest post-trade financial services company. Today, it provides clearance and settlement services for virtually all trades done on the NYSE and NASDAQ. For a description of DTCC subsidiaries, see BIS (2008).

Figure 5: Estimations of the Total Value of Transactions (1975-2009)



Author's calculations, sources: Federal Reserve, BIS, CHIPS, DTCC, NACHA

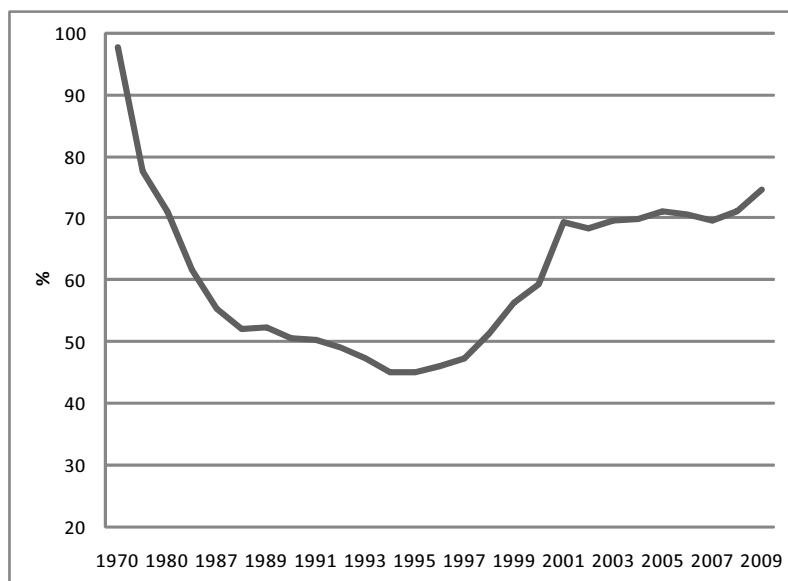
the total value of transactions<sup>41</sup>. In the US, 60% to 70% of the value of total transactions is directly processed by the Federal Reserve, or similarly 60% to 70% of the value of transactions are settled in central bank money. These results show the dependency of the financial sector on the central bank for the provision of the settlement asset<sup>42</sup>. For example, central banks have to play an active role in payment systems by providing intraday credits to depository institutions throughout the business day to ensure the smooth functioning of these systems. These results show also that central bank money represents an increasing share of the total value of transactions. If the value of inter-bank payments has been increasing a lot for twenty years<sup>43</sup>, the demand for central bank money has been even stronger. Contrary to what would be expected, technological development and the deregulation of the financial markets have thus led to an increasing dependence on the central bank. The need for central bank money has increased over the past years due to the shift towards Real Time Gross Settlement Systems (RTGS) in large value payment systems. Indeed, as payments are settled individually in an RTGS system, sufficient liquidity needs to be available to fund each payment. Real-time gross settlement thus reduces settlement risks but results in an increased need for intraday

<sup>41</sup>For Figure 6, because of data limitations, I exclude retail payments from the value of total transactions. The results do not change significantly as 50% of the value of retail payments is processed directly by the Federal Reserve (so already included in the "value of payments processed by the Fed") and because retail payments only represent around 7-8% of the value of total transactions (see Appendix A for a more precise description of retail payments).

<sup>42</sup>These results are comparable to those obtained with the first methodology and BIS data (Table 1).

<sup>43</sup>The lowest dependence on the Federal Reserve was in 1995-1996, and since that time the dependence has been growing steadily. It can be explained by the fact that the trajectory of volumes processed over CHIPS declined significantly in the late 1990s and did not recover until 2001. At the same time, Fedwire was experiencing steady growth. This change coincides with the reduction in Fedwire fees. Large-value payments systems are indeed characterized by large economies of scale, as there are considerable fixed costs in terms of setting up and maintaining the systems. In the 1990s, the Federal Reserve undertook a five-year project to consolidate its processing facilities. The project resulted in significant savings that were passed on to users in the form of lower fees. The average transaction fee (nominal) in Fedwire was reduced by 68 percent (Bech et al. (2008)).

Figure 6: Share of transactions made in central bank money, US, 1970-2009



Author's calculations. Sources: Federal Reserve, BIS, CHIPS, DTCC, NACHA. This estimation excludes CHIPS individual messages which is not the case in Table 1.

liquidity to smooth non-synchronized payment flows.

Estimations in this section aim to calculate the share of transactions made in central bank money (i.e. directly processed by the Fed). It is important to notice that if transactions are not made in central bank money, it does not mean that they are made in private money. The objective of next section is to study more precisely the nature of the transactions not made in central bank money. I will show that it is only if these systems are strictly private, i.e. without any link with central banks and in particular without any funding in central bank money, that we can speak of private money. Anticipating a bit a result shown in chapter 4, systems where competition exists between private and public money are in fact equivalent to systems with only central bank money as each time a bank credits an account, it has to debit another account with central bank money.

### 3 A systematic study of private systems

In previous Section, I showed that if private money potentially exists at the world level, it represents only a small share of the total value of transactions. I try now to determine if these transactions are really made in private money. In its report (2003c), the Bank for International Settlements classifies the payment systems and arrangements in different categories according to their settlement methods. This classification allows me to identify the private systems which do not use central bank money for their settlements, i.e. systems where the settlement method is P4, P5 or P6 (see 2.1) . The BIS enumerates eleven systems that settle on accounts held by direct participants at a private sector settlement institution (among them, Clearstream (Luxembourg), CLS (International), CHIPS (United-States), the USD RTGS in Hong Kong, etc). I use BIS classification to

study exhaustively these eleven private systems. These systems are the potential strictly private systems in my sample of countries, i.e. all the systems where we could observe a privatization of money. The objective is to determine more precisely if they can really be considered as strictly private systems, i.e. as systems without any link with central banks, and so if private money really exists. For example, if a private payment system needs an account with an initial funding with central bank money (as CHIPS in the US), which is used to make debits and credits during the day, then this system cannot be considered as the ultimate issuer of the funds. It just ensures the circulation of central bank money.

### 3.1 The criteria

I apply for this analysis different criteria drawn from the definitions (subsection 2.1). These criteria can also be drawn from the model I develop in the next chapter:

- *Can these systems credit an account without debiting another account?* The possibility to credit without debiting means that the entity is the ultimate creator of money. If a bank needs to debit an account with central bank money in order to credit a private account, it is just changing the physical aspects of central bank money without adding additional liquidity to the economy<sup>44</sup>.
- *Do the funds debited come from an external source?* If a currency is private, the ultimate issuer is the private entity so it must not be possible to find an external source of the funds which are provided. To cope with its daily liquidity needs, the system should not rely on external providers of liquidity.
- *Are extra sources of funds put in place to limit the risk?* In strictly private systems, no extra sources of funds should be put in place in case the normal supply is not sufficient. The system itself is the provider of the funds.
- *What is the ultimate provider of the funds?* For fully private money, no connection should be found with central banks, and the ultimate issuer of the funds should be a private entity.

A synthesis of the results is described in Table 2. I come back in Appendix B on the characteristics of each of these eleven private systems.

### 3.2 The common characteristics of these private systems

These systems result to have common characteristics. None of them can credit an account without debiting another account. The funds debited always come from an external source. Most of the time this external source is a cash correspondent bank which

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<sup>44</sup>See notably Cavalcanti et al. (2005): “When banks issue notes that are backed by accumulated reserves, they are just changing the physical aspects of the means of payments, without necessarily adding additional liquidity to the economy”.



Table 2: The interdependencies between private systems and central banks

	Settlement method <sup>a</sup>	Can they credit an account without debiting another account?	Do the funds debited come from an external source?	Direct origin of the funds (external source)	Extra sources of funds put in place to limit the risk	Ultimate provider of the funds
Euroclear Bank (Belgium)	P6/C2	No	Yes	Cash correspondent banks which themselves hold accounts with CBs <sup>b</sup>	Yes	Central Banks
CDS securities (Canada)	P5	No	Yes	Paying agencies which have accounts with the CBs	-	Bank of Canada, Federal Reserve
Clearstream (Luxembourg)	P6/C2	No	Yes	Cash correspondent banks which themselves have account with CBs	Yes	Central Banks
USD RTGS (Hong Kong)	P5	No	Yes	HSBC's New York correspondent which has an account with the Federal Reserve	Yes	Federal Reserve
Euro RTGS (Hong Kong)	P5	No	Yes	Standard Chartered Bank's London office by accessing Target2 via the De Nederlandsche Bank (= CB)	Yes	European Central Bank
CD/ATMs (Japan)	C2/P5	No	Yes	Central institutions of the cooperative banks which hold accounts at the CB (BoJ)	-	Bank of Japan
USD cheque clearing (Singapore)	P6	No	Yes	Participant correspondent banks and Citibank NY which hold accounts at the Federal Reserve	-	Federal Reserve
EFTPOS (Singapore)	P6	No	Yes	The Development Bank of Singapore which holds an account at the CB	-	Monetary Authority of Singapore
Cash machines/ATMs (Singapore)	P6	No	Yes	The Development Bank of Singapore which holds an account at the CB	-	Monetary Authority of Singapore
Central depository (Singapore)	P6	No	Yes	Selected banks	-	Monetary Authority of Singapore
CHIPS (United States)	P4	No	Yes	Banks participants which hold accounts with the Federal Reserve	-	Federal Reserve
CLS (International)	P4	No	Yes	Banks participants which hold accounts with CBs	Yes	Central Banks

<sup>a</sup>Definitions in Subsection 2.1. Payment arrangements are fully described in Table 3 (Appendix B).

<sup>b</sup>"CBs" means "Central Banks".

holds account with the central bank. The case of Hong Kong is significant. At first sight, HSBC has set up entirely private settlement arrangements for making payments in US dollars with no connection to the Federal Reserve (Kahn (2008)). The analysis shows that the funds come in fact from HSBC's New York correspondent which has itself an account with the Federal Reserve. Similarly, Clearstream (CBL) has in place a network of cash correspondents through which settlement is performed. Only these cash correspondent banks, because they have accounts with central banks, can provide intra-day and overnight credit lines to guarantee timely execution of Clearstream's payment obligations.

The first consequence of these observations is that these eleven systems are not the ultimate issuers of the funds. Settlement is thus not made with private money. This explains also why most of these systems have put in place extra sources of funds they can raise in case of an emergency. These contingency plans to raise additional liquidity are essential when private systems do not have direct links with payment systems, as it is the case in Clearstream or Euroclear. These plans are not necessary when systems have direct access to central banks (CLS, CHIPS).

This systematic study shows that no system can be considered as a strictly private system (i.e. as a system without any link with central banks). If these systems are privatized, no privatization of money can really be found. In each of these eleven systems, the ultimate providers of liquidity are central banks. These systems use in fact only central bank money, and are thus dependent on central banks.

### **3.3 Is money privatization limited to netting systems and to transactions inside a bank?**

Netting systems and "on-us" transactions (i.e. transactions inside a bank) have in common to enable liquidity saving but not liquidity creating. Some of the systems describe in previous subsections, as CHIPS in the United States, use netting mechanisms. I showed that these systems cannot be considered as strictly private systems as they are all deeply connected to central banks. But one could say that if all the transactions are made inside a netting system, central bank money is not necessary as these transactions can be settled on the books of the clearing house, i.e. with the private money of this system. A specific focus on netting systems is thus necessary to justify why, even in these systems, no privatization of money can be found. The same mechanism applies for transactions inside a bank or "on-us" transactions.

**Netting systems.** At first sight, there is a strong difference in the use of central bank money between Real-time Gross Settlement Systems (RTGS) and netting systems. Indeed, by reducing the number and overall value of payments between financial institutions, netting minimizes the usage of settlement asset. Thanks to netting, much more operations can be realized than the value of the transactions settled. On the contrary, RTGS systems settle each payment individually (i.e. on a gross basis). Differences be-

tween these two systems explain why netting systems enable liquidity saving, but they do not mean that netting systems enable liquidity creation. Indeed, even if transactions are only settled at the end of the day, each participant in a netting system has a cash position which is used to register operations during the day. Double-entry accounting applies also in netting systems as each operation is registered by crediting an account and by deducting the amount from another account. For each payment in a netting system, an account with central bank money is debited and another account with central bank money is credited. So even if netting minimizes the use of the settlement asset, double-entry accounting implies a “virtual” circulation of central bank money. For example, in CHIPS, the private large-value payment system in the United-States, participant’s intra-day current position cannot be less than zero (minimum) nor more than twice (maximum) its initial balance requirement. Similarly, a participant is never in a debit position. Only the double-entry accounting constraint can explain these constraints. During the day, in this netting system, each CHIPS payment message is settled by deducting the amount of the payment message from the sending participant’s current position and adding an identical amount to the receiving participant’s corresponding current position. The total amount of all the participants’ current positions is backed, dollar-for-dollar, by a balance in an account on the books of FRBNY<sup>45</sup>. At the end of the day, this “virtual circulation” becomes real transfer of central bank money. Banks that have positive closing positions receive the amounts that they are due in the form of Fedwire payments. Netting systems enable liquidity saving, not liquidity creating.

**On-us transactions.** The same mechanism applies for transactions inside a bank or “on-us” transactions. At first sight, transactions inside a bank enable this institution to create an almost unlimited amount of money. Indeed, one could say that if all the transactions are made inside the same bank, central bank money is not necessary as these transactions can be settled on the books of the bank, i.e. with the private money of the bank. It is not the case. Because of double-entry accounting, on-us transactions require at least a “virtual” circulation of central bank money. In some countries, on-us transactions are even made directly in central bank money. For example in the United States, transactions between a bank and its correspondents are made using Fedwire, i.e. the system operated by the Federal Reserve: “Banks use the Fedwire not only to handle their transactions in the Fed funds market, but for other transactions. Each major bank has hundreds of correspondent –domestic and foreign –banks that keep accounts with it, and it keeps accounts at other banks. Throughout the day, monies are constantly being paid into and out of these accounts over the Fedwire in connection with securities transactions, collections and so forth.” (Stigum and Crescenzi, 2007, p.496). So even on-us transactions are settled with central bank money.

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<sup>45</sup>CHIPS, 2009, p. 29. See also FFIEC, 2004, p.9

## Conclusion

I discuss in this chapter the consequences of modern banking for the provision of money. Two conceptions of modern banking conflict. For the goldsmiths view, widespread in modern theories of banking and in institutional publications, money creation takes place primarily in private banks. It is because banks issue private money that they can create money. Money privatization is seen as one of the main features of modern banking. The opposing view point considers on the contrary that the banking system only ensures the circulation of central bank money as the only asset used for settlement is central bank money. This chapter has brought some evidence to try settle between these two conceptions.

I calculate the percentage of total transactions that are directly settled in central bank money with a precise estimate in the US case, and by giving orders of magnitude for a sample of 15 countries. Central bank money represents a very large share of the value of transactions in these countries -more than 95% of the value of transactions in payment systems in 12 countries. To investigate the evolution of this variable, I focus on the United States, and construct new datasets on the total value of transactions in retail and large-value payment systems over the last 40 years, which have not previously been calculated as far as I know. Contrary to what could have been expected with technological development and the rise of private systems, a growing share of the total value of transactions is directly processed by the central bank. The remaining transactions are those which are potentially made with private money. I thus study characteristics of all the private systems classified by the Bank for International Settlements, i.e. I analyze exhaustively all the arrangements and systems where settlement potentially involves private money. Results of the analysis show that the conditions for a privatization of money are not fulfilled today. Instead of a "world without money", it is more realistic to describe modern banking as world with a monopoly of central bank money. The goldsmiths view seems not a good framework for modern banking.

Empirical evidence could have consequences both in terms of risk propagation mechanisms and for the power of central banks. For example, transmission channels of monetary policy are probably dependent on the asset used as money in modern banking. Shocks can also spread through settlement assets, as shown during the recent financial crisis by the consequences of the use of US dollar as settlement asset in global finance. I develop these policy implications in the next chapter.

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## A Estimation of the value of retail payments in the US

There are no real specificities of retail payments relative to large-value payments (Federal Financial Institutions Examination Council, 2010). They broadly work the same way<sup>46</sup>. Most of the time, a clearing house routes the transactions between financial institutions. But what is interesting is that final settlement is made mainly (directly or indirectly) using central bank money.

Estimations of the value of retail payments are given in Figure 7. They show that transactions made with central bank money have represented around 60% of total non-cash payments for the last twenty years. Even when we take into account on-us transactions, the indicators remain above 40%. To have an estimation of the value of total non-cash payments, we add: the total non-cash transactions processed by the Reserve Federal<sup>47</sup> (\$34 Trillion in 2009); total ACH Transactions with and without on-us payments<sup>48</sup> (\$30 Trillion without on us payments and 37 with on-us transactions in 2009); total paid checks (\$30.1 Trillion without on-us checks in 2009, 29.6 in 2006, and 41.6 with on-us checks<sup>49</sup> in 2006). Total non-cash payments are around \$87 Trillion with on-us payments in 2009 and \$60 Trillion without on-us transactions. Retail payments represent a small fraction of the value of total payments. For the last twenty years, they have represented around 7-8% of total payments (retail payments+ large value payments)<sup>50</sup>. The fraction was around 15% in 1980.

## B Main characteristics of private systems

### Definitions:

- Delivery versus payment (DVP): a link between a securities transfer system and a funds transfer system that ensures that delivery occurs if, and only if, payment

<sup>46</sup>For example, for check Clearing and Settlement, the check or an electronic presentment file is sent to the consumer's financial institution, and the financial institution's account at the correspondent or Reserve Bank is debited. Many financial institutions participating in check clearing houses use the Federal Reserve's National Settlement Service (NSS) to effect settlement for checks exchanged each business day.

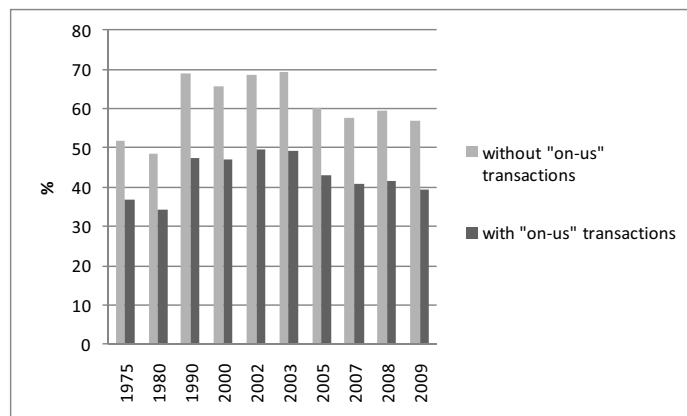
<sup>47</sup>The Federal Reserve provides retail services: Checks Collected through the Federal Reserve (\$14.1 Trillion in 2009) ; Automated Clearinghouse (ACH) Transactions processed by the Fed (\$19.7 Trillion in 2009); Currency and Coin Services (\$0.9 Trillion in 2009). Source: Federal Reserve (Federal Reserve System, n.d.).

<sup>48</sup>Data on total ACH Transactions are collected from NACHA reports (NACHA, n.d.). Some reports include data on "on-us" transactions, others don't. Data on "on-us" Transactions are also collected from BIS ( (BIS, 2009), (BIS, 2003b)) and from Federal Reserve System (Federal Reserve System, 2008).

<sup>49</sup>Due to data limitations, data on "on-us" checks cannot be obtained for every year. Sources: Gerdes and Walton ((Gerdes and Walton II, 2002),(Gerdes et al., 2005)), Federal Reserve System ( (Federal Reserve System, 2004), (Federal Reserve System, 2007)).

<sup>50</sup>Author's calculations. Retail payments are highly concentrated. Checks and ACH payments represent more than 95% of the value of non-cash payments.

Figure 7: Retail Payments, share of transactions made in central bank money, United-States, 1975-2009



Author's calculations, sources: see Appendix A

occurs.

- **Clearing and Settlement.** Clearing is the transfer and confirmation of information between the payer (sending financial institution) and payee (receiving financial institution). It is the process of transmitting and confirming payment orders or security transfers arising from market trades, as well as establishing, possibly by way of netting, final positions for settlement. Settlement is the actual transfer of funds between the payer's financial institution and the payee's financial institution. Settlement discharges the obligations between two or more parties arising from the market trades.

Table 3: Main characteristics of private systems

	Settlement method <sup>51</sup>	Main characteristics	Sources
Euroclear Bank <sup>52</sup> (Belgium)	P6/C2	<ul style="list-style-type: none"> <li>• Transactions between Euroclear participants are settled on a Delivery versus Payment basis on the books of Euroclear. Each participant holds both cash and securities accounts at Euroclear Bank.</li> <li>• <i>Direct origin of the funds.</i> To cope with its daily liquidity needs, Euroclear Bank relies on a wide network of Cash Correspondent banks (in about 43 countries), has direct access to TARGET2 (= C1, i.e. a system directly processed by the Central Bank) for euro payments, and has developed a broad access to the interbank market. <i>It conducts money settlement on its own books and rely upon these commercial correspondents to send and receive funds arising from participants' settlement positions.</i> They provide the link between Euroclear Bank and the national cash payment system(s) in the country of the currency. As a result, Euroclear participants are exposed to settlement asset risk. Euroclear will not, as a rule, credit a participant's account with cash or securities before receipt by Euroclear of the cash or securities in its local account with finality.</li> <li>• <i>Extra sources of funds.</i> Liquidity is necessary for Euroclear Bank to perform its settlement operations efficiently. Euroclear has a strong liquidity risk management framework. Beside its usual liquidity supply sources, Euroclear maintains a <i>liquidity contingency plan</i> on a permanent basis to provide extra sources of funds in case the normal supply is not sufficient. Liquidity risk is the risk of loss arising from Euroclear being unable to settle an obligation for full value when due. It does not imply that Euroclear is insolvent since it may be able to settle the required debit obligations at some unspecified time thereafter.</li> </ul>	BIS ((BIS, 2003c), (BIS, 2003a)); Euroclear (Euroclear, 2010); Euroclear Annual Reports (Euroclear, n.d.).

<sup>51</sup>Settlement methods are defined in 2.1.

<sup>52</sup>Euroclear is an International Central Securities Depositories (ICSDs), i.e. it settles trades in international securities and in various domestic securities, usually through direct or indirect links. Clearstream and Euroclear are the two ICSDs in the world.

CDS securities (Canada)	P5	<ul style="list-style-type: none"> <li>• <i>Direct origin of the funds.</i> Securities positions are moved on a gross basis and cash payments are netted and completed via designated <i>paying agencies</i>. Canadian funds <i>settlement is completed through</i> the Automated Clearing Settlement System (= C1, i.e. a <i>system directly processed by the Central Bank</i>) while US dollar funds settlement is completed through Fedwire (=C1). More precisely, for US dollar-denominated funds, settlement is completed via designated paying agencies with the funds being sent through Fedwire into CDS's banker's account at the Federal Reserve Board.</li> <li>• <i>Extra sources of funds:</i> not needed because of direct access to Central Banks.</li> </ul>	BIS((BIS, 2003c), (BIS, 2003a),(BIS, 2005))
Clearstream (Luxembourg)	P6	<ul style="list-style-type: none"> <li>• Each participant holds both cash and securities accounts at Clearstream. Trades are settled by book entry on a simultaneous DVP basis.</li> <li>• <i>Direct origin of the funds.</i> Clearstream bank (CBL) has in place a <i>network of cash correspondents</i> through which the settlement of the cash leg of securities transactions is performed. CBL holds its customer's cash via this network of cash correspondent banks which involves currently around 70 cash correspondents and depositories (for example, the Deutsche Bank in Germany). <i>Participants need to provision their cash accounts in order to settle their operations.</i> Final funds transfers are made as debits and credits to customer's cash accounts which CBL holds via correspondent banks on behalf of its customers. The correspondent banks maintain intra-day and overnight credit lines to guarantee timely execution of CBL's payment obligations to customers and other business partners.</li> <li>• In <i>contingency situations</i>, Clearstream might need to raise additional funds. It can for example issue commercial papers to raise liquidity on the market.</li> </ul>	BIS (2003a (BIS, 2003c)); Amati (2003 (Amati, 2003)); Clearstream annual report (2002, 2007, 2008, 2009 (Clearstream, n.d.))

USD RTGS  
(Hong Kong  
SAR)

P5

- The settlement institution (“SI”) for the Dollar CHATS is HSBC (Hong Kong). All transactions are settled in real time on a gross basis across the books of the relevant settlement institution.
- *Direct origin of the funds: intra-day funding from the US.* Direct participants can enjoy an interest-free overdraft facility and interest-free intraday repo if they can repay *HSBC’s New York correspondent* before the close of the New York CHIPS on that value day. A direct participant may also arrange intra-day funding for its US dollar settlement account *by requesting its US correspondent bank to send HSBC New York a Fed-wire payment for onward transmission to HSBC Hong Kong* (the USD SI) for the credit of the direct participant’s settlement account in the USD CHATS. In doing so, the settlement account balance of a direct participant in the USD CHATS can be increased according to needs. There are US-dollar funds availability risks in the event of an emergency.

BIS ((BIS, 2003c), (BIS, 2003a), (BIS, 2009) ), HKMA ((Hong Kong Monetary Authority (HKMA), 2000), (Hong Kong Monetary Authority (HKMA), 2001)), EMEAP (EMEAP, 2002)

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Euro RTGS (Hong Kong SAR)	P5	<ul style="list-style-type: none"> <li>• The settlement institution for the Euro CHATS is Standard Chartered Bank (Hong Kong) Limited (“SCB”). All transactions are settled in real time on a gross basis across the books of the relevant settlement institution.</li> <li>• <i>Direct origin of the funds.</i> The settlement institution (SCB), through its London office, is able to access the payment systems in Europe to pay or receive euro for the pay-in and pay-out activities, or for its funding management to facilitate the operation of Euro CHATS. Through SCB’s London office, it provides end-of-day pay-in and pay-out service by accessing TARGET2 (=C1) via the De Nederlandsche Bank. In managing funds in the settlement account, a direct participant can choose to transfer the balance in its settlement account with Euro CHATS to accounts of its correspondents in Europe at the end of the day to eliminate its exposure to the settlement institution. For example, a participant can arrange a “pay-in” to the Euro CHATS by requesting its counterpart to pay SCB London office for its account in the Euro CHATS.</li> <li>• <i>Extra sources of funds.</i> SCB has put in place a number of alternative measures to secure its euro funding. It has stand-by arrangements with a number of financial institutions in the euro area for euro liquidity. In the unlikely event that there is system problem and TARGET2 is inaccessible, SCB can arrange euro funding with its reserve counterparty which is a UK-based bank. A further backup arrangement is to swap Hong Kong dollar into euro in the inter-bank money market.</li> </ul>	BIS ((BIS, 2003c), (BIS, 2003a), (BIS, 2009)), HKMA ((Hong Kong Monetary Authority (HKMA), 2007), (HKMA)), EMEAP (EMEAP, 2002)
CD/ATMs (Japan)	C2/P5	<ul style="list-style-type: none"> <li>• <i>Direct origin of the funds.</i> The four clearing systems (operated by the four types of cooperative banks) settle in their central organizations. But the central organizations for cooperative financial institutions hold accounts at the Central Bank (BOJ Accounts).</li> </ul>	BIS ( (BIS, 2003c), (BIS, 2003a)), EMEAP (EMEAP, 2002), BoJ (Bank of Japan, 2005)

USD cheque clearing (Singapore)	P6	<ul style="list-style-type: none"> <li>Obligations arising out of the US Dollar Cheque Clearing System are settled across participants' accounts held with Citibank NA, the settlement agent. At a stipulated time each working day, the settlement obligations for each participant are sent to Citibank NA. For the settlement of USD cheques, participating banks must maintain USD accounts with Citibank NA with minimum balances of USD 10,000.</li> <li><i>Direct origin of the funds: Citibank NA has an account with Citibank NY for the provision of funds.</i></li> </ul>	BIS ((BIS, 2001), (BIS, 2003c), (BIS, 2003a)), EMEAP (EMEAP, 2002)
EFTPOS (Singapore)	P6	<ul style="list-style-type: none"> <li>Settlement institution is DBS, the Development Bank of Singapore Ltd. The net amount is submitted to DBS for debiting/crediting of the member banks'.</li> <li><i>Direct origin of the funds. Member banks then manage their nostro accounts at DBS through MEPS (=C1, i.e a system directly processed by the Central Bank).</i></li> </ul>	BIS ((BIS, 2001), (BIS, 2003c), (BIS, 2003a)), EMEAP (EMEAP, 2002)
Cash machines/ATMs (Singapore)	P6	<ul style="list-style-type: none"> <li>Settlement institution is DBS. A multilateral net settlement positions for each member bank is calculated. The net amount is then provided to DBS for direct debiting/crediting of the member banks' accounts with DBS.</li> <li><i>Direct origin of the funds: Member banks then manage their nostro accounts at DBS through MEPS (=C1).</i></li> </ul>	BIS ((BIS, 2001), (BIS, 2003c), (BIS, 2003a)), EMEAP (EMEAP, 2002)
Central depository (CDP) (Singapore)	P6	<ul style="list-style-type: none"> <li><i>Direct origin of the funds. Settlement institutions are banks selected by the Singapore Exchange to facilitate the funds settlement between CDP and the principals (companies approved by CDP to settle trades on a DvP basis for their clients). They hold accounts at the Monetary Authority of Singapore.</i></li> </ul>	BIS ((BIS, 2001), (BIS, 2003c), (BIS, 2003a)), EMEAP (EMEAP, 2002)

CHIPS  
(United  
States)

P4

- *Direct origin of the funds.* Each CHIPS participant has a pre-established opening position (or *initial prefunding*) requirement, which, once *funded via a Fedwire Funds Service* funds transfer to the CHIPS account, is used to settle payment orders throughout the day. *The total amount of all the participants' current positions is backed, dollar-for-dollar, by a balance in an account on the books of Federal Reserve Bank of New York.* At the end of the day, banks that have positive closing positions receive the amounts that they are due in the form of Fedwire payments.
- Participant's intraday current position cannot be less than zero (minimum) nor more than twice (maximum) its initial balance requirement. Similarly, a *participant is never in a debit position.* Each CHIPS payment message is settled by deducting the amount of the payment message from the sending participant's current position and adding an identical amount to the receiving participant's corresponding current position.

BIS((BIS,  
2003c), (BIS,  
2003a),  
(BIS, 2008)),  
CHIPS(  
(CHIPS,  
2007),  
(CHIPS,  
2009))

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CLS (International)

P4

- CLS Bank (CLSB) is the settlement institution for CLS - ie settlement is not directly processed by central banks.
- *Direct origin of the funds.* All payments to and from CLS are made through the issuing central bank, so central bank money retains a necessary role. Each direct participant ("settlement member") in CLS holds an account at CLS Bank which is divided into sub-accounts, with one sub-account for each currency that CLSB settles. Foreign exchange deals are settled one by one (gross) on these accounts by simultaneously debiting the sub-account of the currency being sold and crediting the sub-account of the currency being bought. Where they accumulate debit balances, members have to pay in funds to CLSB in order to restore their sub-account in that currency to zero by the end of the day. Correspondingly, CLSB makes payouts to members with net long positions. These *pay-ins and payouts are made using RTGS systems or their equivalent to transfer funds to and from accounts CLSB holds at the central banks* of the currencies concerned. Central bank money is thus used in the funding and defunding process because of the requirement that members start and end each day with zero balances at CLSB. *At any point in time on a given day, any requirement to pay out more than has been received via a clearing system has to be covered by central bank overdrafts.* As the incoming payments are highly unpredictable, any specific intra-day pay-out requirement raises the amount of the central bank overdraft. Although CLS Bank has accounts at the central banks of issue for its funding process, *many of the participants in CLS use correspondent banks* to execute their pay-ins and receive their payouts in various currencies.
- *Extra sources of funds.* A number of large financial institutions act as liquidity providers to CLS in order to allow CLS Bank to fulfill its payout obligations should a participant be unable to fulfill its pay-in obligations. Risks for CLS : the inability of a CLS participant to provide funding to CLS in one currency (and LVPS) may have a direct impact on the timing and value of funds to be received by this participant's counterparties. Risk management : limits on participants' positions to deal with settlement disruptions.

BIS ((BIS, 2003c), (BIS, 2008)), Knorr (Knorr, 2002)

## Chapter 4

# Money Creation in modern banking and the settlement asset channel

### Abstract

Modern banking features, characterized notably by the development of private payment arrangements and the globalization of banking, have led to a growing questioning of the role of central banks on the provision of money. Central bank money seems to be challenged by the rise of private substitutes, suggesting a privatization of money. To investigate the consequences of these transformations on money creation, I model the conditions for a privatization of money, i.e. for a coexistence between public and private settlement assets. I show that if banks have a balance-sheet constraint on lending, such a coexistence is not possible as only public money is accepted as a settlement asset in equilibrium. The constraint does not prevent private money creation but restricts the use of private settlement assets to separated markets. The model shows also the existence of a "settlement asset channel" as risk propagation mechanisms and the transmission channels of monetary policy are directly impacted by the settlement assets used in banking systems. A direct application of this channel can be found in international banking, through the use of the dollar as settlement asset in global finance.

**Keywords:** money, private money, payment interdependencies, monetary policy

**JEL classification:** E42, E52, E58

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## Introduction

This chapter investigates the consequences of modern banking transformations on money creation channels and on the efficiency of central banks' instruments. It helps understand risk propagation mechanisms in the current crisis, notably with the dollarization of globalized banks. The mechanism developed in this chapter is based on an analysis of the effects of modern banking features on the settlement assets<sup>1</sup> used in banking systems.

With modern banking, central bank assets<sup>2</sup> seem to be more and more challenged by the rise of private substitutes -suggesting a privatization of money and a competition in the supply of money between central banks and private providers. This phenomenon is not neutral. Money is an asset necessary for the settlement of almost all transactions. It is thus of particular interest to understand how shocks spread in a system and which institutions are able to limit the risk. If different assets are used as money, as is the case when public and private monies coexist, one can assume that the propagation of a shock would be limited to the compartment where each asset is used. Similarly, one can expect that the power of central banks and the transmission channels of monetary policy will be dependent on the assets used as money in modern banking. For example, if the world is segmented between public and private monies, the transmission channels of monetary policy would be limited to the markets where central bank money is used. Discussing the existence of competition in the supply of money can thus be important to understanding risk propagation and the power of central banks in modern banking.

As I noticed in Chapter 3, existing literature tends to support the thesis of a competition in the supply of money. In particular, the last fifteen years have seen a growing questioning of the central bank's role and of the power and efficiency of monetary policy. Both theoretical monetary economists and central bankers have started to discuss the consequences of a "world without money" (Woodford (2000)) for the future of central banking. The monopoly of central banks on the provision of money is questioned through several phenomena: the development of information technology, the increasing use of electronic money, the rise of private intermediaries, or the globalization of banking. It is probably in payment systems that these changes are the most spectacular<sup>3</sup>. Bank activity increasingly takes place through private settlement arrangements, such as CHIPS, the private large-value payment system in the United-States. Similarly, an increasing proportion of economic activity is paid through "on-us" transactions within a bank's accounts (intra-bank transactions). All these transformations suggest a privatization of money, and strong competition between public and private issuers of money, which challenge the role of central banks and the efficiency of monetary policies.

This chapter questions the existence of such competition. After the empirical evi-

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<sup>1</sup>A settlement asset is an asset used for the final settlements of debts.

<sup>2</sup>"Central bank asset" is a synonym for central bank money, public money or fiat money in this chapter.

<sup>3</sup>Kahn (2008) argues that "recent developments in private payments arrangements, particularly at the wholesale level, challenge central banks' longstanding monopoly on the provision of the ultimate means of settlement for financial transactions".

dence of chapter 3, I build a model to analyze the following questions: does modern banking transform money creation channels and lead to the rise of private substitutes to the central bank assets? In particular, does the development of private arrangements imply a privatization of money? What are the consequences of these modern banking features for the power of central banks? The objective of this chapter is *not* to discuss the optimality of a competition between different suppliers of money or to compare the efficiency of a private payment organization with the efficiency of a public system (Green (1999)). I discuss instead the consequences of modern banking for the provision of money. I show that modern banking features, in particular with the development of private systems, do not change money creation mechanisms as settlement assets are unchanged. This implies a monopoly of central bank money as settlement asset that has consequences both for risk propagation mechanisms and for the power of central banks in modern banking.

**Definitions.** We use the definitions of money, central bank money and private money we developed in Chapter 3. An asset will be called money only if it serves as a medium of exchange and as a settlement asset, i.e. if it is used for the final settlements of debts. To define public and private money, another characteristic must be added: the double-entry accounting principle, i.e. the fact that an entity cannot add a credit without accounting for a debit. The possibility to credit without debiting means that the entity is the ultimate creator of money. For example, the Federal Reserve can credit without debiting an account with US dollars. So, an asset will be defined as central bank money only if the ultimate issuer of this fund is a central bank. Similarly, it is only if the ultimate creator of money is a private entity that the asset will then be called private money.

**The model.** To discuss the consequences of modern banking for the provision of money, I model the conditions under which a coexistence between different settlement assets is possible<sup>4</sup>. Private banks can indeed create money if they can issue settlement assets that can coexist with existing mediums of exchange<sup>5</sup>. The model presented here is a model of separated islands built on Freeman (1996a) and Freeman (1996b)<sup>6</sup>. I first construct an adaptation of these models which enables to distinguish three different systems of payments: systems with only private money, systems with only central bank money, and mixed cases where a coexistence between public and private issuers of money can exist. To describe these different cases, I focus on an important feature of Freeman models : as agents are not conveniently synchronized between the different islands, a liquidity-constrained equilibrium can emerge. Both public and private actors can remove this

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<sup>4</sup>Competition is traditionally modeled by describing the coexistence of private debt with a demand for fiat money such as in Sargent and Wallace (1982), or Townsend (1989), among others, but in these models debts are repaid effortlessly without any special need of fiat money.

<sup>5</sup>The condition for such a coexistence would be that the assets they issue can be accepted as perfect substitutes for fiat money (central bank money).

<sup>6</sup>In the first paper, the author models the role of private banks in the central clearing of debt, with a focus on the potential for an inflationary overissue of private bank notes. In the second paper, Freeman presents a model of the payments system in which agents may be occasionally constrained by a lack of liquidity and the arrangement that arises to facilitate the repayment of debt.

liquidity shortage. In particular, assets issued by private entities can coexist with central bank money (Section 1). This initial framework enables to model a banking system where private banks can create money (the "goldsmiths approach" I described in Chapter 3). However, as public and private assets are supposed to be perfect substitutes in this initial framework, the coexistence of different providers of money is always possible, an assumption not discussed in Freeman models<sup>7</sup>. In particular, any asset issued by a private entity can be accepted as a medium of exchange<sup>8</sup>. I thus change the initial features of the model to discuss the conditions for an asset to be accepted as a medium of exchange and to differentiate public and private monies. To do so, I add a central assumption, the double-entry accounting hypothesis. This is equivalent to a balance-sheet constraint on bank lending. I show that to coexist with the existing medium of exchange, a private asset has to be a perfect substitute for central bank money (fiat money). The double-entry constraint is essential to determine the substitutability between assets. If the existence of such a constraint does not prevent *per se* private money creation, with this constraint, private assets cannot be accepted as perfect substitutes for central bank money. It results a segmentation between the markets where each settlement asset is used, private assets being used only in separated markets. This implies that only extreme cases remain: systems with only private money or systems with only public money. I show in particular that systems where public and private settlement assets seem to coexist are equivalent to systems with only public money<sup>9</sup>. Empirically, as markets with only private money are quite a marginal phenomenon, this points to a monopoly of central bank money as settlement asset, i.e. no private money creation<sup>10</sup>. This monopoly does not mean however a full-reserve banking system à la Fisher (1935) or Friedman (1948) (Section 2).

**The settlement asset channel.** The monopoly of central bank money as settlement asset is not neutral both in terms of risk propagation and for the transmission channels of monetary policy. They are indeed both dependent on the assets used as money in modern banking. In particular, shocks can spread in a systemic way through the settlement asset. This settlement asset channel finds a direct application in international banking, through the consequences of the dollarization of European banks' balance sheets. The globalization of banking has indeed led to the use of specific settlement assets (especially the US dollar) for transactions at the world level. Existing compartments between central bank monies are gradually diminishing with this phenomenon so risk propaga-

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<sup>7</sup> Starting from this hypothesis, Freeman then discusses the efficiency of public and private provisions of money. The purpose of Freeman models is thus different from the questions raised in this chapter.

<sup>8</sup> This implies also that private money cannot be precisely defined, so it is not possible to distinguish the development of private systems from the privatization of money.

<sup>9</sup> The intuition of this result is as follows. If systems are not fully private, i.e. if operations are for example backed by initial funding in public money, only this public money is used as a medium of exchange (and as a settlement asset) in equilibrium. Indeed, because of double-entry accounting, an entity cannot add a credit without accounting for a debit. With initial funding in public money, it results that any credit has to be registered by debiting an account with public money as only this public money is accepted as a medium of exchange in equilibrium.

<sup>10</sup> Following the chapter 3, I can speak about a *monopoly* of central bank money as what can be considered as strictly private currencies are still very marginal phenomena (Bitcoins, Ithaca Hours, etc.).

tion cannot be limited to a national banking system. The mechanism impacts also the power of central banks. Because of the use of the dollar as settlement asset in global finance, monetary authorities have realized during the crisis their dependency on the Federal Reserve for the provision of US dollars (Section 3).

**Outline.** The rest of the chapter proceeds as follows. In Section 1, I present the structure of the model. I show that in the initial framework the coexistence of different providers of money is possible. In particular, both public and private actors can remove the liquidity shortage. In Section 2, I introduce in the model the double-entry accounting constraint, and I show the consequences in terms of money provision and risk propagation (the settlement asset channel). Finally, in Section 3, I present two applications of the settlement asset channel.

## 1 The structure of the model

In this section, I first build an adaptation of Freeman models (1996a, 1996b) which enables to discuss the conditions for competition in the supply of money and to distinguish different systems of payments, i.e. systems with only private money, only central bank money, and mixed cases where competition can exist. This latter case is close to the "goldsmith view" I described in Chapter 3. With this adaptation, I can also describe major payment interdependencies in modern banking systems, and in particular both intrabank transactions and interdependencies between payment systems. The initial features of the model are similar to those in Freeman: purchases are made with debt, debts are settled with a final payment of fiat money<sup>11</sup>, and there exists an active market for the resale of bilateral debt. Because agents are spatially separated, private debt is incurred between two parties and can only be redeemed with fiat currency at a central clearing area. If the arrival of creditors and debtors at this central clearing area is not conveniently synchronized, a liquidity-constrained equilibrium can emerge. To remove this liquidity shortage, private actors and/or the central bank can wish to respond depending on the system considered. This section is used as a benchmark to study policy implications when private and public settlement assets are considered as perfect substitutes.

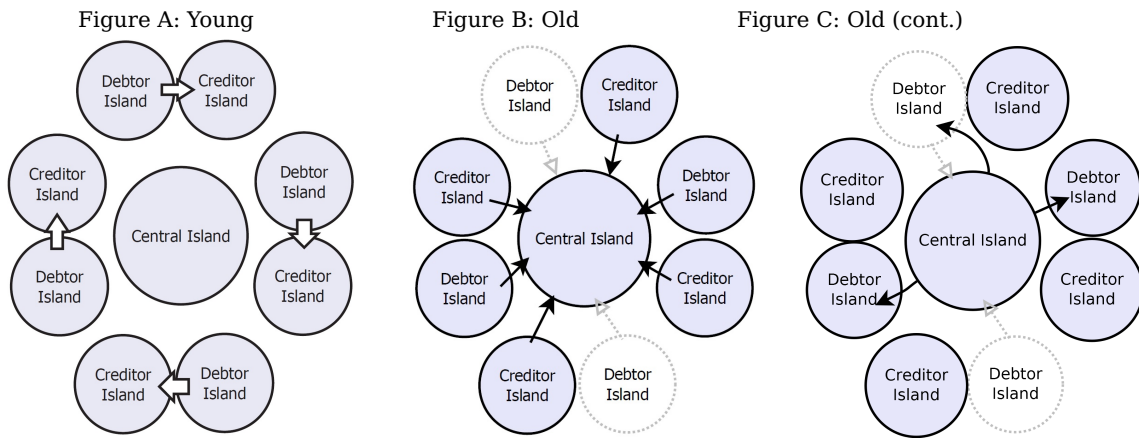
### 1.1 Structure of the model.

A large even number  $I$  of outer islands are arranged in pairs around a central island. Each pair contains both of two types of islands, which will be called "creditor" and "debtor" islands. On each island,  $N$  two-period-lived agents are born in each period  $t \geq 0$ . In the first period each island also has  $N$  agents (the initial old) who live only in the first period. For simplicity,  $N$  is normalized to 1. The sequence of events in the model

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<sup>11</sup>Fiat money is equivalent to central bank money or public money in this chapter.

Figure 1: The sequence of events



**Figure A:** Period 0: young debtors consume creditor goods (debt repaid to creditors in the next period in the central island).

**Figure B:** Period 1: all old creditors but only a fraction  $\lambda$  of old debtors (*solid arrows*) arrives at the central island.

**Figure C:** Period 1 (cont.): before the arrival of remaining debtors (*dotted arrows*), a fraction  $(1 - \alpha)$  of creditors leaves the central island to its final destination (*solid arrows*).

is summarized in Figure 1. Events are described precisely at the end of the chapter in Table 1 (Appendix A).

**Debtors.** Each agent born on a debtor island (each "debtor") is endowed at birth with  $x$  units of a non storable good specific to his island (and with nothing when old). Agents wish to consume the goods of both debtor and creditor islands when young and nothing when old. The utility of a debtor is given by the function  $v(d_{xt}, d_{yt})$  where  $d_{xt}$  and  $d_{yt}$  represent his consumption of debtor and creditor island goods.

At the beginning of the period, young debtors travel to the creditor island with which they are paired, where they may consume creditor island goods (Figure 1A). They own no goods valued by the young creditors that can be offered in immediate direct exchange. Nor do they have any money at the time of this visit. The only thing a debtor can offer creditors is a promise to pay a sum of money in the next period on the central island. Young debtors return to their island later in the period. A young debtor will acquire this money by selling some of his endowment to those bringing money to the island later in the period (the sequence of travel is described in Table 1 in Appendix A).

**Creditors.** Each agent born on a creditor island ("creditor") is endowed at birth with  $y$  units of a non storable good specific to his island (and with nothing when old). He wishes to consume the good of his home island when young ( $c_{yt}$ ) and of debtor islands when old ( $c_{x,t+1}$ ). The utility of a creditor is given by the function  $u(c_{yt}, c_{x,t+1})$ <sup>12</sup>. To consume when old, creditors must bring something of value to the debtor islands. Fiat money will

<sup>12</sup>Both utility functions  $u(\cdot, \cdot)$  and  $v(\cdot, \cdot)$  are additively separable, strictly increasing and concave in each argument, continuous, and continuously differentiable, with indifference curves that do not cross the axes.

be accepted by young debtors if it helps them to acquire the goods they desire. If it is accepted in equilibrium, fiat money serves as a “medium of exchange”.

**The central island.** When old, agents from each island travel to the central island. Arrival at the central island takes place in two stages. In the first, all old creditors and a fraction  $\lambda$  of old debtors arrive ( $0 \leq \lambda \leq 1$ ) (Figure 1B). At the end of the first stage, a fraction  $1 - \alpha$  of the old creditors leave for their final destination, while the rest stay until the end of the second stage (Figure 1C). The remaining  $1 - \lambda$  debtors arrive in the second stage. If all debtors and creditors arrive on the central island at the same time ( $\lambda = 1$ ), the clearing of debts can take place without difficulty because the money promised to creditors equal the money brought in by debtors. Suppose instead that the arrival of creditors and debtors is not so conveniently synchronized: let  $\lambda < 1$ . Then, in the first stage, less money arrives from debtors than is needed to pay off all creditors (Figure 1B). Those creditors leaving early will offer to sell their debt to those leaving later. The nominal amount of debt that can be redeemed in this resale market is limited by the size of the cash balances on the central island in the first stage.

All creditors face the same chances of leaving early or late, and all debtors face the same chances of arriving early or late. Each learns his arrival or departure time as soon as he turns old but not before. Old creditors then continue on to a randomly selected debtor island where they may trade with young debtors (Figure 1C). The old creditors are evenly divided among debtor islands, each old creditor with an equal chance of going to any given debtor island. The actual destination is not known until arrival.

All agents are able to issue unfalsifiable IOU's that identify the issuer. A legal authority exists on the central island that can enforce agreements between parties currently on that island. No such authority exists to enforce agreements at agents' final destinations.

There exists on the central island a monetary authority able to issue fiat money, which is non counterfeitable, unbacked, intrinsically useless, and costlessly exchanged. This authority issues an initial stock of  $M$  units of fiat money to each initial old creditor<sup>13</sup>.

## 1.2 Equilibrium

Debtors wish to consume debtor goods ( $d_{xt}$ ) and creditor goods ( $d_{yt}$ ) when young and nothing when old. The budget constraints of a debtor born at  $t$  may be written in nominal terms:

$$xp_{xt} = d_{xt}p_{xt} + m_t = d_{xt}p_{xt} + h_t = d_{xt}p_{xt} + p_{yt}d_{yt} \quad (1)$$

where  $p_{xt}$  and  $p_{yt}$  respectively represent the "fiat money" price of a good on a debtor island and a creditor island at date  $t$ ,  $m_t$  denotes the debtor's nominal demand for cur-

<sup>13</sup>Money is essential in the model for the clearing of debt and the existence of a credit market: without valued money, equilibrium debt equals zero. In equilibrium, debt is equal to the stock of fiat money because all the debt is paid off by currency (and all currency is used to pay off the debt). In the rest of this chapter, we make the simplifying assumption that young creditors made their loans to young debtors with the  $M$  units of fiat money.



rency, and  $h_t$  denotes the nominal value at  $t$  of his indebtedness. Combining these budget constraints yields  $x = d_{xt} + d_{yt}p_{yt}/p_{xt}$ .

The resulting first order condition for utility maximisation is  $v_x/v_y = p_{xt}/p_{yt}$ , where  $v_x$  and  $v_y$  denote respectively the derivatives of  $v(.,.)$  with respect to consumption of good  $x$  and  $y$ .<sup>14</sup>

Let  $l_t$  represent the nominal value at  $t$  of a creditor's loans to debtors. Let  $q_t$  represent the par value of nominal debt purchased by those leaving late. Let  $\rho_{t+1}$  represent the discounted nominal value of one unit of fiat money of that debt at time  $t + 1$ . One can interpret  $1/\rho_{t+1}$  as the short-run (gross) interest rate. Consumption when old of those leaving late will be marked with a star (i.e.,  $c_{x,t+1}^*$ ).

Creditors wish to consume creditor goods ( $c_{yt}$ ) when young and debtor goods ( $c_{x,t+1}$ ) when old. The budget constraint of a creditor born at  $t$  may be written in nominal terms as follows:

$$yp_{yt} = c_{yt}p_{yt} + l_t \text{ (when young)} \quad (2)$$

$$\rho_{t+1}(1 - \lambda)l_t + \lambda l_t = c_{x,t+1}p_{x,t+1} \text{ (for the old leaving early)} \quad (3)$$

which states that to consume debtor goods,  $c_{x,t+1}p_{x,t+1}$ , the old creditors leaving-early either receive the money brought in by the early-arriving debtors ( $\lambda l_t$ ) or have to sell their debt to the creditors leaving late if their debtors did not arrive in time ( $\rho_{t+1}(1 - \lambda)l_t$ ).

$$l_t + (1 - \rho_{t+1})q_t = c_{x,t+1}^*p_{x,t+1} \text{ (for the old leaving late)} \quad (4)$$

which states that to consume debtor goods,  $c_{x,t+1}^*p_{x,t+1}$ , the old creditors leaving-late either receive the money brought in by debtors,  $l_t$ , or may benefit from a margin on the debt sold to the creditors leaving earlier ( $(1 - \rho_{t+1})q_t$ ) if debt sells below par ( $\rho_{t+1} < 1$ ).

By rate of return equality, the net nominal interest rate of debt will equal zero in equilibrium, the rate of return of fiat money. The budget constraints have already taken this into account.

Creditors leaving late face the liquidity constraint:

$$\lambda l_t - \rho_{t+1}q_t \geq 0 \quad (5)$$

which states that the nominal value of debt purchased by a late-leaving creditor,  $\rho_{t+1}q_t$ , is limited by the cash balances available to a creditor at the end of the first stage,  $\lambda l_t$ .

The clearing of the resale market for loans requires that  $\alpha q_t = (1 - \alpha)(1 - \lambda)l_t$ , which means that the market clears when the supply (that is, creditors who lend money are the late-leaving creditors,  $\alpha$ ) equals the demand for debt (that is, creditors who borrow

<sup>14</sup>Recall the simplifying assumption that  $v(.,.)$  is additively separable.

money are the early-leaving creditors,  $(1 - \alpha)$ , that were not were not paid back because of the late-arriving debtors,  $(1 - \lambda)$ .

If the liquidity constraint (5) is binding<sup>15</sup>, this implies that  $\rho_{t+1} = (\alpha/(1 - \alpha))(\lambda/(1 - \lambda))$ .

So  $\rho_{t+1} < 1$  if and only if  $\alpha + \lambda < 1$ , i.e. the number of early-leaving creditors  $(1 - \alpha)$  exceeds the number of early-arriving debtors  $(\lambda)$ . The existence of a liquidity-constrained equilibrium depends only on  $\alpha$  and  $\lambda$ .

### 1.3 Risk faced by creditors

If liquidity is insufficient, creditors face the risk of an individual loss.

The individual loss is such that  $L = (\rho_{t+1} - 1)q_t$  with  $\rho_{t+1} < 1$  when debt sells below par. So the aggregate loss can be written  $\bar{L} = (1 - \alpha)L = (1 - \alpha)(\rho_{t+1} - 1)q_t$  as  $1 - \alpha$  is the fraction of old creditors who borrows money (i.e. leaves early). When liquidity is insufficient to cover the shortfall,  $(1 - \alpha)$  of creditors are forced to sell their debt at a discount. If the liquidity constraint is binding, equation (5) can be written  $\lambda l_t = \rho_{t+1}q_t$ . The aggregate loss can be found to be:

$$\bar{L} = (1 - 1/\rho_{t+1})(1 - \alpha)\lambda l_t \quad (6)$$

When debt sells below par ( $\rho_{t+1} < 1$ ), creditors who stay late on the central island benefit at the expense of those leaving early, increasing the risk faced *ex ante* by creditors<sup>16</sup>. If the fraction of old creditors who borrow money  $(1 - \alpha)$  is high, the aggregate loss may be significant (for the given quantity of cash available,  $\lambda l_t$ ).

### 1.4 The diversity of the providers of liquidity

If the arrival of creditors and debtors is not conveniently synchronized, we can have a liquidity-constrained equilibrium. To remove this liquidity shortage, a private clearinghouse or the central bank may wish to respond<sup>17</sup>. Additions to the fiat money stock (M) or banknotes issued by the clearinghouse could be used for this purpose.

#### 1.4.1 The potential competition

We can consider a regime in which a private clearinghouse (or bank), operated by agents of the central island, is permitted to print its own banknotes entitling the bearer of the note to one unit of fiat money, payable on the demand of the bearer. The old creditors will accept clearinghouse notes as *perfect substitutes*<sup>18</sup> for fiat money because they can exchange them for the endowments of the young debtors. The young debtors will accept

<sup>15</sup>See Appendix B for a complete description of the liquidity-constrained equilibrium.

<sup>16</sup>For a precise description of the optimality conditions, see Appendix B.

<sup>17</sup>In this chapter, *competition* refers to the possibility of a coexistence between different issuers of money.

<sup>18</sup>Perfect substitutability is necessary for private assets to be accepted as a medium of exchange. The purpose of next section is to discuss the conditions for a such a perfect substitutability.

these notes because they know they will travel to the central island in the next period, where they may redeem the notes for fiat money if they choose. The effects of provision of private banknotes depend on the frequency at which these banknotes are redeemed for fiat money<sup>19</sup>. Agents, being atomistic, are individually indifferent between banknote redemption rates. Suppose that a constant fraction  $\gamma$  of all banknotes are redeemed. For example, if  $\gamma = 1$ , the notes are always redeemed for fiat money in the period after their issue, so the clearinghouse must hold as reserves all the fiat money it receives in order to meet the anticipated redemption.

The current stock of banknotes ( $B_t$ ) is equal to the old unredeemed banknotes plus the new banknote issue<sup>20</sup>. The clearinghouse is permitted to issue enough notes to cover the current nominal debt,  $h_t$ . It has a license to print money equal to the nominal value of the debt brought in<sup>21</sup>. The stock of banknotes is then given by

$$B_t = (1 - \gamma)B_{t-1} + h_t \quad (7)$$

In equilibrium, the current debt,  $h_t$ , is equal in size to old currency balances ( $M - R_{t-1} + B_{t-1}$ ) because all currency is used to pay off the debt. Bank reserves are also equal to the quantity of banknotes redeemed ( $R_{t-1} = \gamma B_{t-1}$ ). Therefore (7) simplifies to  $B_t = 2(1 - \gamma)B_{t-1} + B_0$ , with  $B_0 = M$ , and can be rewritten as

$$B_t = \frac{2(\gamma - 1)M(2 - 2\gamma)^t + M}{2\gamma - 1} \quad (8)$$

I can now rewrite the liquidity constraint (5) to understand how the clearinghouse and/or the central bank can respond to the liquidity shortage. The clearing of the market for loans requires  $l_t = h_t$ , and the current debt,  $h_t$ , is equal in size to old currency balances ( $M - R_{t-1} + B_{t-1}$ ), with  $R_{t-1} = \gamma B_{t-1}$ . So the liquidity constraint, before the private creation of banknotes at date  $t$ , can be rewritten:

$$\lambda[M + (1 - \gamma)B_{t-1}] \geq \rho_{t+1}q_t \quad (9)$$

To remove a liquidity shortage, three potential cases can be considered depending on the fraction of redemption ( $\gamma$ ) and on  $B_0$ . These three cases can represent major payment interdependencies in modern banking systems:

- A system with only private money ( $\gamma \approx 0$  and  $B_0 \neq M$ ). This case can describe

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<sup>19</sup>This conception is notably expressed in BIS (2003): "Confidence in commercial bank money lies in the ability of commercial banks to convert their sight liabilities into the money of another commercial bank and/or into central bank money upon demand of their clients".

<sup>20</sup>New banknotes are not destructed automatically when they reach the Central island in the next period.

<sup>21</sup>This level of private money creation is a discretionary choice in the model. It is an upper limit of private money creation. This choice does not change the main results of the model but it simplifies the effects of private money creation on the price levels (see 1.4.2). This level of money creation is secondary in our model as our objective is not to study the consequences of an over-issue of money (as Freeman (1996a)). Indeed, I focus instead on who can remove the liquidity shortage, i.e. on the existence of a diversity of providers of liquidity. That is why the central equation of our model is (9).

strictly private systems as discussed in chapter 3.<sup>22</sup> These systems should have no connection to central banks.

- A system with private money and central bank money ( $\gamma \neq 0$  and  $B_0 = M$ ). This case is close to the "goldsmiths view" I described in Chapter 3. At first sight, this competition between issuers of money could describe also how on-us transactions (intrabank) and correspondent banking (tiering) work. Starting from a small amount of central bank money, these systems are supposed to enable private money creation<sup>23</sup>. This implies no full redemption.
- A system with only central bank money ( $\gamma \approx 1$  and  $B_0 = M$ ). This is the case for a large number of large-value payment systems, and especially real-time gross settlement systems (RTGS), where transactions are settled directly in central bank money. Payments are directly processed by central banks (see chapter 3).

### 1.4.2 Policy implications

Policy implications are very different in these three cases:

**The case of a system with only private money ( $\gamma \approx 0$  and  $B_0 \neq M$ ).** In this case, there is no redemption ( $\gamma \approx 0$ ) and the system does not start the period with an initial amount of central bank money.

The liquidity constraint, before the private creation of banknotes at date  $t$ , can be written:

$$\lambda B_{t-1} \geq \rho_{t+1} q_t \quad (10)$$

The nominal value of debt purchased by a late-leaving creditor,  $\rho_{t+1} q_t$ , is limited by the cash available to a creditor at the end of the first period. In this case, only the clearinghouse can remove the liquidity constraint. The central bank will not be able to play the role of lender of last resort. The liquidity constraint is not binding if the clearinghouse provides an elastic supply of inside money. The clearinghouse can lend money to old debtors (i.e. banks), with  $r_{t+1}^p$  the gross nominal interest rate charged on this loan within period  $t + 1$ . Because of arbitrage, old creditors will borrow from the clearinghouse until  $1/\rho_{t+1} = r_{t+1}^p$ . If the clearinghouse sets  $r_{t+1}^p = 1$ , it eliminates the effects of the liquidity constraint. The stock of banknotes at period  $t$  simplifies to  $B_t = B_0(2^{t+1} - 1)$ .

The stock of currency doubles in every period as the clearinghouse creates new banknotes equal in value to the nominal debt, which is equal to the previous period's

<sup>22</sup>I showed in chapter 3 that private payment arrangements in modern banking are not strictly private systems as the ultimate providers of money in these systems are central banks.

<sup>23</sup>For example, Kahn (2008) argued that "[i]n the UK, the increased concentration of payments into a handful of major settlement banks through "tiering" has meant that an increasing proportion of economic activity is paid through "on-us" transfers within a bank's accounts, never reaching the central system".

stock of currency. Because of the money market clearing condition ( $m_t = B_t$ ), using (1), the price level will also double in every period in a stationary equilibrium such that  $p_{xt} = B_0(2^{t+1} - 1)/(x - d_{xt})$ .

**A system with private money and central bank money.** It is the most general case with  $\gamma \neq \{0, 1\}$  and  $B_0 = M$ . Competition between issuers of money exists<sup>24</sup>.

The liquidity constraint, before the private creation of banknotes at date  $t$ , is the same as (9):  $\lambda[M + (1 - \gamma)B_{t-1}] \geq \rho_{t+1}q_t$ .

The cash available at the end of the previous stage is composed of fiat money and banknotes issued by the clearinghouse. Both the central bank and the Clearinghouse can remove the liquidity constraint. Because of arbitrage, old creditors will borrow from the clearinghouse and/or the central bank until  $1/\rho_{t+1} = r_{t+1}^p = r_{t+1}$ , with  $r_{t+1}$  being the gross nominal interest rate charged on the central bank loan within period  $t+1$ . We have also in this case the risk of an inflationary banknote creation<sup>25</sup>. The stock of banknotes at period  $t$  is given by (8).

**A system with only central bank money.** In this case ( $\gamma = 1$ ), the liquidity constraint is simply:

$$\lambda M \geq \rho_{t+1}q_t \quad (11)$$

Only the central bank can remove the liquidity constraint (and play the role of lender of last resort). The liquidity constraint is not binding if the central bank provides enough central bank money to enable the payment of creditors. If the central bank sets  $r_{t+1} = 1$ , it eliminates the effects of the liquidity constraint. The increase in the supply of central bank money ( $M$ ) will not be inflationary if it is only temporary. The central-bank loan will be repaid with fiat money upon the arrival on the central island of the late-arriving borrowers.

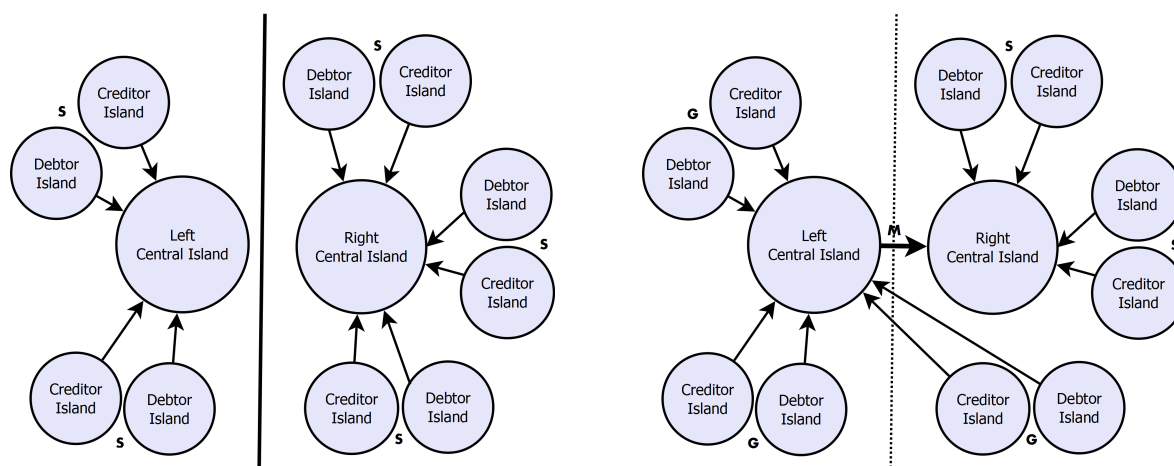
## 2 Money in a “non-segmented” world

In the previous section (and in Freeman models), any asset issued in the central island was accepted automatically as a medium of exchange. Whatever the redemption rate, private banknotes were indeed considered as perfect substitutes for fiat money (public money). It was sufficient for a privatized system to issue money for this currency to be

<sup>24</sup>According to BIS (2003), “Central bank and commercial bank money coexist in a modern economy [...] The multiplicity both of issuers of money and of payment mechanisms is a common feature in all developed economies”.

<sup>25</sup>If  $\gamma$  is a constant, we have a fixed exchange rate between banknotes and reserves such that  $R_t = \gamma B_t$ . The inflationary banknote creation could lead to Gresham’s law (bad money drives out good if their exchange rate is fixed”, Hayek (1976)). The clearinghouse could then use its reserves to purchase goods for its own consumption. But we could also imagine that the redemption rate ( $\gamma$ ) depends negatively on the quantity of banknotes created. In this case, we could have a “depreciation” of the private money, creditors preferring to borrow at the central bank.

Figure 2: Assets used as money in a segmented world or in a non-segmented world



accepted as a medium of exchange in equilibrium. Privatization of systems and privatization of money were not strictly differentiated. I specify now the conditions for an asset to coexist with the existing medium of exchange, i.e. to be accepted as a perfect substitute for fiat money. To do so, I introduce a double-entry constraint: an entity cannot add a credit without accounting for a debit (unless he is the ultimate issuer of the funds<sup>26</sup>). The addition of this constraint is essential to determine the substitutability between settlement assets, i.e. to understand the conditions for a privatization of money<sup>27</sup>.

## 2.1 Money, a medium of exchange

I modify the initial features of the model to discuss the conditions for an asset to be accepted as a medium of exchange, i.e. to be used as money. The sequence of events described in table 1 changes slightly.

**Two sides.** The world is divided into two sides, the left-hand and the right-hand sides (Figure 2). On the left-hand side, we have the left central island or public island where stands the monetary authority. On the right-hand side, we add a second central island. The private clearinghouse stands in the right central island or private island. On each side, a large even number  $I$  of outer islands are arranged in pairs around the central island. When old, agents from a debtor island and a creditor island that are paired travel to the same central island (the “left central island” or the “right central island”). There are two types of pairs of islands. Agents from *globalized* pairs of islands (denoted by  $G$ ) can be sent randomly to one of the two central islands whereas agents from *segmented* pairs of islands (denoted by  $S$ ) can only be sent to the central island of the side they

<sup>26</sup>If strictly speaking central banks respect double-entry accounting, it is not a real constraint for them as they can credit an account with central bank money without accounting for a debit with the same asset (commercial banks can provide or not collateral against this central bank money).

<sup>27</sup>If a system is privatized, but has to compete with another (existing) system, the currency it issues will not automatically be accepted as a medium of exchange (or a settlement asset) as a currency provided by the other system may already exist and play this role. Some conditions should be fulfilled for this private money to be accepted as a perfect substitute for public money.

belong to (see Figure 2)<sup>28</sup>. Agents from *globalized* pairs of islands need a medium of exchange that can be accepted in the two sides.

**Two sides, separated or not by a frontier.** The two sides can either be separated by a closed frontier or by an open frontier. If the frontier is closed, there are only segmented pairs of islands on each side. If the two sides are separated by an open frontier, a medium of exchange, i.e. an asset accepted in both parts, is necessary to enable transactions between these two sides (right panel in Figure 2). With an open frontier, all the pairs of islands are globalized on the left-hand side, whereas only a fraction  $\theta$  is globalized on the right-hand side ( $0 \leq \theta \leq 1$ ). When  $\theta = 1$ , all the pairs of islands are globalized. In addition, when the frontier is open, private and public central islands are connected together, i.e. the public island can provide public money without any discount or cost to the private island and to old creditors in the private island in the case of liquidity shortage<sup>29</sup>. This asymmetry between the two sides exists because we are studying the conditions for a privatization of money, i.e. for a coexistence between different suppliers of money when one currency is already used as a medium of exchange<sup>30</sup>. The provision of public money is not possible if the frontier is closed.

**Money in a segmented world and in a non-segmented world.** The distinction between a segmented world (closed frontier) and a non-segmented world (open frontier) is essential to define the nature of money as a medium of exchange. An asset will be used as a medium of exchange if it is accepted by old creditors and if then, old creditors can use this asset against the endowments of the young debtors. In a segmented world, assets from the two sides do not need to be perfect substitutes. Private assets will only be accepted in the private central island, public assets in the public central island. In a non-segmented world, young debtors cannot accept the private notes automatically as they are not sure to which central island they will travel in the next period. I will show that in non-segmented market only one asset is used as a settlement asset (or medium of exchange) whereas in a segmented world we can have as many assets as segmented markets.

## 2.2 The monopoly of central bank money

I discuss now which assets can be accepted as a medium of exchange in a non-segmented world (open frontier)<sup>31</sup>. This is the interesting case as a coexistence between settlement

<sup>28</sup>If old debtors coming from a segmented pair of islands can only be sent to a pair of islands of the same side, old debtors coming from a globalized pair can be sent randomly to a pair of islands of either side.

<sup>29</sup>Central-bank loans must be repaid to the monetary authority within the period, so the total stock of public money is the same at the end of the period as it was at the beginning.

<sup>30</sup>There is an asymmetry between public money and private money as public money is accepted in both central islands. Public money is the settlement asset for “historical” reasons. Because initial old creditors received  $M$  units of fiat money, young creditors made their loans with the  $M$  units of fiat money, so they have to be paid back with public money.

<sup>31</sup>In a segmented world, any asset issued in a central island is accepted automatically as a medium of exchange as in Section 1.



assets is possible. I show that perfect substitutability between settlement assets is necessary for private banknotes to be accepted as a medium of exchange. Two assets are perfect substitutes if they can be used indifferently as a settlement asset for the same transaction without any discount or cost<sup>32</sup>. The double-entry constraint is the condition for such a perfect substitutability.

**The double-entry constraint.** The double-entry constraint is such that the quantity of banknotes in  $t$ , ( $B_t$ ), before the private creation of banknotes in the period, comes from the quantity available in  $t - 1$  ( $B_{t-1}$ ), or from the central bank money in the system ( $M$ ).  $\mu$  is the share of money which is debited from an account with private money, and  $(1 - \mu)$  is the share debited from an account with central bank money, with  $0 \leq \mu \leq 1$ .

$$B_t = \mu B_{t-1} + (1 - \mu)M \quad (12)$$

This is a balance-sheet constraint on (bank) lending. It is important to notice that this constraint does not mean (*ex ante*) that to add a credit agents need to debit an account with only public money. It just implies that it is not possible to credit an account without debiting another account. So they can add a credit by debiting an account with private money ( $B_{t-1}$ ).

In a non-fully private system<sup>33</sup>, that is, in a system with initial funding in fiat money as it is the case in the model,  $B_0 = M$ , it results from the double-entry constraint (12) that:

$$B_t = M \quad (13)$$

From equ.8, we have  $B_t = \frac{2(\gamma-1)(2-2\gamma)^t + M}{2\gamma-1} = M$ , so  $\gamma = 1$ . The hypothesis of double-entry accounting implies full redemption. With the constraint, systems where competition seems to exist between private and public money are thus equivalent to systems with only public money. It is important to notice that double-entry accounting does not mean a full-reserve banking system (100% reserve ratio) à la Milton Friedman (1948). Even with the constraint, it is possible to have full redemption and 0% reserve ratio<sup>34</sup>.

<sup>32</sup>For example, Dollars and Euros are not perfect substitutes as a transaction cannot be settled indifferently in these two currencies (at least without a discount rate or conversion cost). Wages in the US have to be paid in USD; a loan in Euros has to be paid back in Euros. The settlement asset is not neutral. European banks have realized during the current crisis that the dollarization of their balance sheet was not a neutral source of funding (see 3.2).

<sup>33</sup>An entirely private system ( $B_0 \neq M$ ) can exist only if all pairs of creditor and debtor islands are sent to the private central island, i.e. in a segmented world (2.3.1). Fully private systems need to function in closed channel. If not, the system cannot be fully private. Indeed young debtors will not accept private notes as they do not know to which central island they will travel in the next period. If they travel to the public island, they will not be able to redeem their notes for fiat money as the private system does not hold any public money ( $B_0 \neq M$ ).

<sup>34</sup>In this case, the agent lends everything it receives. This is the case implicitly in Freeman:  $l_t = (1 - r_0) \cdot [M + (1 - \gamma)B_{t-1}]$  with  $r_0 = 0$ . A reserve ratio must take into account, not only the private money at disposal, but the total quantity of money available. On the contrary, the redemption rate ( $\gamma$ ) describes the degree of convertibility between public and private money ( $R_{t-1} = \gamma B_{t-1}$ ). It is a fixed exchange rate as the rate of \$35 per ounce of gold between dollar and gold during Bretton Woods. 0% redemption rate means that the agent can lend more than what it has, which is only possible in the case of two different assets (as dollar and gold). 0% reserve ratio means that the agent can lend everything it has (but no more than what it has).



We show now that the constraint is the condition for private banknotes to be accepted as perfect substitutes for fiat money, i.e. to be accepted as a medium of exchange in a non-segmented market. On the contrary, the non-compliance of the constraint would imply an *ex nihilo* creation of money. But if in this latter case, private banknotes can be created *ex nihilo*, they would not be accepted as a medium of exchange in a market where a different settlement asset exists already.

**Why should the private provider of banknotes respect the constraint?** Private banknotes can be issued in the private central island (the right-side central island) where stands the clearinghouse. To observe a privatization of money, private money must be accepted as a medium of exchange in equilibrium. With a second central island, this is not automatically the case. As in the initial framework (Section 1.4.1), an asset will serve as a medium of exchange only if it is first accepted by old creditors and if it is then accepted by young debtors. Note that we introduced in last subsection an asymmetry between assets as fiat money is the existing medium of exchange and can be used in both sides. The public island can also provide fiat money to the private island without any discount or cost in the case of a liquidity shortage. At each stage, private banknotes would be accepted only if they are perfect substitutes for fiat money. There are two reasons for that. Firstly, as initial old creditors received  $M$  units of fiat money, this fiat money was initially the only asset accepted as a medium of exchange. Young creditors made their loans with these units of fiat money, and they have to be paid back with this asset<sup>35</sup>. Secondly, if at each stage, agents have the choice to accept private notes or to accept fiat money provided without any cost, they will only accept these private notes if they are perfect substitutes for fiat money.

We develop more precisely the different stages. A private currency, issued in the private central island, would be accepted as a medium of exchange if old creditors accept clearinghouse notes as *perfect* substitutes for fiat money<sup>36</sup>, i.e. if they can exchange them for the endowments of young debtors. For their part, young debtors accept these notes only if they can redeem these notes for fiat money when they travel to a central island in the next period. However, contrary to the initial framework, young debtors can now be sent randomly to one of the two central islands in the next period. Suppose young debtors are sent with their private notes to the public central island. In this case, banknotes may not be accepted as a medium of exchange. Indeed, young debtors will accept the private notes from old creditors only if they can redeem them for fiat money in the public central island, i.e. only if the monetary authority in the the public central island accepts to redeem these private notes for fiat money without any discount or cost.

The monetary authority can only accept to redeem these notes without any cost if they are perfect substitutes for fiat money. Such a perfect substitutability requires that

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<sup>35</sup>Of course, the same mechanism would work if the initial loan was made with a private asset. In this case, the existing medium of exchange would be a private asset, and public money would not be accepted automatically as a settlement asset.

<sup>36</sup>Perfect substitution is necessary as the public island can still provide public money to old creditors in the private island without any discount or cost in the case of liquidity shortage.

these notes are entirely backed by fiat money. If not, the central bank would have no reason to always accept these private notes as perfect substitutes for fiat money, especially if the private entity pursues an inflationary banknote creation policy (low redemption rate,  $\gamma$ ). It would be all the more the case if several private entities could issue different types of private banknotes corresponding to different policies, more or less risky (i.e. with different redemption rates). Redemption rates,  $\gamma$ , would be equivalent to exchange rates existing between these private currencies and fiat money (and between private currencies themselves), a low value of  $\gamma$  implying a large *ex nihilo* creation of banknotes and thus a depreciation of this private asset relative to fiat money<sup>37</sup>. So, if the notes are not entirely backed by fiat money, the central bank could still accept them but with a discount. In this case, private notes are not perfect substitutes for fiat money and so they will not be accepted as a medium of exchange. The double-entry constraint is thus the condition for such a perfect substitutability. It implies as we showed in equ.13, that  $B_t = M$ . The stock of banknotes ( $B_t$ ) is equal to the initial stock of public money ( $B_0 = M$ ).

**The monopoly of central bank money.** With initial funding in public money, it results that any credit has to be registered by debiting an account with public money as only this public money is accepted as a medium of exchange (and as a settlement asset) in equilibrium<sup>38</sup>. The double-entry constraint is the condition for private banknotes to be accepted as a medium of exchange. If this condition is not fulfilled, the central bank does not always accept to redeem private banknotes for public money, so private banknotes and public money are not perfect substitutes. So, without the constraint, private entities can issue private banknotes (not backed by public money) but these notes are not accepted as a medium of exchange. On the contrary, with the constraint, private banknotes are accepted as a medium of exchange yet they are not private money but a change in the aspect of public money as they are entirely backed by public money ( $B_t = M$ ). These private banknotes are just public money but with a different physical aspect<sup>39</sup>. That is why only public money is accepted as a medium of exchange in equilibrium in a non-segmented market. I illustrate this monopoly of central bank money in Figure 2 of Chapter 3.

<sup>37</sup>This argument can be used to justify why commercial banks have a balance-sheet constraint on lending in modern banking. Without this constraint, banks could create private money but this money would not be a perfect substitute for central bank money. As a consequence, exchange rate variations would exist between commercial bank monies themselves and between a specific commercial bank money and central bank money. This was the case in the US in the 19th century where domestic exchange rates existed between private monies (Section 1 in chapter 3).

<sup>38</sup>If private money was accepted as a medium of exchange, it would have been possible to add a credit by debiting an account with private money. So, in the model, it is only *ex post* that it results that only public money is used as a medium of exchange.

<sup>39</sup>A close idea is expressed in Cavalcanti et al. (2005): "When banks issue notes that are backed by accumulated reserves, they are just changing the physical aspects of the means of payments, without necessarily adding additional liquidity to the economy."

## 2.3 The settlement asset channel

I develop now the policy implications after the addition of this constraint. From the three initial cases described in Section 1.4.2, only two cases remain. The case of a monopoly of central bank money seems the most realistic empirically. This monopoly of public money as settlement asset is not neutral in terms of risk propagation and for the power of central banks in modern banking.

### 2.3.1 A fully private system ( $B_0 \neq M$ ) is only possible in the case of a segmented world.

In this section, it is still possible to have a fully private system but only in a segmented world. Because markets are segmented, it is not necessary for the private notes issued in the right-hand side to be perfect substitutes of the currency issued in the left-hand side. As each market issues its own asset, not substitutable to the asset of the other side, each side has its specific double-entry constraint. In a segmented world, there are thus two double-entry constraints<sup>40</sup>. On the left-hand side, we have a system with only central bank money. With  $B_0 = M$ , as the stock of banknotes is such that  $B_t = M$ , the liquidity constraint can be written  $\lambda M \geq \rho_{t+1}q_t$ . On the right-hand side, we have a system with only private money, i.e. a fully private system. With  $B_0 \neq M$ , as the stock of banknotes is such that  $B_t = B_0$ , the liquidity constraint can be written  $\lambda B_0 \geq \rho_{t+1}q_t$ . So only the central bank can remove the liquidity constraint on the left-hand side, and only the private entity can remove the liquidity constraint on the right-hand side.

### 2.3.2 In a non-segmented world, a private system ( $B_0 = M$ ) is equivalent to a system with only central bank money.

I determine now the policy implications in a non-segmented world for globalized pairs of islands<sup>41</sup>. It corresponds to the case in the previous section where we had a coexistence of public and private money (what is seen as the most general case). In a non-segmented world, assets have to be perfect substitutes to be accepted as a medium of exchange. With  $B_0 = M$ , as the stock of banknotes at period  $t$  is such that  $B_t = M$ , the liquidity constraint is similar to the case with only central bank money:  $\lambda[M] \geq \rho_{t+1}q_t$ .

The mixed case, which at first sight seems a system with private money, is in fact a system with only central bank money. This result has important policy implications:

**Only the central bank can remove the liquidity constraint.** Without our additional constraint, both fiat money stock (central bank money) and banknotes issued by the

<sup>40</sup>If assets are not perfect substitutes, there is one constraint for each asset used as a medium of exchange. In a two-sides segmented world, there is one constraint for each side. For an illustration with Euros and Dollars, see 3.2.

<sup>41</sup>Segmented pairs of islands (S) behave the same way as in the case of islands of the right-hand side in a segmented world (2.3.1). So there is one constraint for the Segmented islands and one constraint for the Globalized islands. For Segmented pairs of islands, it is still only the (private) entity on the right central island which can remove the liquidity constraint.

clearinghouse could be used as means of paying creditors if they arrive before debtors. With the constraint, only the central bank can limit the risk faced by creditors that they may need to sell their debt at a severe discount.

### 2.3.3 The settlement asset channel and the power of central banks.

An important policy implication concerns the risk associated with the use of settlement assets. I come back to the loss faced by creditors (1.3) to understand risk propagation in these systems. In absolute terms, the aggregate loss (equ. 6),  $\bar{L} = (1 - \alpha)N.(1 + \theta)I.L$ , can be written

$$\bar{L} = \left(1 - \frac{1}{\rho_{t+1}}\right)(1 - \alpha)N.(1 + \theta)I.\lambda M \quad (14)$$

The aggregate loss (and the risk associated) increases with the number of agents who borrow money (for a given quantity of money available  $\lambda M$ ) and with the share of globalized islands ( $\theta$ ). As the provision of public money is the only solution to remove the cash shortage for globalized islands ( $\theta > 0$ ), any additional unit of fiat money may have a significant impact on the reduction of the aggregate risk<sup>42</sup>. This aggregate risk is significantly reduced in segmented markets where different assets can be used as a settlement asset. More precisely, the risk is limited to the segmented market. In a non-segmented world, the marginal utility of the liquidity provided by the central bank increases with the number of agents. Central banks can thus become more and more powerful with the increasing number of transactions as these transactions always use the same  $M$  units of central bank money. It is important to notice that in this case, because of the double-entry constraint, private systems cannot provide liquidity. If private systems could issue liquidity, the increasing number of transactions (agents) will not lead to an increasing utility of central bank money. This mechanism has direct consequences in terms of risk propagation and for the instruments of central banks.

**A transmission channel for systemic risk.** If we were observing a privatization of money, risk could have been segmented to the compartment where each asset is used. I will show in Section 3 that not only can the risk not be segmented in a national banking system due to this monopoly, but existing compartments between central bank monies are gradually diminishing with the globalization of banking, and in particular the dollarization of European banks. Indeed, this globalization of banking leads to the use of specific settlement assets (especially the US dollar) for transactions at the world level. If banks use the same settlement asset, shocks can spread in a systemic way through this settlement asset as shown during the current crisis by the consequences of the scarcity of dollar funding available internationally to financial institutions<sup>43</sup>.

<sup>42</sup>For segmented islands, there is no aggregate risk as the loss is limited to the segmented market.

<sup>43</sup>The settlement asset channel has led to a strong dependency of European Banks on the provision of dollars from the Federal Reserve.

## 2.4 Empirical evidence

I showed in last subsection that from the three initial cases described in Section 1.4.2, only two (extreme) cases remain: systems with only central bank money or systems with only private money. Mixed cases are indeed equivalent to systems with only central bank money (2.3.2). Empirical evidence tends to show that strictly private systems, i.e. systems without any initial funding in public money, as characterized in 2.3.1, are a marginal phenomenon. This implies a monopoly of central bank money as settlement asset in modern banking. Three empirical arguments extracted from Chapter 3 can be used to justify this analysis. Firstly, a very large share of the total value of transactions in banking and payment systems is directly settled in central bank money. I have shown that in the United States, 60% to 70% of the value of total transactions is directly processed by the Federal Reserve, or similarly 60% to 70% of the value of transactions is settled in central bank money (Figure 6 in Chapter 3). In many other countries, central bank money represents more than 95% of the value of transactions in payment systems (Table 1 in Chapter 3). Secondly, I have shown in Chapter 3 that the transactions that are not *directly* settled in central bank money are however not settled with private money as even in private systems the ultimate providers of liquidity are central banks (Table 2 in Chapter 3).

Finally, even netting systems and transactions inside banks do not imply a privatization of money. Some of the systems describe previously as CHIPS in the United States, use netting mechanisms. I showed in Chapter 3 that these systems cannot be considered as strictly private systems as they are all deeply connected to central banks. But one could say that if all the transactions are made inside a netting system, central bank money is not necessary as these transactions can be settled on the books of the clearing house, i.e. with the private money of this system. In Appendix C, I extend the model to describe the particularities of netting systems. Double-entry accounting applies also in netting systems as each operation is registered by crediting an account and by deducting the amount from another account. Indeed, even if transactions are only settled at the end of the day, each participant in a netting system has a cash position which is used to register operations during the day. So even if netting minimizes the use of the settlement asset, double-entry accounting implies a “virtual” circulation of central bank money. For example, in CHIPS, the private large-value payment system in the United-States, participant’s intraday current position cannot be less than zero (minimum) nor more than twice (maximum) its initial balance requirement. Similarly, a participant is never in a debit position. Only the double-entry accounting constraint can explain these constraints<sup>44</sup>. The same mechanism applies for transactions inside a bank or “on-us” transactions. Because of double-entry accounting, on-us transactions require also a “vir-

<sup>44</sup>During the day, in this netting system, each CHIPS payment message is settled by deducting the amount of the payment message from the sending participant’s current position and adding an identical amount to the receiving participant’s corresponding current position. The total amount of all the participants’ current positions is backed, dollar-for-dollar, by a balance in an account on the books of FRBNY (CHIPS (2009), p. 29. See also FFIEC (2004), p.9). At the end of the day, this “virtual circulation” becomes real transfer of central bank money. Banks that have positive closing positions receive the amounts that they are due in the form of Fedwire payments.

tual" circulation of central bank money<sup>45</sup>.

### 3 Two applications of the settlement asset channel

The monopoly of central bank money as the settlement asset is not neutral both in terms of risk propagation and for the power of central banks. They are indeed dependent on the assets used as money in modern banking. I develop two applications of the settlement asset channel. At the domestic level, it implies that intraday credit can become a powerful daily instrument of monetary policy (3.1). This settlement asset channel can also be illustrated during the current crisis by the consequences of the dollarization of European banks' balance sheets. The globalization of banking has indeed led to a competition between central bank monies for the role of settlement assets at the world level (3.2). These two applications are based on a similar mechanism: settlement assets are a transmission channel for risk propagation in modern banking.

#### 3.1 Intraday credit can become a daily instrument of monetary policy.

In 2.3.3, I showed the risk propagation mechanism associated with the settlement asset channel and the power of central banks in this context. With the monopoly of central bank money, only central banks can provide the liquidity needed to limit the risk. These monetary authorities can become more and more powerful in a world with an increasing volume of transactions as only central bank assets can be used for the settlement of transactions. More precisely, the marginal utility of the liquidity provided by a central bank increases with the number of transactions settled in its currency<sup>46</sup>. It would have been different in the case of a privatization of money where both public and private issuers of liquidity would have been able to limit the risk. This mechanism impacts the instruments of central banks. In modern banking and payment systems, creditors rely heavily on the inflows from debtors to fund outflows. A delay (or a default) of a debtor can affect an entire payment system, making normal settlement impossible. The marginal provision of liquidity by the central bank enables significant risk reduction. Even if in value terms intraday credit by central banks does not increase a lot, each unit of central bank money provided is more and more powerful. This increasing power of intraday monetary policy is not only true in periods of crisis<sup>47</sup>. If defaults are rare, delays are

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<sup>45</sup>In some countries, on-us transactions are even made *directly* in central bank money. For example in the United States, transactions between a bank and its correspondents are made using Fedwire, i.e. the system operated by the Federal Reserve (Stigum and Crescenzi (2007), p.496). So even on-us transactions are settled with central bank money.

<sup>46</sup>Indeed, I showed in 2.3.3 that in the general case of a non-segmented market, only the central bank can provide liquidity. As it is always the same  $M$  units of central bank money which circulate into the economy, any marginal increase of  $M$  may have huge impacts in systems with increasing volume of transactions.

<sup>47</sup>Recent events showed the usefulness of intraday lending by the central bank as tools for managing demands for liquidity. On September 11, 2001, banks experienced difficulties in making their payments because of widespread damage to communications systems. These disruptions left some banks unable to execute payments to other banks through Fedwire, and liquidity shortages developed at many banks. The Federal Reserve responded by supplying abundant liquidity to the banking system in unprecedented amounts (McAndrews and Potter 2002).

very frequent in modern banking and payment systems<sup>48</sup>. Central banks grant credit on a temporary basis to solve daily situations when participants in payment systems do not have sufficient cash on its account to settle a transaction and/or there are structural time lags in the flow of funds as a result of time-zone differences or differences in operating hours of the various intermediaries involved in payments. Intraday credit could become a real daily instrument of monetary policy.

### **3.2 Bank globalization and the competition between central bank monies**

A direct application of the settlement asset channel can also be found in international banking. The globalization of banking implies that monetary authorities are more and more dependent on each other. With the monopoly of central bank money, if only central banks can limit the risk, not all the central banks can do it effectively. Indeed, only the issuer of the central bank money used by globalized banks can provide the specific liquidity needed. In particular, with the dollarization of European banks, the European Central Bank cannot any more exert fully its function of lender of last resort, and is deeply dependent on the Federal Reserve for the provision of dollars.

**The globalization of banking questions the lender of last resort role of central banks.** The model helps to understand interdependencies which developed in global finance. With the globalization of banking, central banks have been affected by an historical change. They were created to function as lender of last resort, i.e. to provide an infinite amount of liquidity if needed. They have become mutually interdependent for the provision of liquidity. As globalized banks increasingly use foreign currencies to settle their transactions, only the central bank which created this money can provide the liquidity needed. In the same way as private systems are dependent on central banks for the provision of liquidity, the European Central Bank has realized during the current crisis that it cannot any more fully function as lender of last resort as it is deeply dependent on the US Central Bank for the provision of dollars.

This dependency on the Federal Reserve is due to to the dollarization of European banks balance sheets. This dollarization can be observed in table 2 and figure 3a in Appendix A. Until 2007, European banks were financing their longer-term investments in non-banks by short-term dollar borrowing in the interbank market<sup>49</sup>. Following a scarcity of dollar funding available internationally to financial institutions, in December

<sup>48</sup>In the model, the lack of liquidity is not the result of a financial panic but of a de-synchronization between debtors and creditors.

<sup>49</sup>See figure 3b in Appendix A where we can observe the growth in European banks' dollar funding needs in the run-up to the crisis, and the growing funding risk prior to the crisis, as the longer-term investments in non-banks became increasingly dependent on short-term foreign currency funding. Indeed, since 2000, European banks have increasingly transformed interbank funds, and those from official monetary authorities, into US dollar-denominated claims on non-banks. In the figure, information on the counterparty type (monetary authority, non-bank, interbank) is used to proxy for the (unavailable) remaining maturity of positions, where interbank positions and net foreign exchange swap ("Cross-currency") positions are assumed to have a shorter average maturity than positions vis-à-vis non-banks ( BIS (2011)).



2007, the Federal Reserve began to establish or expand swap facilities to provide dollar liquidity to fourteen other central banks. From December 2007 to July 2010, foreign central banks received more than \$10,000 billion from the the Federal Reserve (Figure 5 in Appendix A). Another way to measure the dependency of globalized banks on the Federal Reserve is the Term Auction Facility (TAF). It was introduced at the end of 2007 in the early stages of the financial crisis as a way to provide Federal Reserve liquidity support to commercial banks by auctioning off short-term funding, without forcing banks to face the stigma of borrowing from the Federal Reserve's discount window. TAF funding was in addition to the US dollar funding received by European global banks under the central bank swap facilities. Foreign banks were among the biggest beneficiaries of this program. Approximately 65% of the TAF loans were allocated to non-U.S banks, with a preponderance of European banks (see figure 5 in Appendix A). From December 2007 to July 2007, foreign banks borrowed with this program almost \$4,000 billion. This underlines the crucial role of the Federal Reserve as the lender of last resort for the world's banking sector.

This is line with recent empirical evidence from Acharya et al. (2013) : “Dollars are the lifeblood of global finance, so it matters that US and non-US banks have different access to dollar funding [...] The global financial crisis has revealed a new fragility in bank funding – uncertainty around access to dollar funding for non-US banks”. Bank dollarization is not a neutral source of funding as only the US Central Bank can create dollars<sup>50</sup>.

**The globalization of central bank monetary policy.** The Federal Reserve is significantly reinforced by modern banking because of the widespread use of the dollar as a settlement asset. The dollarization of globalized banks has created a dependency on the Federal Reserve. This implies also a globalization of US central bank's monetary policy<sup>51</sup>. The monopoly of central bank money, and among these central bank monies the increasing use of the dollar, means that the world is less and less compartmentalized. Monetary policy decisions can thus spread at the world level through the settlement asset. It is interesting to notice that this globalization of central bank monetary policy is true also to a certain extent for other central banks. As shown by figure 4, the dollar is not the only asset used by globalized banks. Euro assets and liabilities of banks outside the Eurozone, or Sterling assets and liabilities of banks outside the United-Kingdom, have also increased a lot during the last ten years. With this globalization of central bank monetary policy, we are far from a “world without money”.

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<sup>50</sup>It illustrates the fact that Dollars and Euros are not perfect substitutes. It is the case of a non-segmented world, where there is one double-entry constraint for the banks using only Euros (the “segmented”) and one constraint for the globalized banks using Dollars. Dollar and Euro operations are two different segmented markets (see 2.3.1 and 2.3.2).

<sup>51</sup>For a discussion about banking globalization in the United States and its consequences on monetary policy transmission, see Cetorelli and Goldberg (2008).



## Conclusion

I discuss in this chapter the consequences of modern banking features for the provision of money. In particular, I question the rise of private substitutes for central bank assets in banking systems. The development of private systems does not imply a privatization of money as even in private systems, settlement assets are central bank monies. If private systems would have settled their transactions with private money, central banks would have lost the power to act in major compartments of banking systems.

The model determines the conditions for a privatization of money. By introducing a double-entry accounting constraint, necessary to define private money, it shows that systems where public money and private money seem to compete are in fact equivalent to systems with only central bank money. If the conditions for a privatization of money can be described in the model in strictly private systems, empirical evidence questions their existence<sup>52</sup>. Instead of a world without money, the most realistic case today seems a world with only central bank money.

The monopoly of central bank money as the settlement asset implies increasing interdependencies both at domestic and international levels. Settlement assets are indeed a transmission channel for risk propagation in modern banking. If we were observing a privatization of money, risk could have been segmented to the compartment where each asset is used. Not only can the risk not be segmented in a national banking system due to this monopoly, but existing compartments between central bank monies are gradually diminishing with the globalization of banking. Shocks can thus spread in a systemic way through the settlement asset as shown during the current crisis by the consequences of the dollarization of European banks.

What can we conclude about the power of central banks in this context? On one hand, central banks' monetary policy can be more efficient in modern banking as only central banks can provide the cash needed to answer the increasing risk linked to liquidity shortage. It results that intraday credit is an increasingly powerful tool for central banks that could be used as a policy instrument<sup>53</sup>. On the other hand, with the globalization of banking, central banks are more and more dependent on each other. In the same way as private systems are dependent on central banks for the provision of liquidity, the European Central Bank has realized during the current crisis that it cannot any more fully perform its function as lender of last resort as it is deeply dependent on the Federal Reserve for the provision of dollars. These interdependencies underline the crucial role of the Federal Reserve as the lender of last resort in global finance. Instead of a "world without money", this leads to the globalization of the transmission channels of monetary policy.

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<sup>52</sup>In chapter 3, I showed that of the eleven private systems enumerated by the Bank for International Settlements, where settlements could potentially be made in private money, none of them fulfills the conditions for a privatization of money.

<sup>53</sup>The efficiency of this instrument results notably from the consequences of delays between debtors and creditors which increase with the number of transactions in modern banking. These delays are frequent and can affect the entire payment system, making normal settlement impossible.

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## A Appendix. Tables and figures

Table 1: The sequence of travel in periods 0 and 1

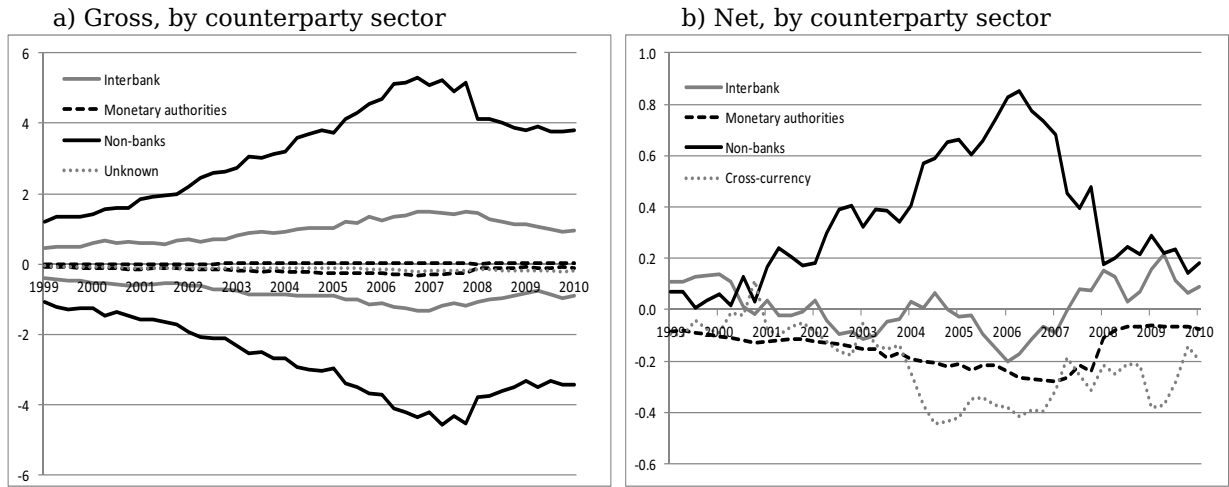
Step	Period 0	Period 1: Old	Period 1: Young
0	Each initial old creditor receives an initial stock of $M$ units of fiat money.		
1	Young debtors visit neighboring creditor islands	All old creditors (young in period 0) and $\lambda$ old debtors (young in 0) visit the central island for debtors to pay back their debt.	Young debtors (born in period 1) visit neighboring creditor islands
2		$1 - \alpha$ old creditors leave the central island with their money	
3		$1 - \lambda$ old debtors visit the central island	
4		Remaining ( $\alpha$ ) old creditors leave the central island with their money	
5	To consume creditor goods, young debtors get into debt with young creditors.		To consume creditor goods, young debtors get into debt with young creditors (born in 1).
6	Young debtors return from the neighboring creditor islands.		Young debtors return from the neighboring islands
7	Young debtors trade with arriving old creditors	Old creditors trade with young debtors (born in period 1) in debtor islands.	Young debtors trade with arriving old creditors (young in 0)

Table 2: US dollar share of non-US banks foreign claims

Positions at end-2007									
Banking system	CA	CH	DE	ES	FR	IT	JP	NL	UK
Total assets (\$bn)	2,437	3,810	10,585	4,541	8,359	4,180	9,845	4,649	10,008
Foreign claims (\$bn)	912	3,390	5,177	1,416	4,456	1,543	2,571	2,962	4,378
over total assets (%)	37	89	49	31	53	37	26	64	44
over annual GDP (%)	63	776	155	98	171	18	58	378	157
US dollar share (%)	70	60	33	36	31	10	48	31	42

Table extracted from McGuire and Von Peter (2009)

Figure 3: US dollar asset and liability positions of the major European banks since 1999

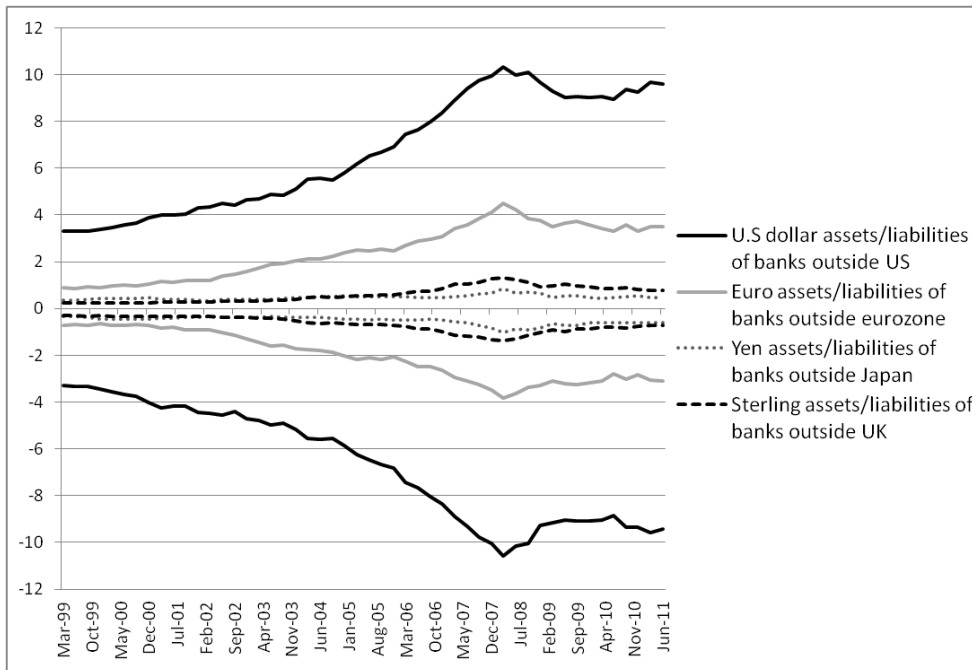


In trillions of US dollars

Cross-currency: implied cross-currency funding (ie FX swaps), which equates US dollar assets and liabilities.

Source: data extracted from BIS (2011)

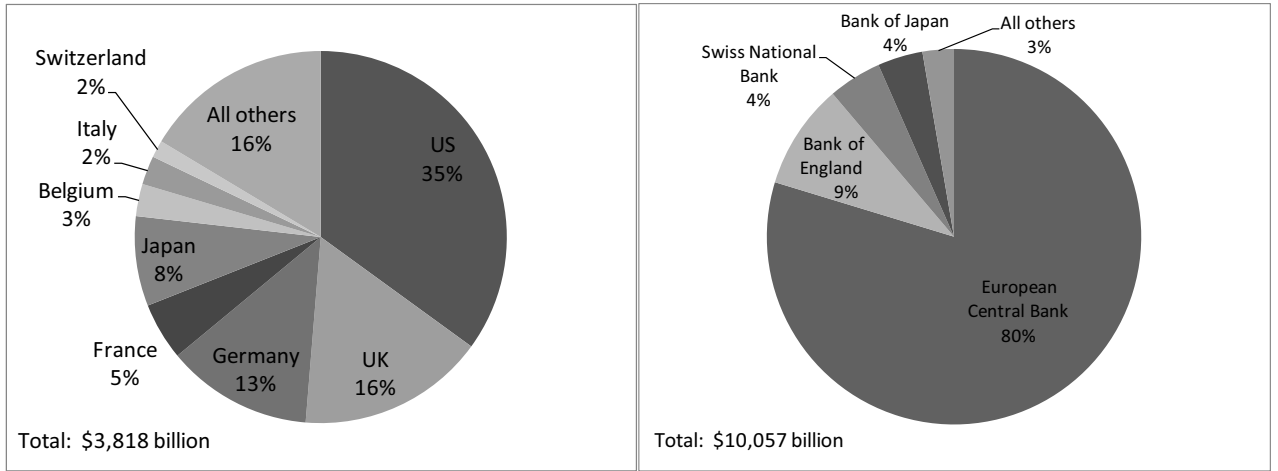
Figure 4: Cross-border foreign currency claims of BIS reporting banks by currency



In trillions of US dollars

Source: BIS locational banking statistics, Table 5A (BIS 2012)

Figure 5: Top 25 Largest TAF Borrowers by banks nationality and Foreign Central Banks' Use of Dollar Swap Lines



Period: December 2007- July 2010.

Author's calculations. Source: Federal Reserve System (2011)

## B Appendix. The model

Appendix B is built from Freeman (1996b).

**The liquidity-constrained equilibrium.** For creditors, we have the liquidity constraint:

$$\lambda l_t - \rho_{t+1} q_t \geq 0.$$

$u_x$  and  $u_y$  are respectively the derivatives of  $u(\cdot, \cdot)$  with respect to consumption of good  $x$  and  $y$ .  $\mu$  denotes the Lagrangian coefficient for the liquidity constraint. The resulting first-order maximization conditions with respect to  $l_t$  and  $q_t$ , can be written as:

$$-\frac{u_y}{p_{yt}} + (1 - \alpha)[\rho_{t+1}(1 - \lambda) + \lambda] \cdot \frac{u_x}{p_{x,t+1}} + \alpha \frac{u_x^*}{p_{x,t+1}} + \mu \lambda = 0 \quad (\text{B.1})$$

and

$$(1 - \rho_{t+1})\alpha \frac{u_x^*}{p_{x,t+1}} - \mu \rho_{t+1} = 0 \quad (\text{B.2})$$

These can be combined as

$$-\frac{u_y}{p_{yt}} + (1 - \alpha)[\rho_{t+1}(1 - \lambda) + \lambda] \cdot \frac{u_x}{p_{x,t+1}} + \alpha \left[1 + \lambda \left(\frac{1}{\rho_{t+1}} - 1\right)\right] \cdot \frac{u_x^*}{p_{x,t+1}} = 0 \quad (\text{B.3})$$

If the liquidity constraint is not binding ( $\mu = 0$ ), then IOU's are not discounted when sold [ $\rho_{t+1} = 1$  from (B.2)]. In this case,  $c_{x,t+1} = c_{x,t+1}^*$  and (B.3) simplifies to  $u_y/p_{yt} = u_x/p_{x,t+1}$ .

If the liquidity constraint is binding ( $\mu > 0$ ), IOU's are discounted when sold [ $\rho_{t+1} < 1$  from (B.2)]. In this case,  $c_{x,t+1} < c_{x,t+1}^*$  and  $u_x > u_x^*$ . So, the liquidity-constrained equilibrium increases the risk faced by creditors, by making late-leavers better off than early-leavers.

**Optimality.** To evaluate the welfare properties of the monetary equilibrium, Freeman sets as a benchmark the stationary allocations that maximize a weighted average of the

expected steady-state utility of those born on debtor and creditor islands:  $\theta v(d_x, d_y) + (1 - \theta) * [\alpha u(c_y, c_x^*) + (1 - \alpha)u(c_y, c_x)]$ .

with  $0 < \theta < 1$  and subject to the feasibility constraints:  $y = d_y + c_y$  and  $x = d_x + (1 - \alpha)c_x + \alpha c_x^*$ .

Freeman calls these "golden-rule" allocations. The first-order conditions for this golden rule require the equality of marginal rates of substitution:  $u_x = u_x^*$  and  $u_y/u_x = v_y/v_x$ .

The equilibrium satisfies these optimality conditions only in the case of no discount on debt ( $\rho_{t+1} = 1$ ). When debt sells below par ( $\rho_{t+1} < 1$ ), creditors who stay late on the central island benefit at the expense of those who leave early, increasing the risk faced ex ante by creditors.

## C Appendix: do netting systems imply a privatization of money?

Netting systems justify a particular focus. The pessimistic view about the future of central banks is indeed especially relevant in this case<sup>a</sup>. These systems seem very close to strictly private systems where only private money is used. Thanks to netting, much more operations can be realized than the value of the transactions settled. We extend the model to describe the particularities of netting systems. We answer the following questions. Can we observe a privatization of money in these systems? Does netting imply a marginalization of the monetary policy?

### C.1 The seeming absence of liquidity shortage

At first sight, netting systems give to their participants a high freedom in the management of their transactions. The fact that the arrival of debtors and creditors is not perfectly synchronized is not problematic as all the transactions are settled at the end of the day. Liquidity shortage seems thus paradoxical in such systems. The desynchronization or time-lag simply results in the temporary indebtedness of some agents to other actors of the system. This claim will be cancelled later during the day by a offsetting claim in the other way.

Even if transactions are only settled at the end of the day, each participant in a netting system has a cash position which is used to register operations during the day. If the arrival of debtors and creditors is not perfectly synchronized<sup>b</sup>, the system needs to allow the indebtedness of some agents to other agents. The registration of operations

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<sup>a</sup>Netting is an agreed offsetting of positions by trading partners or participants. By reducing the number and overall value of payments between financial institutions, netting minimizes the usage of settlement asset. Suppose Bank A has to pay \$500 million to Bank B, and Bank B has to pay \$500 million to Bank A. Without netting, Bank A would send \$500 million to Bank B, and it would thus experience a decline in its available cash while it was awaiting the payment from Bank B. The effect of netting these payments is that Bank A's cash position is simultaneously reduced by its payment to Bank B and increased by receipt of its payment from B. The overall effect on Bank A's cash position is thus zero. On the contrary, RTGS systems settle each payment individually (i.e. on a gross basis).

<sup>b</sup>To simplify we come back here to the initial case with only one central island.

in cash positions explains that this indebtedness is equivalent to a provision of liquidity. Creditors may not have enough liquidity to remove the shortfall.  $h_t$  is the gap (i.e. a claim) between debtors and creditors which cannot be registered with the quantity of liquidity in the netting system ( $B_{t-1}$ ) at date  $t - 1$ . If the quantity of liquidity is not enough, the system can provide additional liquidity to fill this gap. The quantity of money ( $B_t$ ) in a netting system can be written:

$$B_t = B_{t-1} + h_t \quad (\text{C.1})$$

where  $B_t$  is equal to the quantity of money ( $B_{t-1}$ ) at date  $t-1$  plus the claims accumulated ( $h_t$ ) which could not be registered with available liquidity.

## C.2 Netting systems work as zero-sum games

We introduce the double-entry constraint which applies in all types of systems. It implies that each operation in a netting system is registered by crediting an account and by deducting the amount from another account. With this constraint, the quantity of liquidity in a netting system cannot anymore increase endogenously. More precisely, two constraints, at the aggregate level (C.2.1) and at the level of the participants (C.2.2), limit the number of operations possible in a netting system. Only the central bank can respond to these specific liquidity problems (C.2.3).

### C.2.1 Netting systems enable liquidity saving, not liquidity creating

Netting systems cannot increase the quantity of liquidity endogenously. As in previous sections, we can distinguish fully private systems and systems which start the day with a certain amount of public money ( $B_0 = M$ ).

**Strictly private netting systems ( $B_0 \neq M$ ).** With the double-entry accounting constraint,  $B_t = B_{t-1} = B_0$ , (C.1) gives us  $h_t = 0$ . This means that at the level of the netting system (aggregate level), indebtedness is not possible. No more liquidity exists, than the quantity at the beginning of the day ( $B_0$ ). Even in a strictly private netting system, the quantity of liquidity cannot increase endogenously. Netting systems enable liquidity saving and not liquidity creating.

**In the more realistic cases where  $B_0 = M$ .** The constraint (equ. 12) gives us  $B_t = M$ . So again, with (C.1), we have  $h_t = 0$ . At the aggregate level, a gap is possible only if the system has enough liquidity. As in the previous case, indebtedness is not possible as a netting system is a zero-sum game with a fixed amount of "liquidity".

With the double-entry accounting constraint, a netting system is more constrained than expected. It enables the circulation of a certain amount of liquidity in a closed



channel. At the individual level of the participants, another constraint must be taken into account.

### C.2.2 Participants in a netting system are constrained in their operations

Double-entry accounting implies that each operation in a netting system is registered by crediting an account and by deducting the amount from another account<sup>c</sup>. That is why, paradoxically, specific liquidity shortages can exist even in netting systems. Depending on the arrival of debtors and creditors, three cases must be distinguished. Liquidity shortage appears only in the last one.

- If  $\lambda = 1 - \alpha$ . This is the clearing case. The arrival of debtors and creditors is perfectly synchronized. Thanks to clearing, this situation is not risky.
- If  $\lambda > 1 - \alpha$ . This case is not problematic in a netting system. More money arrives from debtors than is needed to pay off all creditors. This means that the positions of participants in the netting system are positive. A desynchronization exists, but participants can deal with this gap because they have net credit positions. This situation is not risky because, as participants have net credit positions, it is always possible to settle the transactions at the end of the day.
- If  $\lambda < 1 - \alpha$ . At first sight, this case is not problematic in a netting system. If the arrival of debtors and creditors is not perfectly synchronized, participants with net debit positions can still borrow from participants with net credit positions. But the indebtedness of participants is limited. Participants should not have too negative net debit positions. The net debit cap represents the maximum net debit position that a participant may be allowed. Low values of  $\alpha$  indicate that only a small fraction of old creditors want to stay late, so the indebtedness is high. Suppose  $\bar{\alpha}$  is the minimal fraction of old creditors who must stay late for the indebtedness not to be too high. It represents the net debit cap. With net debit caps, a liquidity constraint can appear even in a netting system:
  - If  $1 - \alpha > 1 - \bar{\alpha} > \lambda$  (i.e. if the condition  $\alpha > \bar{\alpha}$  is not fulfilled), a liquidity shortage appears. The fraction of creditors who want to leave early is too high, i.e. the indebtedness is too high relative to the positions of the participants. Transactions in the netting system cannot continue<sup>d</sup>

<sup>c</sup>This mechanism works very clearly in CHIPS. For each payment in a multilateral netting system, an account with central bank money is debited and another account with central bank money is credited. Each CHIPS payment message is settled by deducting the amount of the payment message from the sending participant's current position and adding an identical amount to the receiving participant's corresponding current position (CHIPS 2009).

<sup>d</sup>Often, transactions in netting system are seen as not constrained ( $\bar{\alpha} = 0$ ). The indebtedness between participants can be very high. The creditors who leave early can borrow all the liquidity that the creditors who stay late have. Nevertheless, netting systems today are very close to the case where  $\bar{\alpha} = 1$ . All the creditors must stay late. It is the case in CHIPS where participant's intraday current position cannot be less than zero (minimum) nor more than twice (maximum) its initial balance requirement. Similarly, a participant is never in a debit position (CHIPS 2009).

### C.2.3 Policy implications

Two constraints limit the flexibility of netting systems. At the aggregate level, a netting system is a closed channel where indebtedness is not possible. It is a zero-sum game which can only ensure the circulation of the existing quantity of money. At the individual level, participants are also constrained in their operations. In the case where  $1 - \alpha > 1 - \bar{\alpha} > \lambda$ , a shortage of liquidity can exist even in a netting system. The situation is thus not optimal.

In the general case where  $B_0 = M$ , only the central bank can remove this specific liquidity constraint ( $\lambda M \geq \rho_{t+1} q_t$ ). But this intervention is not authorized in all netting systems. In this case, no one can remove the liquidity shortage<sup>e</sup>. During the day,  $M$  is a constant and not an exogenous variable for the system.

The model can also take into account systemic risk in the case of a default of one participant. Under net settlement, a default of a net debtor necessarily affects the entire payment system, making normal settlement impossible. If there is such a risk ( $\rho_d < \rho_{t+1}$ ), a fraction  $d$  of old debtors arriving late can default ( $\lambda + d(1 - \lambda) < 1$ ). Again only the central bank can respond this very risky liquidity shortage.

Some policy implications result from extensions of the model. Central banks encourage the development of RTGS systems to limit systemic risk. They can also intervene more easily in these systems. On the contrary, the lower intervention of central banks in netting systems is one of the major constraints of these systems. They can suffer from liquidity shortage and the risk of default exists. And, even in netting systems, as they are not fully private systems, only the central bank can remove liquidity shortage. Yet, the intervention of central banks is not possible in all netting systems, which makes them all the more risky. This risk, and the lack of possibilities to limit it, may explain also why netting systems are less and less used<sup>f</sup>. From this perspective, Real Time Gross settlements offer more flexibility to their participants and are less risky as central bank interventions are always possible.

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<sup>e</sup>Central bank interventions can be explicitly planned in netting systems. The maximum amount (overdraft) that a participant may owe to other participants in connection with netting within the day may be negotiated with the central bank. Before a maximum netting balance is reached, a participant with a negative balance is obliged to make every effort to prevent the rejection of a payment order by depositing funds in its netting account (i.e. by borrowing from the central bank) (Oygard and Palsson (2009)).

<sup>f</sup>By 1985, three central banks—the Federal Reserve, Danmarks Nationalbank, and the Nederlandsche Bank—had implemented RTGS systems. A decade later, that number had increased to sixteen. At the end of 2006, 93 of the world's 174 central banks were using RTGS systems (Bech et al. (2008)).



# Conclusion

At the end of the journey, I hope to have convinced the reader that housing macroeconomics is a promising avenue for future research. We have shown in Chapter 1 that house prices are an important factor in the determination of current accounts, not only during the recent period but over the last 40 years. Following a house price increase, private savings decrease, through wealth effects rather than consumer-finance based mechanisms, while non-residential investment rises through a relaxation of financing constraints for firms. House prices have also a causal effect on employment dynamics. They impact not only the unemployment rate, through notably the effects on employment in construction, but also sectoral labor reallocation between tradable and non-tradable sectors. Housing booms lead indeed to real exchange rate appreciations that affect manufacturing activity. They seem to cause a deindustrialization phenomenon reminiscent of a Dutch Disease. Future research could investigate further the mismatches created by this labour reallocation. We can make in particular the hypothesis that as housing busts tend to be more sudden than booms, labor reallocation effectively needs to be a lot faster during busts than booms, creating mismatch unemployment.

Policy implications of housing macroeconomics are potentially important. The financial crisis has shown the dangers of neglecting real estate booms and in particular the financial risks associated with housing bubbles. In a recent speech at the Annual Meeting of the American Economic Association, Chairman Bernanke (2010) expressed clearly this concern:

[H]aving experienced the damage that asset price bubbles can cause, we must be especially vigilant in ensuring that the recent experiences are not repeated. All efforts should be made to strengthen our regulatory system to prevent a recurrence of the crisis, and to cushion the effects if another crisis occurs. However, if adequate reforms are not made, or if they are made but prove insufficient to prevent dangerous buildups of financial risks, we must remain open to using monetary policy as a supplementary tool for addressing those risks." (Bernanke (2010)).

It is perhaps a bit worrisome that close recommendations emerged from the Great Depression of the thirties. As early as 1933, the Committee on Banking and Industry of the Social Science Research Council launched a comprehensive program of research into the problems of real estate and economic stability. This ambitious program resulted in the

Wickens (1941) report, carried on under the auspices of the NBER. Recommendations of this report could have been written during the recent years:

"The Committee recommended the study of real estate financing because of the importance of real estate in national wealth. It is one of the greatest outlets for long term investment by banks, insurance companies, and private investors, and economic stability generally is influenced in a large degree by what happens in real estate. The Committee was of the opinion also that real estate financing had been commonly under stressed in the discussions of banking and credit phases of stabilization problems and that a major effort was necessary to organize the field by a comprehensive study on a national scale. [...] Effective measurements of real estate phenomena incident to financing are fundamental to an understanding of the problems of financing and economic stability." (Wickens (1941)).

The report urged more research in the area to understand better real estate. More than 70 years after these recommendations, housing macroeconomics is still a relatively unexplored area within the field of macroeconomics. Recent Nobel prize awarded to E. Fama, L. Hansen and R. Shiller "for their empirical analysis of asset prices" could encourage more work in this direction.

I hope that this thesis could have also contributed to an old question of monetary theory regarding money creation mechanisms. I have shown that despite the recent transformations in modern banking, notably with the development of private payment arrangements, settlement assets used in banking and global finance remain unchanged. We do not observe a privatization of money as central banks are still the only issuers of settlement assets. This monopoly of central bank money is not neutral for central banks and for risk propagation as settlement assets are both a transmission channel of monetary policy and a propagation channel for shocks. Recent episodes during the financial crisis, linked to the shortage of US dollars, have shown the importance of the settlement assets used in global finance. For the same reason that only central banks can provide central bank money, only the Federal Reserve can provide US dollars. Other currencies or assets are not perfect substitutes of these central bank assets. As real private monies such as online currencies (*Bitcoins*, *Amazon coins*) are still in value quite marginal phenomena, there is no (significant) private creation of money in modern banking. If commercial bank money is said to be a perfect substitute for central bank money, this is true as commercial bank money is not private money but another name for central bank money<sup>7</sup>. In the case of a liquidity shortage, only the effective creator of money can provide the liquidity needed. In a domestic banking system, only the central bank can

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<sup>7</sup>If private banks could indeed create money, they would have been able to create new assets in the case of a liquidity shortage. Creators of money such as Amazon in the case of a private currency or central banks in the case of central bank money can indeed effectively provide new assets if needed. They can create these assets *ex nihilo*. For the same reason that the ECB cannot create USD dollars in the case of liquidity shortage, commercial banks have balance-sheet constraint on lending and cannot create money *from nothing*.

do it. In global finance, with the use of the dollar as the settlement asset of globalized banks, only the Federal Reserve can exert the role of lender of last resort.

Further research could investigate the expected consequences of the development of online currencies. Such a development could effectively lead to a privatization of money and to a competition in the supply of currencies as recommended by Hayek (1976) in his famous book *Denationalisation of Money*. Hayek advocated a real privatization of money with banks competing to issue currencies denominated in new units of their own definition, implying variable exchange rates between these private currencies<sup>8</sup>. Questions raised by Hayek echo the large uncertainty surrounding the development of private online currencies:

"There is no answer in the available literature to the question why a government monopoly of the provision of money is universally regarded as indispensable. [...] Nor can we find an answer to the question of what would happen if this monopoly were thrown open to the competition of private concerns supplying different currencies." (Hayek (1976)).

If in the current situation, virtual currencies schemes do not pose a risk to price stability as money creation continues to stay at a low level, or to financial stability given the low volume traded and the lack of wide user acceptance (ECB (2012)), future policy implications depend deeply on the evolution of the size of these schemes.

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<sup>8</sup>Writing when inflation was at its peak, he insisted that holding a money whose purchasing power the issuing bank has staked its valuable reputation on preserving would be so attractive that banks could induce the public to switch from government currencies to their own.







