Economic policy in globalization : four essays in economics of trade and migration

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Economic Policy in Globalization

Four Essays in Economics of Trade and Migration

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General Introduction

One of the most interesting questions in international economics is to understand the interaction between globalization and the balance of power between divergent interests within nations. This interaction goes in two directions. Globalization has a distributive impact within economies, and modifies the shape of domestic interests. Political forces within countries are pushing for or against engagement in globalization, and defending different modes of integration into the world economy. The State has a plural role in face of this interaction: acting as the "midwife of globalization" (in the words of Janine Brodie), it is expected to create the conditions for the economy to benefit from integration; to operate internal transfers to compensate those adversely impacted by it; and to impose the prevalence of common over private interests.

The capacity of the State to intervene in the integration process, and to modify the effects that globalization exerts on the national economy, is a matter of debate, on both positive and normative grounds. Globalization is often viewed as weakening the control of nation-states over the evolution of their economic fate, as economies become more interdependent. Global processes of integration appear too powerful for the State to countervail the structural transformation it imposes onto the domestic system of production and exchange. Marx saw this force in action in the diffusion of global trade, as he wrote in the *Communist Manifesto*: "The need for a constantly expanding market for its products chases the bourgeoisie over the whole surface of the globe. It must nestle everywhere, settle everywhere, establish connections

everywhere... The cheap price of its commodities are the heavy artillery with which it batters down all Chinese Walls. It compels all nations, on pain of extinction, to adopt the bourgeois mode of production; it compels them to introduce what it calls civilization in their midst... In one word, it creates a word after its own image." Successive waves of globalization have been associated with similar processes of diffusion of goods, technologies, and ideas. Most recently, the fragmentation of modes of production, elicited by the lowering of trade costs, has seen countries setting to trade not only final goods, but components, tasks - such as the assembly of components -, and in general, the single contribution to the production of final value which they are in position to provide at the lowest cost. The spectacular rise of China in global trade is largely attributable to this new organization of global production chains.

The questions of whether economic policy has the means to oppose such a transformative process, and of whether it should, are in reality intertwined; as the force which draws an economy into the global process of exchange is nothing else than its own interest. This does not imply, however, the denial of any means of action. A number of countries have been adopting non-neutral trade and industrial policies, including tax breaks, protection and export subsidies; some with apparently striking success. South-Asian countries in the 1960s to 1980s, China in the past two decades, have seemed to epitomize the capacity of State intervention to reap the largest gains from the integration process. But how much credit can these policies really take for the huge growth rates achieved remains a crucial question. Chapter 1 examines some aspects of this question in the case of China.

The intrusive effects of globalized exchanges described by Marx are also at play in their distributive effects. By modifying the internal balance of polities, they are one way in which integration is seen as questioning the sovereignty of States. This question has been at the center of economic analyses. Classical insights from economic theory have brought general answers to this question in stylized situations. In matters of trade, the standard model based on factor proportions shows two

groups being differently impacted by the country's participation to world exchange. A similar mechanism is at play with the migration of workers, which can conceptually be assimilated to trade in factors of production: opening trade in factors generates large efficiency gains, but some groups within each country are to be negatively impacted by it.

These are, however, not the only channels through which globalization modifies the balance of interest within nation-states. Trade integration is often credited with reducing rents through increased competition, and accelerating transition between declining and emerging sectors of the economy. In recent years, China has provided a striking example of a society experiencing tremendous internal transformations while integrating into the world economy at an astounding pace; which one of the two processes has been leading the other is not clear-cut. Chapter 2 documents that the process of internationalization of China's economy has been accompanied with a not less spectacular transformation of the domestic landscape of firms. In the mid-1990s, State-owned firms benefited from a particular treatment in the largely state-controlled credit market, while Private firms were discriminated against. The effect of these distorsions is apparent on the export structure of these firm categories. This pattern has been reversed in less than one decade, while the degree of State control over the credit allocation system decreased substantially.

Theoretical insights on the distributive impact of integration also apply to migration flows. While the entry of additional workers is generating a net economic surplus to residents of the host country, casual observation of immigration policies across countries, where restrictions dominate, suggests that the design of these policies does not proceed by direct summing up of individual interests. There, as for trade policy, evidence has accumulated on the need to consider how conflicting interests are weighted by the policy maker. The exposure of residents to the economic effects of immigration varies not only with their position in the production system, but also with their geographic location. Chapter 3 makes the point that, when a relatively immobile resident population is confronted with an inflow of more mobile

workers, then the impact of immigration becomes even more polarized; as a result, political opposition to it is reinforced.

Finally, Chapter 4 considers the reverse question of how internal balance of power plays out in shaping the mode of integration of economies, focusing on the case of trade policy. Trade openness creates a wedge between declining industries, which face increased competition from it, and those rising, which are to benefit from increased market access. The interests of producers are also not aligned with those of consumers (insofar as these can be considered as separate groups) in the process of opening to trade: while the objective of maximizing a nation's real income is best achieved by a unilateral, non-discriminatory opening of trade barriers, this first-best option is rarely observed in practice. As written by Paul Krugman, "The compelling economic case for unilateral free trade carries hardly any weight among people who really matter" (Krugman, 1997). In other words, a satisfactory description of how countries decide on trade policy has to start by assuming that special interests are disproportionately represented in the decision process. Chapter 4 studies which trade agreements are engaged into by countries, and infers from this pattern the respective weights of producers and consumers' interests in shaping the trade policy of countries. Consistently with other studies on the design of trade policy, it finds evidence that special interests have an excessive influence on policy.

The rest of this introduction will review the contents of each chapter in detail.

Chapter 1 Recent developments in the theory and empirics of economic growth have proposed to reconsider the role of structural transformation as the engine of development (McMillan and Rodrik, 2011; Lin, 2011). In this strand of literature, the importance of the nature of products exported by a country or region as possible determinants of growth and development has been put forward. The idea dates back at least to attempts, since Solow's model (Solow, 1956), to characterize the process of accumulation of knowledge as the main engine of growth, apart from capital accumulation. The idea that the type of goods produced and exported by a

country could be seen not exclusively as the outcome of comparative advantages determined by the technology and factors available, but also as the result of a process of "discovery", i.e. of innovation, and therefore as an essential component of the growth process, has been recurrent in the study of growth. This idea has been particularly prevalent among economists attempting to understand the "growth miracles" of south-east Asian economies in the 1960s to 1980s. For instance, Robert Lucas wrote: "The main attraction of a learning spillover technology... is that it offers the potential of accounting for the great difference in productivity growth rates that are observed among low and middle income economies. East Asian miracles all have involved sustained movement from less to more sophisticated products. A growth miracle sustained for a period of decades thus must involve the continual introduction of new goods, not merely continual learning on a fixed set of goods" (Lucas, 1993). Theoretically, Arrow (1962) showed that, in presence of "learning by doing", investments in an industry generate benefits for future investors, benefits which are not paid for in a pure competitive regime. More recent theoretical works have emphasized the information externalities inherent to the process of starting the production of new goods (Hausmann and Rodrik, 2003) , as the initiators of a new production process generate information which is valuable to their imitators. In the presence of such externalities, the type of goods in which a country specializes may explain part of its growth trajectory. An additional contribution of the recent literature has been to propose innovative methods to identify the link between the specialization pattern of a country and its level of growth. Hausmann *et al.* (2007) and Lall and Zhang (2005) have proposed an index of the 'sophistication' of goods which computes an average level of income of countries exporting a particular good. The idea is that goods generating higher positive externalities through learning by doing or inter-industry spillovers can be identified by matching data on trade and income levels (after controlling for physical and human capital stocks). This index of the "sophistication" of exports has been shown to be a predictor of growth across countries (Hausmann *et al.*, 2007; Mishra *et al.*, 2011).

In this renewed case for industrial policy, China may have appeared as a poster child. Its very gradual process of trade opening during the 1990s', which led to the entry into the WTO in 2001, resembled that implemented by south-east economies two decades earlier. In addition, China implemented a policy of support to the development of high-technology and export-oriented sectors, in particular through the creation of low-tax export development zones and subsidies to foreign firms. In the 1970s and 1980s, the high growth rates achieved by countries such as Taiwan and South Korea were seen as a sign of the success of policies of protection and promotion of specific capital-intensive sectors. Similarly to these countries, China's growth trajectory has clearly been driven by the rapid expansion of exports, which went from less than 10% of GDP in 1980 to more than 37% in 2007. In addition, this process has been accompanied by a rapid diversification and upgrading of China's trade, as its manufactured exports pervaded all sectors of world trade, in particular products with high technological content and that are usually considered as belonging to the area of specialization of more developed countries. Proponents of industrial policy have concluded that the rapid structural transformation which occurred in China in the 1990s and 2000s would not have been possible without an active policy of support to those specific sectors which have made China's success on export markets. Using the sophistication index developed in Hausmann *et al.* (2007); Rodrik (2006) shows that China's export basket is similar to that of countries with high income levels, and sees it as a sign that " Government policies have helped nurture domestic capabilities in consumer electronics and other advanced areas that would most likely not have developed in their absence."

This view has however been criticized on several grounds. First, the level of sophistication of Chinese exports may be overvalued due to the importance of processing trade in China's export sector, as many of the high-technology goods exported by China are produced using labor-intensive processes and imported inputs. The sophistication of these exports thus includes the technology embedded in the imported inputs, and not necessarily any greater degree of complexity or technology

in the Chinese final assembly process. Moreover, a considerable share of high-technology exports comes from partially or wholly foreign-owned firms (mainly operating in the assembly-trade sector): this raises the question of whether the observed upgrading of Chinese exports reflects the genuine adoption of technology at the local level (Lemoine and Unal-Kesenci, 2004; Amiti and Freund, 2010; Wang and Wei, 2008; Lardy, 2005).

In addition, Schott (2008) has conjectured that the observed sophistication level of Chinese exports results from the large disparities in factor endowments across Chinese regions which, along with impediments to internal factor mobility, may explain both the diversity of Chinese exports, and the overlap between the diversification cones of skill- and capital- abundant provinces such as Shanghai and those of more developed countries.

These arguments all lead to question the conjecture that China's growth performance has anything to do with this peculiar pattern of exports. This upgrading may have been an artefact of China's position in vertical chains of international production. In addition, if the sophistication of Chinese exports reflects regional differences in income or in factor endowments, then it may be a mere consequence of local factor proportions.

This chapter tests the conjecture that the sophistication of Chinese exports has contributed to its growth trajectory. It addresses the two concerns highlighted above by using data for trade by province and prefecture of origin, and by trade regime (processing or ordinary). Decomposing trade values along these dimensions allows to evaluate their respective contributions to overall export sophistication, and to growth.

It first estimates the upgrading of China's exports by measuring export sophistication separately for ordinary and processing-trade transactions and for domestic and foreign firms. It then estimates the relationship between export sophistication and real growth rates of provinces in China.

Results confirm that regions specializing in sophisticated goods grow faster,

consistently with the cross-country pattern found in Hausmann *et al.* (2007). Thus, export sophistication varies substantially across regions, even after controlling for income and factor proportions; this difference, in turn, matters for growth.

Finally, the chapter investigates whether the relationship between export sophistication and income per capita growth depends on the trade regime (processing or ordinary) and ownership type (domestic or foreign) of exporting firms. We find that export sophistication in the assembly sector bears no relation to real growth, confirming that the contribution of assembly exports to the upgrading of China's exports should be put to one side for the measurement of the real improvement in the country's level of technology.

Conversely, we find that growth-enhancement is limited to the ordinary export activities of domestic entities: no additional direct benefits pertain from the upgrading of foreign exporters, either in assembly or ordinary exports. This result may seem surprising in the Chinese context. The country adopted, starting in the early 1980s, a policy of opening to foreign investment, precisely in the hope that technological capabilities and management practices would spill over and bring about greater productivity and export performance and sustain higher growth rates. These policies were believed by many to be one of the key factors explaining both China's high-end export structure and its rapid growth (Rodrik, 2006). These results suggest, by contrast, that policies supporting innovation by domestic entrepreneurs may have been as important in supporting growth as FDI promotion.

Chapter 2 A large literature emphasizes the role of finance for development. Consistently with the classical view of the financial system allocating resources to their best use (e.g. Bagehot (1873), Schumpeter (1911)), a large number of works have confirmed a statistical association between a more developed financial system and higher growth rates (e.g. Goldsmith (1969)). However, it has proven more difficult to provide evidence of a causal link explaining these results, as the hypothesis of reverse causality has appeared as equally probable, and has been

defended by some authors (e.g. Robinson (1952)). Indeed, one can think that the growth of activity in the economy is creating demand for financial services, thus leading financial development rather than being led by it. Alternatively, a number of omitted variables, influencing positively both finance and growth, can be thought of, for example the saving rate of households. A number of empirical studies have attempted to circumvent these difficulties to establish causality (King and Levine, 1993; Beck *et al.*, 2000; Beck, 2002; Levine, 2003).

Two recent developments have contributed to the understanding of the role of finance for growth. First, Rajan and Zingales (1998) have proposed an original method to identify causality in the relationship. These authors have shown that the financial development impacted not only the level, but also the structure of growth across sectors. Their hypothesis is that the the need for external credit, as well as the capacity to secure external funds, depends in part on intrinsic, i.e. technological characteristics of sectors. The need to maintain stocks, the tangibility of assets, or long-term investments such as R&D count among these characteristics. Under the hypothesis that such characteristics of sectors are maintained across countries, these authors show that countries with more advanced financial systems grow faster in finance-dependent sectors.

Second, the impact of finance has been shown to be particularly important for the development of the export sector. Models by Chaney (2005) and Manova (2008b) have formalized the intuition that, if financial development promotes a growth biased toward financially dependent industries, then this impact should be even more apparent on export growth, because access to export markets is more demanding in terms of external finance, due to the presence of fixed costs of entry. A large body of empirical work has documented the impact of the financial sector on trade. At the macro level, the impact of the financial system on the volume of trade, and on the structure of exports across sectors, has been identified in cross-country studies (Beck, 2002; Berthou, 2010; Manova, 2008a). These studies establish that the pattern of international trade flows is consistent with the hypothesis of financial development

acting as a source of comparative advantage: countries with more advanced systems export more in the sectors where credit is most needed or harder to obtain. In parallel, firm-level studies have shown how the financial constraints faced by a firm impact its decision to enter export markets, as well as the volume it will be able to export on these markets

This chapter contributes to this literature, by considering the role of within-country heterogeneity in access to finance, as a determinant of export patterns. Focusing on China, it shows that the ownership type of firms, as well as the province of localization, is a determinant of the conditions faced by firms on credit markets, which in turn determine export patterns. In other words, a pattern of specialization by finance dependence emerges across regions and across firm types, similarly to what is observed across countries. Foreign firms export relatively more in sectors where finance is most needed, i.e. where larger investments are required and/or returns to investment take more time to materialize. Private domestic firms, by contrast, are the least active in these sectors, consistent with abundant evidence of them being excluded from some formal credit markets. State-owned firms, long described as facing "soft budget constraints" in China, exhibited in 1997 an advantage in finance-dependent sectors which has considerably eroded over the period 1997-2004. In addition, we consider the impact of banking liberalization on this pattern of specialization; and find that this liberalization s been associated with a reduction of the gap in export structures between firm types, in particular between private and foreign firms. This is consistent with the hypothesis that the liberalization dampened the differences in access to credit between private and foreign firms.

Chapter 3 A large body of work has appeared in the past 20 years on the labor market impacts of immigration in host countries. Motivated, in part, by the parallel growth of concerns about immigration in the political debate in these countries, this literature has been dealing primarily with the question of the wage and welfare impacts of immigration. In a standard, basic model of the labor

market, immigration, taken as a shock to labor supply, is predicted to have a negative impact on the wages of workers with similar skills as the entrants, in the short run; and a positive impact on the income of other workers and capital owners; the net impact being positive (Borjas, 2003, 2009). Several subsequent studies have considered modifications of this model to include imperfect substitution between workers (Ottaviano and Peri, 2012), wage rigidities (D'Amuri *et al.*, 2010), and flexibility in tasks (Peri and Sparber, 2009). These theoretical approaches all consider a perfectly spatially integrated labor market and ignore its regional dimension.

On the empirical front, a number of works have attempted to identify the causal impact of immigration on wages, most frequently relying on a spatial correlation approach. This method consists in using variation in immigration inflows across locations - typically, regions or cities within a country - to measure their impact on local wages. Two hypotheses need to be made in this approach. First, local labor markets must necessarily be fragmented to some degree, for a spatial difference in wage to persist, and to be measured. Second, identification generally requires assuming that the differences in inflows across locations are not related to labor market conditions themselves. In other words, a perfect empirical setting would require immigrant flows to be randomly distributed across locations, and to generate persistent wage differences. The contradiction between these two requirements is one of the main difficulties faced in empirical studies: indeed, spatial wage differences almost surely have a bearing on location choices made by immigrants, as immigrants entering a country should be expected to compare expected wage levels (in addition to other economic and non-economic variables), when choosing where to settle. This behavior creates a classic omitted variables problem in empirical studies, which has motivated the search for instrumental variables in empirical works.[1] Other studies have advocated instead to use national data, in order to circumvent this problem.

[1] One popular method has been using local stocks of past immigrants as an instrument for the flows, based on the hypothesis of network effects. Altonji and Card (1989) has been the first to use it, based on a study of network effects by Bartel (1989).

This chapter argues that the endogeneity of immigrants' location choices should be considered not merely as an obstacle to empiricists, but rather as an inherent characteristic of immigration which contributes to define the impact of immigration on the economic lives of residents. Intuitively, a higher spatial flexibility, or mobility, of immigrants, affects the *efficiency* of labor markets: if incoming workers allocate themselves to places where they are most productive, efficiency at country level should increase, compared to any other allocation rule. In addition, this mobility also has consequences for the *distributive effects* of immigration, as regional markets will be unequally affected by the inflow of new workers. This also implies that political attitudes regarding immigration also depend on the mobility of immigrant. The political stance on immigration is classically viewed as being shaped by the distribution of its impacts among the population with political voice (Benhabib, 1996; Facchini and Willmann, 2005). The chapter considers how the political equilibrium between divergent interests is influenced by the spatial localization of immigrants.

The chapter therefore modifies the standard labor market model used for the analysis of the impact of immigration, to include fragmented local markets and immigrants' mobility, in order to examine how the impact of immigration on wages and on residents' welfare is modified in such a framework. The model considers skilled and unskilled labor, and focuses on the effects of unskilled immigration. It incorporates frictions between regional markets, which make possible the persistence of wage differences. This is done by introducing heterogeneity among workers in the costs of mobility, thus assuming that workers differ in their "spatial flexibility", or equivalently, in their attachment to a specific location of residence. Regional fluctuations are then modeled using local exogenous shocks to productivity, creating differences in factor returns, which costly mobility of workers reduces only in part. The chapter then consider equilibrium settlement patterns of immigrant workers, as a function of regional differences. A static comparative exercise is performed, which considers how the degree of spatial flexibility of immigrants modifies their impact

on wages and on residents' welfare. Next, the impact of flexibility on the political equilibrium of immigration policy is considered.

Results show that the "immigration surplus" - the gain in welfare accruing to native factors from an inflow of additional workers - is increasing with regional fragmentation, i.e. with regional disparities, and with foreign workers' flexibility, that is their propensity to exploit such regional differences. However, the distribution of these gains also becomes more polarized, more unequal across factors and across regions for each factor. In other words, residents who tend to suffer economically from immigration - unskilled workers, in the case of unskilled immigration considered - are more negatively impacted, on average, when the immigrant workforce is more spatially mobile. The efficiency gain associated to immigrants' mobility is thus entirely captured by the complementary factor - skilled workers -, whose gain from immigration increases. As a consequence of this redistribution of the gains, the political equilibrium is shifted toward more restrictive policies. In the setting considered, political groups representing the interests of unskilled labor will increase their opposition to immigration, which results in a lower level of politically admissible immigration. These results are shown to hold in an extension of the model to the case where both foreign and native workers are mobile across regions.

Chapter 4 In matters of trade liberalization, the preferential mode of opening has preexisted to the multilateral one: as noted by the WTO itself (WTO, 2011), the idea of a multilateral trade agreement did not emerge before the creation of the GATT in 1947. Thus, for most of modern history, trade agreements have been implicitly "preferential", i.e. involving a limited number of partners, typically two in a bilateral commercial treaty. Since 1947, this mode of liberalization has continued to exist in parallel to multilateral trade talks: the number of preferential trade agreements ("PTAs") has continued to grow to reach 300 in force as of 2011.

Understanding the motives behind countries' choices to engage in preferential, or in multilateral liberalization has been the object of a large literature. Standard

theory identifies the "terms-of-trade" effect as one important such motive: in a non-cooperative game, countries with market power (i.e. those large enough to have an influence on their terms-of-trade) will tend to use trade policy to manipulate their terms-of-trade (i.e., to lower the relative price of their imports to their exports)(Johnson, 1953). Such a policy creates a negative externality on other countries. Engaging in a trade agreement helps to neutralize this negative externality, by securing market access with one or more partners, in exchange for reciprocal trade opening. Among possible agreements, preferential ones reduce externalities among members, but to the expense of non-member countries, which face trade diversion (their market access to members of the agreement deteriorates). Thus, a multilateral agreement can be shown to be the first-best option (Bagwell and Staiger, 2004) [2]

This trade diversion effect is also a potential explanation for the growth of the number of PTAs. Facing a loss of market access, countries which remained out of signed agreements have an incentive to join existing blocs, or to create new agreements, to mitigate this negative externality. This intuition was formalized in a theoretical model by Baldwin (1993), and empirical support in favor of this mechanism was found in Egger and Larch (2008); Baldwin and Jaimovich (2010).[3]

Empirically, Baier and Bergstrand (2004) have proposed to confront the list of implemented PTAs to a number of predictors of their economic effects, in order to perform a systematic analysis of the motives for PTA signing. Their results show that variables signaling higher economic gains from a PTA, such as shorter distance

[2] Another externality associated to trade policy is due to countries trying to attract production in the domestic territory, known as the production relocation effect (Venables, 1987). Similarly to the terms-of-trade effect, this effect leads to a non-efficient non-cooperative outcome, while the first-best option is multilateral opening. This effect is outside the scope of this chapter.

[3] Other economic motives for trade agreements have been put forward in the literature; these include time-consistency problems, where a government uses PTAs to lock-in its policies against the possibility of a reversal, and to reinforce its credibility (Fernandez and Portes, 1998). Maggi and Rodriguez-Clare (1998) argue that PTAs serve to minimize the costs of distorsions associated to the protection of inefficient sectors. Increasing market size, in particular for motives of FDI attraction can also be a motive for signing PTAs. Finally, Lawrence (1996) argues that PTAs can serve to achieve deep integration, as it requires a level of coordination easier achieved at the regional than the multilateral level.

between partners, similarity of the two economies (as proxied by real GDP levels), and difference in capital-labor endowment ratios, all contribute to predicting the PTAs that are actually observed. Their model provides a rather high fit to the data, with 85% of actual PTAs being predicted. In other words, their results suggest that countries rightly choose to engage in the agreements which are most beneficial to them, in terms of welfare.

The analyses listed so far implicitly consider that countries should decide on their trade policy by considering the terms-of-trade and welfare effects of the different options, that is, the net gains or losses faced by the country as a whole. By contrast, an important literature has argued that the distribution of gains from trade agreements in the population matters. This literature adopts the general view of Putnam (1988) on international relations, which argues that international actions taken by countries involve two distinct stages: one of negotiations between domestic interests, which determines the government's preferences; and one of negotiation at the international level. In the context of trade policy, domestic interests at stake include the sectors of production, which may face gains from market access, or losses from import competition, depending on their relative costs of production relative to foreign competition; and consumers, who face gains in real income from a reduction of trade barriers. Grossman and Helpman (1994) have proposed a model where industry interests make campaign contributions contingent on trade policy. An incumbent governments trades off these contributions and voters' welfare to decide on trade policy. This model predicts that the level of protection applied by a country across sectors, will be a function of import elasticity and penetration, and of the organization of sectors into political influence groups. These predictions have been confirmed empirically by Goldberg and Maggi (1999); however, they find that US tariffs are consistent with a weight of about 1 (0.99) to welfare, implying that the US government is close to being a perfect welfare maximizer. Gawande and Bandyopadhyay (2000) also find support for the model with US protection data, but with results consistent with equal weights put by the government on

welfare and contributions - implying that a lobby is required to compensate for the deadweight loss associated with a distorsion in trade policy. Similarly, Baldwin (1986) and Baldwin and MaGee (2000), among others, have provided evidence of the US government favoring special interests over welfare when deciding on trade policy. Gawande *et al.* (2009) estimate the "welfare mindedness" of governments in trade policy and show that the relative weight put on welfare relative to special interests varies across countries, in conjunction with the quality of democratic institutions.

Concerning the formation of PTAs, Grossman and Helpman (1995) have used the same theoretical framework to study how the interaction between the government and interest groups representing industries is to shape a country's choice of trade agreements. Their analysis shows that, among possible agreements, a government is unlikely to sign those most beneficial to voters' welfare: essentially, a welfare-improving PTA requires a failure of coordination among interest groups to become viable. Moreover, an agreement is more likely to be politically feasible if it generates more diversion than creation, in which case it is detrimental to welfare.

Chapter 3 examines how much the effects of trade agreements on the interests of producers, consumers, and on overall welfare, contribute to shaping a country's trade policy. Using a simple model of international trade, calibrated with data on trade flows and tariffs for the recent period (2001-2007), it evaluates the potential effects that each hypothetical agreement involving two countries, would have on each partner's export and import prices, and on its real income level. These effects are then confronted to the list of actually implemented PTAs, and the empirical model tests the explanatory power of each effect on countries' trade policy.[4]

Results indicate that the expected net income gains from a trade agreement statistically predict actual agreements: in other words, countries engage in the PTAs which are more beneficial to them in terms of economic welfare. However, market access gains to producers have an impact on the probability of signing an agreement

[4] The empirical exercise is thus similar to the one in Baier and Bergstrand (2004), however an important difference is in the focus on distributive effects of PTAs within a country, rather than on only net gains and losses.

that is about twice as large as the expected gains to consumers. In other words, countries tend to exhibit a bias in favor of producers when choosing trade agreements. This result is in contrast to the view that net economic gains are the main drivers of trade policy. The empirical analysis provides additional insights on the determinants of trade policy. It shows that the potential gains which a country may expect from multilateral opening reduce the probability of signing a PTA, which may help explain why some countries tend to favor one or the other mode of liberalization. It also confirms that the diversion effects from PTAs are also a determinant of agreements. Overall, the chapter contributes to the understanding of the formation of trade policy, by proposing an original, theory-based method to evaluate the determinants of PTAs.

Chapter I

Export Sophistication and Economic Growth: evidence from China[1]

1 Introduction

Recent developments in the theory and empirics of economic growth have proposed to consider the products exported by a country or region as possible determinants of growth and development. The title of the paper by Hausmann *et al.* (2007), "What you export matters", summarizes the idea that the type of goods produced and exported by a country could be seen not exclusively as the outcome of comparative advantages determined by the technology and factors available, but also as the result of a process of "discovery", i.e. of innovation, and therefore as an essential component of the growth process. Recent theoretical works emphasize the information externalities inherent to the process of starting the production of new goods (Hausmann and Rodrik, 2003) , as the initiators of a new production process generate information which is valuable to their imitators. Older works already put

[1] This chapter is based on my paper entitled "Export Sophistication and Economic Growth: evidence from China", co-written with Sandra Poncet, which has been published in the Journal of Development Economics, May 2012.

forward the existence of market failures due to the presence of learning by doing (Arrow, 1962; Stokey, 1988), industry externalities (Jaffe, 1986), or technological spillovers between industries (Jaffe *et al.*, 1993). Hausmann and Rodrik (2003) and Hidalgo *et al.* (2007) provide models where product externalities make the trajectory of a country in the "product space" indeterminate. In the presence of such externalities, the type of goods in which a country specializes may explain its success or failure to generate growth.

In this renewal of the case for industrial policy, China may have appeared as a poster child. The country's growth trajectory has apparently been driven by the rapid expansion of exports, which went from less than 10% of GDP in 1980 to more than 37% in 2007. This process has been accompanied by a rapid diversification and upgrading of China's trade, as its manufactured exports pervaded all sectors of world trade, in particular products that are usually considered as belonging to the area of specialization of more developed countries.

Rodrik (2006) notes that China is an outlier regarding the overall *sophistication* of its exports: according to the sophistication index of Hausmann *et al.* (2007), which estimates the average "income level of a country's exports", China's export bundle is similar to that of a country with a level of income per-capita three times larger than China. Using an alternative indicator, Schott (2008) also finds that China's export bundle is increasingly overlapping with that of the world's most-developed economies.[2]

This view has been criticized on several grounds. First, the level of sophistication of Chinese exports may be overvalued due to the importance of processing trade in China's export sector, as many of the high-technology goods exported by China are produced using labor-intensive processes and imported inputs. The sophistication of these exports thus includes the technology embedded in the imported inputs, and not necessarily any greater degree of complexity or technology in the Chinese final assembly process. Moreover, a considerable share of high-technology exports comes

[2] See also(Fontagné *et al.*, 2008).

from partially or wholly foreign-owned firms (mainly operating in the assembly-trade sector): this raises the question of whether the observed upgrading of Chinese exports reflects the genuine adoption of technology at the local level (Lemoine and Unal-Kesenci, 2004; Amiti and Freund, 2010; Wang and Wei, 2008; Lardy, 2005). These concerns are backed up by statistics on Chinese trade: In 2007, 54% of Chinese exports were in the processing trade sector; the analogous figure is 85% for high-technology exports. Yao (2009) argues that once China's processing-trade regime is taken into account, Chinese exports no longer look very different from those in other countries with similar levels of development, a point also made by (Assche and Gangnes, 2010).

Second, Schott (2008) conjectures that the observed sophistication level of Chinese exports results from the large disparities in factor endowments across Chinese regions which, along with impediments to internal factor mobility, may explain both the diversity of Chinese exports, and the overlap between the diversification cones of skill- and capital- abundant provinces such as Shanghai and those of more developed countries. A related argument is made in Xu (2010), who argues that there may not be much of a gap between income levels and export sophistication when looking at province-level data.

Third, Schott (2008) also makes the point that Chinese exporters essentially specialized on the low-quality end of the market, so that the observed similarity in the exports of China and of developed economies does not signal a capacity to compete directly with the production of high-income countries in high-tech product markets.

These arguments all lead to question the conjecture that China's growth performance has anything to do with its peculiar pattern of exports. Export upgrading may be entirely attributable to the assembly sector, in which case one should not take it as a signal of technology adoption at the local level. In addition, if the sophistication of Chinese exports reflects regional differences in income or in factor endowments, then its export sophistication could well be rationalized in a

standard factor proportions framework.

In this chapter, we use data on trade at province level, differentiating between processing trade and ordinary (i.e. non-processing) trade, as well as between exports by domestic and foreign-owned firms, to test the conjecture that China's growth is, indeed, a "sophistication" story.

We first estimate the upgrading of China's exports by measuring export sophistication separately for ordinary and processing-trade transactions and for domestic and foreign firms.[3] This decomposition shows that almost three quarters of China's export sophistication growth can be attributed to processing trade, in line with previous findings (Lemoine and Unal-Kesenci, 2004; Amiti and Freund, 2010). In addition, virtually all of processing-trade's contribution to China's export sophistication came from foreign firms. We however find that the recent upgrading of China's trade has also involved domestic producers, and especially their ordinary trade activities which account for the remaining quarter of this growth.

Second, we estimate the relationship between export sophistication and real growth rates of provinces in China. As we rely on regional variations within a single country, we provide a test of Hausmann *et al.* (2007)'s model relating production structure to economic growth, with the advantage that, by comparing China's provinces, we can mitigate the problems of omitted variables related to different legal and institutional systems that arise in cross-country analysis. The cross-country empirical patterns found in Hausmann *et al.* (2007) continue to hold across the regions within China. We thus confirm the validity of Hausmann *et al.* (2007) in the Chinese context: regions specializing in sophisticated goods grow faster. Our results contrast with the criticisms of Yao (2009) and Xu (2010) by showing that, even at the sub-national level, export sophistication varies substantially, controlling for income, and that this difference in turn matters for growth. The relation of export sophistication to growth is robust to a number of sensitivity checks, and is

[3] Here and in the rest of the article, we define "foreign firms" as those with some foreign capital ownership: i.e. wholly foreign-owned firms as well as joint ventures (this latter including equity and non-equity joint ventures, and joint cooperatives).

not restricted to locations that are heavier exporters.

Third, we investigate whether the relationship between export sophistication and income per capita growth depends on the trade regime (processing or ordinary) and ownership type (domestic or foreign) of exporting firms. We find that export sophistication in the assembly sector bears no relation to real growth, consistently with the view that export upgrading in this sector should not be taken as a signal of Chinese technology adoption, but rather as an artefact due to China's role in the increasing international fragmentation of production. The contribution of assembly exports to the upgrading of China's exports should thus be put to one side for the measurement of the real improvement in the country's level of technology.

We find that growth-enhancement is limited to the ordinary export activities of domestic entities: no additional direct benefits pertain from the upgrading of foreign exporters, either in assembly or ordinary exports. This has important implications for China. The country adopted, starting in the early 1980s, a policy of opening to foreign investment, precisely in the hope that technological capabilities and management practices would spill over and bring about greater productivity and export performance and sustain higher growth rates. These policies were believed by many to be one of the key factors explaining both China's high-end export structure and its rapid growth (Rodrik, 2006). By way of contrast, we find that, even though foreign producers are the main contributors to export upgrading, foreign sophistication appears to have little relation to subsequent growth. Note however that our results do not exclude the possibility of positive spillovers from foreign-invested to domestic firms.

The remainder of this article is organized as follows. Section 2 presents our measure of export sophistication and the dataset used, and describes the recent evolution of China's export sophistication. Section 3 presents our empirical approach and discusses our results. Last, Section 4 concludes.

2 The Evolution of the Structure of Chinese Trade

2.1 Measuring export sophistication

Externalities in the production of goods, due to e.g. learning by doing (Arrow, 1962; Stokey, 1988), information diffusion (Hausmann and Rodrik, 2003), or to technological spillovers across goods (Hidalgo *et al.*, 2007), imply that countries specializing in goods generating higher externalities display higher growth rates. In particular, (Hausmann and Rodrik, 2003) argue that the the production of new goods in a country generates valuable information on the technology, which lowers the cost of production for subsequent producers. Hidalgo *et al.* (2007) argue that the development of specific capabilities for the production of a good makes it easier to produce a set of goods with similar requirements. Both mechanisms lead to indeterminacy in the set of goods in which a country successively specializes and in associated growth rates.

Lall and Zhang (2005) and Hausmann *et al.* (2007) have proposed an empirical method to identify goods with higher growth potential. Instead of making hypotheses about the growth potential of products and the mechanisms at the source of the differences between goods, these authors argue that one should rather assume that the export baskets of the most developed countries are revealing information about high externality goods. This leads to adopting an index of similarity of a country's exports with the exports of the most developed economies, as an indicator of a product's growth potential. This index of the "sophistication" of exports has been shown to be a predictor of growth (Hausmann *et al.*, 2007; Mishra *et al.*, 2011). We rely primarily on this index in our empirical exercise.

This index is constructed as follows. Each good k that a country can potentially produce and export has an intrinsic level of sophistication[4] $PRODY_k$, which is the

[4] While (Hausmann *et al.*, 2007) use the word "productivity" to describe sophistication at the good level, we prefer the terms sophistication, high quality or technological advancement.

weighted average of the income levels of good k 's exporters, where the weights correspond to the revealed comparative advantage of each country j in good k:[5]

$$PRODY_k = \frac{1}{C_k} \sum_j \frac{x_{jk}}{X_j} \times Y_j, \tag{I.1}$$

Here x_{jk} is the value of exports of good k by country j, X_j the total value of country j's exports and Y_j per capita income of country j, measured as the real GDP per capita in PPP. C_k acts as a normalization so that the coefficients sum to 1. The more good k weighs in the exports of rich countries, the higher is its $PRODY$, the more sophisticated it is considered to be.

The measure aims to avoid the direct determination of the intrinsic product features (the technology embedded in it, the specialized skills required to produce it, R&D investments, and so on). The measure instead infers, from observed patterns of trade, the products which require greater levels of development to be exported.

The sophistication level of country j's exports, denoted by $EXPY_j$, is then computed as the average level of sophistication of its export basket. This is the weighted sum of the sophistication levels associated with each exported good k, $PRODY_k$, with the weights being the shares of each good in the country's total exports. This thus reflects the degree of specialization of a country in high-$PRODY$ goods.[6]

$$EXPY_{jt} = \sum_k \frac{x_{jkt}}{X_{jt}} PRODY_k \tag{I.2}$$

We compute measures of product-level sophistication $PRODY$ for 1997[7] using

[5] The numerator of the weight, x_{jk}/X_j, is the value-share of the commodity in country j's overall export basket, while the denominator of the weight, $C_k = \sum_j (x_{jk}/X_j)$, sums the value-shares across all countries exporting the good.

[6] Or, equivalently, the similarity of a given export basket with that of the most-developed countries.

[7] The PRODY indicator is thus calculated with 1997 as reference year, the first year of our sample. This approach reduces the likelihood of any bias in the index. First, it is important to use a consistent sample of countries since non-reporting is likely to be correlated with income. Thus, constructing PRODY for different countries over different years could introduce serious bias into the index. In addition, the choice of 1997 helps to ensure that the index is not affected by the rise of China in international trade (or by any other evolution of world trade structure over the period).

the BACI world trade dataset.[8] This dataset, constructed using COMTRADE original data, provides bilateral trade flows at the 6-digit product level (Gaulier and Zignago, 2010).[9]

Tables A-2 and A-3 in the Appendix report the commodities with the highest and lowest PRODY values among all China's exports. As we would expect, items with low PRODY tend to be primary commodities (dried leguminous vegetables, nuts, jute), mainly exported by sub-saharan Africa countries. On the other hand, high PRODY are obtained for two sophisticated categories of watches in which Switzerland is the most relatively specialized country, one of the richest country in our sample. Among other high PRODY values one incidentally finds some products from extractive industries which happen to be also exported by some rich countries: this is the case for the Leucite (a mineral found in some lavas). Such occurences undoubtedly underline one caveat of the indicator. The rest of the top PRODY values are reached for two products of industrial chemistry (Butanal and Cyanoguanidine), and some type of photographic films. Other high PRODY are found for some mineral and chemical products (Leucite, Butanal and Cyanoguanidine) for which rich countries like Canada, Germany and Norway have a very high degree of specialization.

We then successively construct the $EXPY$ index for the export baskets of China, its international partners and Chinese localities (provinces and prefectures), as in Equation II.2. Our main source here is Chinese customs data, which report region-level exports and imports by 6-digit product over the 1997-2007 period.[10] One feature of interest in this dataset is that it allows us to differentiate between domestic

[8] The BACI dataset is downloadable from http://www.cepii.fr/anglaisgraph/bdd/baci.htm. World countries' real GDP per capita in PPP are taken from the World Development Indicators database (World Bank).

[9] The flow dataset is constructed using an original procedure that reconciles the declarations of exporters and importers. The harmonization procedure enables to extend considerably the number of countries for which trade data are available, as compared to the original dataset.

[10] To compute the $EXPY$ index for China's trade, the Chinese customs data were converted into the 1992 Harmonized system (HS) classification to match the 1992 classification used in the BACI dataset.

and foreign trading firms, and between processing trade and ordinary trade.[11]

Hausmann *et al.* (2007)'s $EXPY$ measure of sophistication has been criticized on a number of grounds. It has first been argued to be sensitive to the size of the country under consideration (Kumakura, 2007) and the choice of product nomenclature (Yao, 2009). Given these weaknesses, we will use an alternative measure of sophistication (the share of high-technology manufacture in total exports) to check that our results regarding the positive association between export sophistication and subsequent growth are robust. High-technology products are identified via Lall's classification of products by technological level (Lall, 2000). The two measures of export sophistication are closely related, as can be seen in Appendix Figure I.4. The coefficient of correlation between $EXPY$ and the share of high-tech products in exports across Chinese provinces was 61.2% in 1997, varying between 55.1% and 80.3% depending on the sample year.

2.2 China's export sophistication

Figure I.1 shows how EXPY varies across countries in 1997. China's sophistication is shown separately for the exports of domestic and foreign firms. This scatterplot of EXPY against per-capita GDP indicates, unsurprisingly given its construction, a similar pattern to that in Rodrik (2006): there is a strong correlation of 0.79 between these two variables in our sample of around 170 countries. Rich (poor) countries export products that tend to be exported by other rich (poor) countries. China is an 'outlier' in this relationship, in terms of both the product bundles exported by domestic and foreign firms. Note that the regression line in Figure I.1 refers to all 170 countries, while only some of these are illustrated in the Figure, to avoid swamping it. In 1997, the export bundle of domestic firms was as sophisticated (10800$) as that of Belarus, a country 2.5 times richer than China in PPP per capita terms; that

[11] The data also refer to a third ("Others") category that groups other flows such as aid, border trade and consignment. This represents overall less than 1% of total trade value in each year. When we consider the processing/ordinary trade distinction, this category is dropped.

of foreign firms was higher at 12500$, similar to that of Portugal, a country eight times richer than China in PPP per capita terms in 1997.

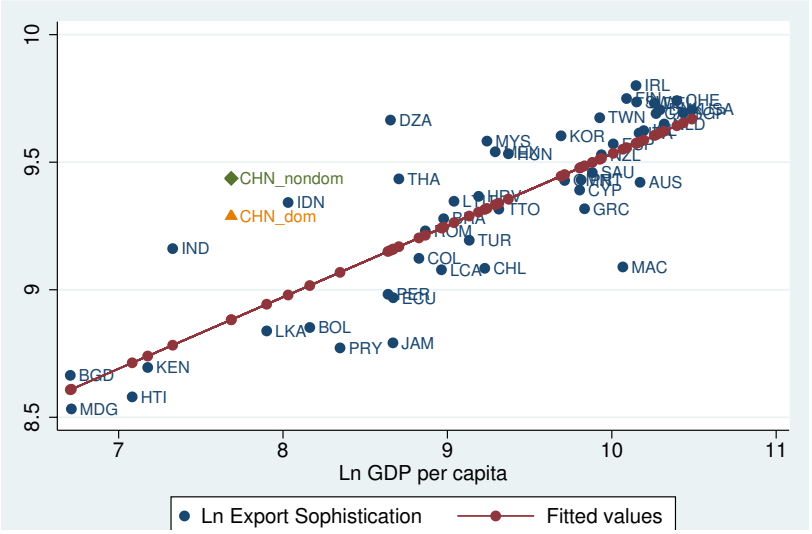

Figure I.1: The relationship between per-capita PPP GDP and EXPY (in logs), 1997. Source: Authors' computations based on BACI and WDI data.

Considering the evolution of China's sophistication over time, distinguishing between domestic and foreign firms, the recent upgrading of China's exports is not confined to foreign entities (which typically operate in processing trade), but also concerns domestic producers. The export sophistication of both types of exporters has risen rapidly. The income level associated with exports by domestic entities increased by 15.5% between 1997 and 2007. Over the same period that of foreign entities however rose even faster, by 25.7%, so that the gap between domestic and foreign export sophistication doubled from 1720$ to 3266$.[12] A similar message comes from the consideration of the share of high-tech products in exports as a measure of export sophistication.

2.3 Export sophistication in Chinese provinces

We now analyze the pattern of export sophistication across Chinese provinces. These exhibit considerable variation in industrial structure and overall development, which

[12] This rise is fully accounted for by the evolution of China's export structure, as the product-level index (PRODY) is computed for 1997 and is thus time-invariant.

translate into differences in export structure and sophistication. One important question for our analysis is to know how much of the variance in sophistication is accounted for by different levels of development across provinces.

Figure I.2 shows the relationship between real income per capita (in constant 2000 dollars) and export sophistication across provinces in 1997. The correlation between these two variables in our sample of 30 provinces is positive, with a figure of 0.60 in 1997,[13] which is somewhat lower than that in the cross-country sample (shown in Figure I.1).

Unsurprisingly, the five provinces ranking highest in export sophistication (Tianjin, Guangdong, Jiangsu, Ningxia and Shanghai) are amongst the richest provinces in real GDP per capita terms, with the exception of Ningxia, an interior province (see Figure I.5 in the Appendix for a map of the provinces). This latter province has a high export sophistication score thanks to its relative specialization in a number of sophisticated synthetic chemicals.[14]

Table I.1 shows that the provinces where particular policies of international trade and foreign-investment liberalization were put into place exhibit some of the highest levels of export sophistication.

[13] This varies between 0.32 and 0.68, depending on the year between 1997 and 2007.

[14] In particular 4.5% of Ningxia's total exports is made up of Cyanoguanidine, a molecule used in fertilizer, of which the most specialized exporters are Norway and Germany. The associated level of income, $PRODY$, for this product is the fifth highest (33,097 PPP $), which helps to explain Ningxia's high level of sophistication.

Table I.1: Summary statistics (by increasing order of sophistication in 1997)

Province	Sophistication 1997	Sophistication 2007	Share of High-Tech exports	No. of zones	GDP per cap. growth	GDP per cap. in $	Domestic firms' export share	Share of ordinary exports	Export ratio	Share in China's exports (in %)	Prefectures number
Guizhou	8307	8884	0.03	1	0.12	265	0.86	0.76	0.05	0.2	2
Inner Mongolia	8706	11327	0.05	1	0.18	570	0.86	0.65	0.05	0.4	3
Jiangxi	9110	12183	0.06	1	0.11	499	0.93	0.88	0.05	0.6	3
Xinjiang	9243	10000	0.02	2	0.08	737	0.92	0.67	0.04	0.3	1
Guangxi	9338	11411	0.02	2	0.11	473	0.83	0.81	0.10	1.2	7
Yunnan	9372	8958	0.06	1	0.08	484	0.96	0.81	0.06	0.6	2
Shanxi	9436	13621	0.01	1	0.11	568	0.90	0.78	0.06	0.6	4
Hainan	9523	12415	0.04	3	0.09	665	0.88	0.81	0.16	0.4	2
Anhui	9664	12922	0.06	2	0.10	526	0.87	0.70	0.05	0.8	9
Henan	9816	12150	0.06	2	0.12	532	0.82	0.72	0.03	0.7	12
Shandong	9962	12556	0.07	6	0.12	913	0.53	0.45	0.14	6.0	13
Jilin	10150	11024	0.06	3	0.13	664	0.72	0.66	0.05	0.5	6
Hubei	10242	12918	0.08	3	0.10	709	0.83	0.67	0.05	1.1	10
Shaanxi	10301	12647	0.12	2	0.15	439	0.90	0.80	0.08	0.7	4
Heilongjiang	10409	9738	0.13	3	0.08	871	0.79	0.57	0.04	0.7	7
Qinghai	10457	10667	0.01	0	0.11	491	0.97	0.98	0.05	0.1	1
Gansu	10623	10179	0.08	1	0.11	378	0.90	0.82	0.04	0.2	1
Sichuan	10786	12819	0.12	2	0.11	475	0.92	0.83	0.03	0.7	6
Hebei	10791	12787	0.05	3	0.11	731	0.80	0.81	0.07	1.8	11
Beijing	10892	15827	0.14	2	0.12	1761	0.87	0.69	0.42	5.3	1
Zhejiang	10914	13407	0.10	4	0.11	1262	0.76	0.73	0.18	5.5	10
Hunan	11079	11906	0.06	1	0.11	558	0.92	0.88	0.04	0.8	10
Liaoning	11164	12316	0.12	5	0.11	1044	0.61	0.50	0.21	5.0	13
Fujian	11245	12820	0.12	4	0.10	1103	0.48	0.39	0.28	5.6	8
Chongqing	11317	14436	0.07	0	0.14	535	0.92	0.88	0.05	0.4	1
Shanghai	11524	15253	0.17	2	0.09	2782	0.54	0.38	0.37	8.2	1
Ningxia	11730	12519	0.02	0	0.12	480	0.83	0.86	0.07	0.1	2
Jiangsu	11800	15594	0.20	7	0.12	1127	0.52	0.47	0.17	7.7	12
Guangdong	12324	14996	0.20	10	0.11	1251	0.50	0.24	0.84	40.8	18
Tianjin	13030	15628	0.34	2	0.13	1564	0.33	0.35	0.35	2.9	1

Values in 1997 except in Column 2 (2007) and in Column 5 which reports average GDP per capita growth between 1997 and 2007. Provinces in bold are located on the coast. Underlined provinces are those identified as the top five exporting provinces which will be excluded from the sample in Table I.2 to verify that the results do not only apply to high-export provinces. The export sophistication value is in 1997 PPP $ per capita. GDP per capita is expressed in dollars. Number of zones: count of the total number of special policy zones located in the province in 1997 (Wang and Wei, 2008). The last column shows the number of prefectures that are used in the prefecture-level regressions in Table I.4 and Table I.7. See the Appendix for the detailed definition of all variables.

The top five provinces in terms of sophistication include the top two provinces in terms of the number of special policy zones designed to attract foreign investors via tax rebates and subsidies (Guangdong and Jiangsu), as well as the two outward-oriented province-level cities of Shanghai and Tianjin.

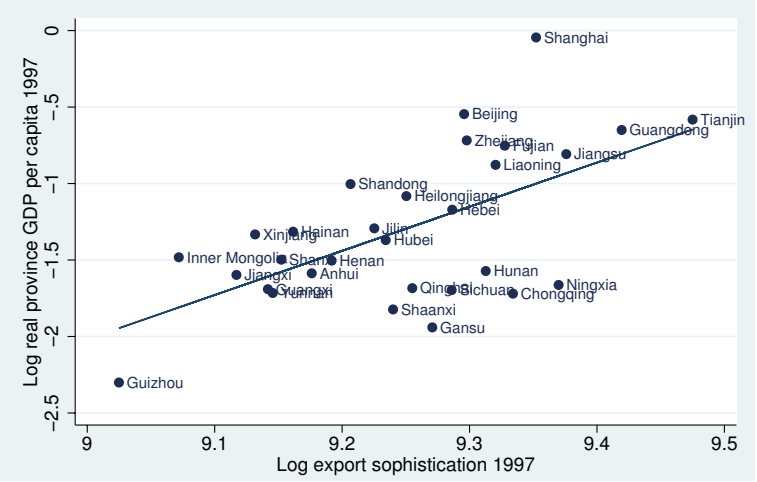

Figure I.2: Export sophistication and real GDP per capita, 1997. Note: The slope is 2.89 with a standard error of 0.64. Source: Authors' computations based on Chinese customs and China Statistical Yearbooks data.

In Figure I.3 we consider the relationship between export sophistication in 1997 and real income per capita growth rates between 1997 and 2009 across Chinese provinces, after controlling for initial levels of GDP per capita. The growth residuals are calculated from the regression of real income per capita growth rates between 1997 and 2009 on the log of GDP per capita in 1997. We find a strong correlation here, showing that the link between initial sophistication and subsequent growth does not simply reflect differences in terms of the initial levels of income.

It is worth noting the outlying position of Inner Mongolia. This province reports an average yearly nominal GDP per capita growth rate of 18% between 1997 and 2009, almost twice as high as the national average. This is largely due to the mining boom that took place in this province over the past 15 years, making it in 2009 the largest producer of coal in the country.[15]. We will control for this province's specificity using a dummy variable in the empirical estimations.

[15] The province's share of national production went from 7% in 2000 to 27.8% in 2011. In addition, extraction of germanium has also accelerated in the recent period (estimated 38% of global reserves)

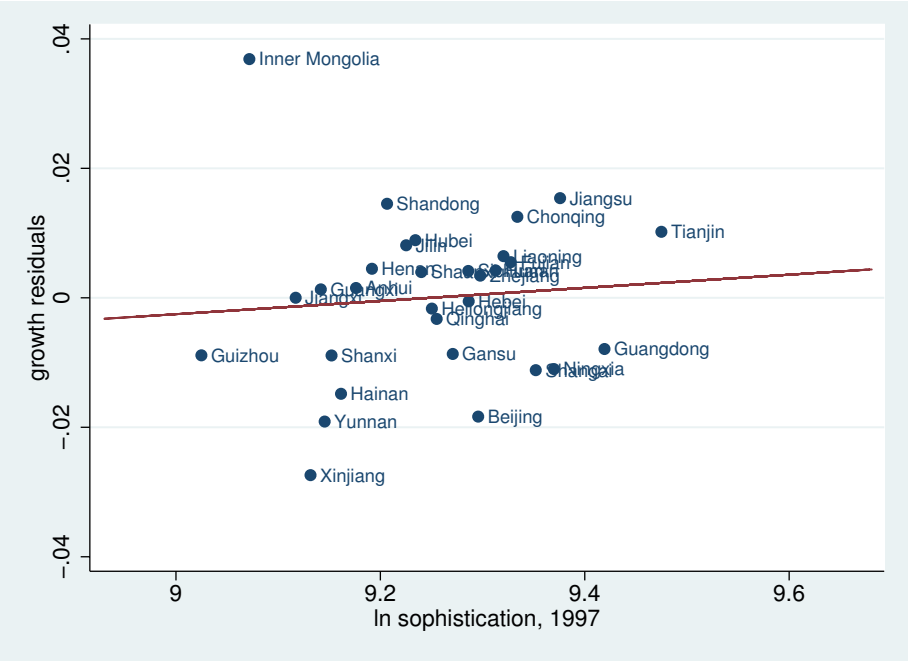

Figure I.3: Export sophistication and real GDP per capita growth (1997-2009) across China's provinces after controlling for Ln GDP per capita in 1997. Note: The slope, which is based on the sample excluding Inner Mongolia, is 0.051 with a standard error of 0.022. Source: Authors' computations based on Chinese customs and China Statistical Yearbooks data.

Figure I.6 in the Appendix presents a similar graph at the prefecture level. This confirms the positive, although weaker, relationship between export sophistication in 1997 and the subsequent real GDP per capita growth rate (1997-2007).

3 Empirical analysis

3.1 Baseline specification

Our baseline regression models the link between initial export sophistication ($EXPY$) and the subsequent growth rate of real GDP per capita, controlling for initial income and the traditional determinants of economic growth. We follow the specification in Table 8 of Hausmann *et al.* (2007), modelling a long difference in GDP per capita growth on initial EXPY, initial income and other controls. Our baseline estimations cover 30 provinces over 13 years from 1997 to 2009.

Our baseline regression takes the following form:

$$\frac{y_{i,2009} - y_{i,1997}}{12} = \alpha_0 + \alpha_1 y_{i,1997} + \beta \ln(EXPY_{i,1997}) + \gamma InvRate_{i,1997} + \delta HumCap_{i,1997} + \epsilon_i \quad \text{(I.3)}$$

where y denotes log real GDP per capita and i indexes our 30 provinces. The variable $EXPY$ is our indicator of export sophistication presented in Section 2. The logarithm of initial real GDP per capita is included to control for convergence across provinces. We also introduce the ratio of investment in fixed assets over GDP (the investment rate) to control for the rate of physical capital accumulation, and the share of population with more than secondary schooling as a proxy for human capital in the provincial workforce (Human Capital). Last, we include a dummy variable for the province of Inner Mongolia, which was identified as an outlier in terms of GDP per capita growth.

Various controls are included to mitigate omitted-variable problems. In the Chinese context, a number of geographical, institutional and political variables are likely to influence simultaneously trade performance and growth trajectories. We introduce dummy variables to capture coastal location and the province-level status of the four 'super cities' (Beijing, Tianjin, Shanghai and Chongqing). To control for differences in the progress of market-oriented reforms and privatization, we measure the weight of state-owned firms in the economy by their share in total investment (Demurger *et al.*, 2002) and (Boyreau-Debray, 2003). We also include the number of special policy zones,[16] as computed by Wang and Wei (2008). We finally control for trade openness (imports plus exports over GDP) and FDI inflows (FDI over GDP), as suggested by Barro (1991); Easterly *et al.* (1997) and Berthelemy and Demurger (2000) in the Chinese context. The summary statistics of all of the variables used in the regressions are displayed in Table A-1 in the Appendix.

We will then check that our results are robust by appealing to a within (fixed-effects) province estimator over three four-year sub-periods. As shown in Equation I.4, panel regressions will include both provincial and time dummies,

[16] Such zones were created by the government starting in 1979 in Guangdong, to promote industrial activity, innovation and export activities. They offer low-tax regimes and faster administrative procedures to favor industrial clustering. See the last column of Table I.1.

denoted by η_i and μ_t respectively.

$$\frac{y_{i,t+4} - y_{i,t}}{4} = \alpha_0 + \alpha_1 y_{i,t} + \beta \ln(EXPY_{i,t}) + \gamma InvRate_{i,t} + \delta HumCap_{i,t} + \eta_i + \mu_t + \epsilon_{i,t} \tag{I.4}$$

3.2 Regression results

3.2.1 The link between export sophistication and real growth

Baseline

Table I.2 shows the impact of export sophistication on long-run real GDP per capita growth. Our benchmark growth regression is in Column 1, and Column 2 adds some controls. The control variables attract coefficients with the expected signs. Initial real GDP per capita has a negative and significant coefficient, indicating convergence across Chinese provinces.[17] Our measure of human capital generally enters with positive and significant coefficient, while that of physical capital accumulation is insignificant. As expected, the openness rate and FDI over GDP attract positive signs, while that on the State share of investment is negative; these coefficients are however not significant. Our main variable of interest, initial export sophistication, attracts a positive and significant coefficient. Provinces whose export structure is more sophisticated achieve higher growth rates over the following 12-year period, conditional on all of the control variables included in the regression. Despite a lower level of significance, our results continue to hold when province-level sophistication is proxied by the share of high-technology products in exports (Column 3).

We can interpret the magnitude of the estimated coefficients in Column 2. Holding other factors constant, a 10% increase in export sophistication (corresponding to the standard deviation divided by the mean, as shown in the summary statistics in Appendix Table A-1) raises the average annual real income per capita growth

[17] However, we should acknowledge that the negative coefficient on initial real GDP per capita in Table 2 and subsequent tables may in part reflect measurement error in initial real GDP per capita, as suggested by Barro and Sala-i Martin (2003). Nevertheless, the finding of convergence across Chinese provinces is in line with much of the empirical literature on regional growth in China (Demurger, 2001).

Table I.2: Cross-section (province): sophistication and real GDP per capita growth 1997-2009

Dependent variable	Province real GDP per capita growth 1997-2009					
	(1)	(2)	(3)	(4)	(5)	(6)
					No top 3	No top 5
Initial Real GDP per capita	-0.021^b	-0.043^a	-0.040^b	-0.044^a	-0.043^b	-0.040^c
	(0.009)	(0.013)	(0.014)	(0.015)	(0.020)	(0.022)
Export sophistication	0.079^b	0.074^a		0.063^b	0.065^c	0.067^c
	(0.030)	(0.025)		(0.027)	(0.034)	(0.032)
Share of HT exports			0.070^c			
			(0.039)			
Inner Mongolia	0.065^a	0.069^a	0.058^a	0.070^a	0.070^a	0.069^a
	(0.006)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)
Investment rate	-0.004	0.002	0.004	0.001	0.002	0.005
	(0.011)	(0.014)	(0.015)	(0.017)	(0.019)	(0.020)
Human Capital	0.022	0.035^b	0.037^c	0.031^c	0.029	0.032
	(0.014)	(0.015)	(0.019)	(0.017)	(0.018)	(0.025)
Coastal Province dummy		0.010	0.010	0.012	0.008	0.008
		(0.009)	(0.010)	(0.009)	(0.009)	(0.009)
Openness rate		0.005	0.005	0.001	0.003	0.002
		(0.005)	(0.005)	(0.006)	(0.007)	(0.008)
FDI over GDP		0.001	-0.001	0.001	0.000	0.002
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Share of state in investment		-0.010	-0.014	-0.005	-0.007	-0.006
		(0.012)	(0.016)	(0.013)	(0.014)	(0.017)
Province-level city dummy				0.013	0.015^c	0.009
				(0.008)	(0.009)	(0.013)
Number of policy zones				0.002	0.003	-0.001
				(0.002)	(0.003)	(0.004)
Observations	30	30	30	30	27	25
R^2	0.551	0.669	0.598	0.687	0.687	0.707

Heteroskedasticity-robust standard errors are shown in parentheses: ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Column 5 reports the results without the three main exporters (Guangdong, Shanghai and Jiangsu), and Column 6 further excludes Shandong and Fujian. The values of the control variables refer to the beginning of the sample period.

rate over the following 12-year period by about 0.7 percentage points. This figure is of the same order of magnitude as the figure of 0.5 obtained by (Hausmann *et al.*, 2007) based on cross-country panel data over the 1962-2000 period.

As noted above, a number of Chinese provinces are clearly different from the rest, in terms of location and policy particularities which have made them richer, faster-growing, and more open, and more likely to export more sophisticated goods. In Columns 4 to 6, we check whether these results are driven by specific province features. Column 4 adds a dummy variable for the four province-level cities and

controls for the number of policy zones. In Columns 5 and 6, we exclude the top three (Guangdong, Shanghai and Jiangsu) and top five (as before plus Shandong and Fujian) exporting provinces, respectively, from the sample; the sample size consequently drops to 27 and 25 respectively. Despite the smaller number of observations, it is striking that the growth elasticity of export sophistication remains significant and of the same size as before, so that the positive relationship between export sophistication and growth is not confined to trade-oriented provinces; even though these are undoubtedly the most important contributors to both the volume and the high-range composition of Chinese exports.

Robustness checks

The cross-section estimates above suggest a pattern which is robust to the introduction of a number of controls, as well as to the exclusion of the provinces which seem to summarize best the export sophistication-growth link. There remain two major limitations: the small number of observations, and potential omitted variables, due to our limited capacity to control, in cross-section analysis, for structural differences between Chinese provinces.

We address these issues in turn. We first apply a fixed-effect estimator to our province-level panel dataset. We then consider data at the prefecture level, which is the administrative unit below the province, to produce cross-section estimates on a larger sample. The corresponding results are found in Tables I.3 and I.4, which follow the same presentation order as Table I.2.

Table I.3 applies a within (fixed-effects) estimator to a province-level panel covering three four-year sub-periods (1997-2001, 2001-2005 and 2005-2009). The results here confirm that the positive relationship between export sophistication and growth does not just reflect differences in time-invariant variables (such as geography or institutions). The inclusion of time dummies controls for any time-varying variables which are common to all provinces (nation-wide reforms, external

Table I.3: Within regressions (province): sophistication and real GDP per capita growth between 1997 and 2009 (3× 4-year sub-periods)

Explained variable	Province real GDP per capita growth 1997-2009, (3× 4-year sub-periods)					
	(1)	(2)	(3)	(4)	(5)	(6)
					no top 3	no top 5
Initial Real GDP per capita	-0.139^a	-0.135^a	-0.119^a	-0.132^a	-0.134^a	-0.129 ^{a}
	(0.036)	(0.038)	(0.040)	(0.037)	(0.037)	(0.038)
Export sophistication	0.150^a	0.144^b		0.150^b	0.155^b	0.157^b
	(0.050)	(0.055)		(0.067)	(0.069)	(0.071)
Share of HT exports			0.084^c			
			(0.044)			
Investment rate	0.076^a	0.075^a	0.080^a	0.075^a	0.084^a	0.086^a
	(0.012)	(0.011)	(0.014)	(0.012)	(0.014)	(0.013)
Human Capital	0.088^c	0.070	0.054	0.080	0.103	0.118
	(0.045)	(0.057)	(0.056)	(0.077)	(0.079)	(0.086)
Openness rate		-0.006	-0.009	-0.004	-0.003	-0.004
		(0.009)	(0.009)	(0.014)	(0.015)	(0.016)
FDI over GDP		0.000	0.000	-0.000	-0.001	-0.001
		(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Share of state in investment		0.013	0.018	0.012	0.009	0.001
		(0.019)	(0.018)	(0.020)	(0.021)	(0.023)
Number of policy zones				-0.001	-0.001	-0.002
				(0.004)	(0.005)	(0.006)
Fixed effects	Province fixed effects and year fixed effects					
Observations	90	90	90	90	81	75
R^2	0.807	0.811	0.785	0.812	0.816	0.820

Heteroskedasticity-robust standard errors are shown in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level. Column 5 reports the results without the three main exporters (Guangdong, Shanghai and Jiangsu), and Column 6 further excludes Shandong and Fujian. The values of the control variables refer to the beginning of the 4-year period.

demand etc.). The coefficient on sophistication is higher here at 0.15, but does not appear to be significantly different from that in the previous cross-section estimates.

We next estimate Equation I.3 on a cross-section of prefectures, using Customs trade data at the prefecture level for 1997 to calculate sophistication. Combining this with prefecture-level information (GDP, population, investment, education)[18] for 1997 and 2007 (the most recent year available), we obtain a cross-section of 181

[18] The data are taken from China Data Online provided by the University of Michigan. Unfortunately, the coverage of this database is more limited than the Customs dataset (220 prefectures from 1997 through 2007), which effectively constrains the ultimate sample for the statistical analyses. See Appendix for definitions of variables and data sources.

Table I.4: Cross-section (prefecture): sophistication and real GDP per capita growth 1997-2007

Explained variable	Prefectures real GDP per capita growth 1997-2007					
	(1)	(2)	(3)	(4)	(5)	(6)
					no top decile	no policy zone
Initial Real GDP per capita	-0.004	-0.013^{c}	-0.011^{c}	-0.012^{c}	-0.013^{c}	-0.015^{c}
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)
Export sophistication	0.028^{c}	0.030^{b}		0.030^{b}	0.025^{c}	0.031^{c}
	(0.016)	(0.015)		(0.015)	(0.015)	(0.016)
Share of HT exports			0.029^{c}			
			(0.016)			
Investment rate	0.019^{b}	0.016^{b}	0.015^{b}	0.016^{b}	0.017^{a}	0.027^{a}
	(0.008)	(0.007)	(0.007)	(0.007)	(0.006)	(0.008)
Human Capital	0.000	-0.004	-0.004	-0.003	-0.007	0.014
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.021)
Province-level city dummy		-0.009	-0.007	-0.009	-0.015^{c}	-0.010
		(0.008)	(0.008)	(0.008)	(0.009)	(0.008)
Openness rate		0.009^{a}	0.009^{a}	0.009^{a}	0.010^{a}	0.010^{a}
		(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
FDI over GDP		-0.003	-0.003	-0.003	-0.003	-0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Policy zone dummy				-0.002	0.001	n.a.
				(0.008)	(0.007)	n.a.
Observations	181	181	181	181	163	125
R^2	0.094	0.192	0.178	0.192	0.247	0.322

Heteroskedasticity-robust standard errors are shown in parentheses: ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. The values of the control variables refer to the beginning of the sample period. Column 5 reports the results without the top decile of exporting prefectures, and column 6 shows the results estimated only on prefectures with no policy zones.

prefectures, covering 90% of China's export value in 1997.[19] Table I.4 shows the impact of export sophistication in 1997 on the subsequent 10-year average real GDP per capita growth rate at the prefecture level.

Column 1 shows the benchmark growth regression. Column 2 adds some controls. The investment and openness rates enter positively and significantly, while human capital attracts a positive but insignificant coefficient. The initial level of export sophistication continues to be a positive and significant determinant (although only at the 10% confidence level in some specifications) of the subsequent growth of GDP per capita. Column 3 checks that this positive association is robust to measuring

[19] They cover the entire Chinese territory. The number of prefectures by province is reported in Table I.2.

sophistication using Lall's (2000) classification.

Our results are in addition robust to the control and exclusion of the most outwardly-oriented prefectures. Column 4 adds a dummy for prefectures which host a policy zone: this is insignificant and its inclusion does not change our previous findings. Column 5 excludes the top decile of exporting prefectures, while Column 6 drops prefectures hosting a policy zone (based on Wang and Wei (2008)). The positive impact of sophistication remains, confirming that it is not limited to locations with preferential trading and investment policies.

3.2.2 Decomposition of export sophistication in China

Our results so far have suggested that specialization in innovative, high-tech products is beneficial, in real growth terms, for both countries and Chinese regions. This would seem at first sight to be an ex post validation of China's industrial and trade policy over the past 30 years, which strongly encouraged export development and supported foreign investment, in the hope of positive technological spillovers. However, the provinces and prefectures which spearheaded these open-door policies - those which were initially chosen by the government to host special economic zones dedicated to export development, and which as a consequence grew into huge investment and export hubs - are seemingly not those where the growth benefits of export upgrading are the most apparent. Controlling for these areas' special features, or alternatively excluding them from the analysis altogether, does not affect our estimates in any significant way.

One possible explanation, as mentioned in our introduction, is processing trade. When calculating export sophistication we need to account for processing export activities, where the sophistication of exports may not generate growth gains, as it does not reflect the characteristics of the local production, but rather those of imported inputs. We will check this by (1) seeing whether it is the sophistication of imports that is actually driving our results; and (2) distinguishing between trade types and firm-ownership categories. Doing so will allow us to test whether China's

unique processing-trade regime systematically upwardly distorts the 'true' level of export sophistication. Moreover, this will address the possibility that the positive growth externalities from sophisticated exports are conditional on the trade regime. To see whether they are also conditional on exporting firm types, we will further decompose the total effect of export sophistication on growth into the contributions of domestic and foreign firms, relying on the firm-ownership information in the Customs data.

Tables I.5, I.6 and I.7 disentangle the roles of trade regime and firm type in the growth-sophistication relationship, for provinces in cross-section and in panel, and in a cross section of prefectures, respectively. Each table proceeds in three steps. We first introduce separately the sophistication level of imports[20] and exports. In the first column of each table, the coefficient on import sophistication is insignificant, while that on export sophistication remains positive and significant, and of the same size as beforehand. Importing sophisticated inputs (or capital goods) does not seem to yield direct gains in growth. This finding is robust to the addition of other control variables (in Column 2 of each table).

In a second step, the next two columns (3 & 4) of each table introduce separate (province or prefecture) export-sophistication indices ($EXPY$) for the processing and ordinary export baskets. We also control for the share of ordinary trade in the total export value of the region. We obtain, in each case, a positive and significant coefficient only for the ordinary component of trade, while processing exports sophistication is not correlated with growth.

[20] This is computed analogously to that for exports, by applying the formula in Equation II.2 to the import basket of a given region, yielding the average value of the product-level index $PRODY$ in imports, weighted by import shares.

Table I.5: Decomposing export sophistication: cross-section (provinces)

Dependent variable	Province real GDP per capita growth 1997-2007							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial Real GDP per capita	-0.034^{b}	-0.036^{b}	-0.036^{b}	-0.036^{b}	-0.037^{c}	-0.039	-0.037^{c}	-0.040
	(0.013)	(0.015)	(0.015)	(0.017)	(0.018)	(0.023)	(0.018)	(0.024)
Export sophistication	0.074^{b}	0.063^{b}						
	(0.027)	(0.029)						
Import sophistication	0.008	-0.001						
	(0.023)	(0.030)						
Ordinary export sophistication			0.091^{a}	0.080^{b}				
			(0.030)	(0.028)				
Processing export sophistication			-0.009	-0.016				
			(0.016)	(0.015)				
Share of ordinary trade in exports			-0.005	0.001	-0.003	0.002	-0.004	0.001
			(0.014)	(0.017)	(0.019)	(0.023)	(0.016)	(0.024)
Domestic export sophistication:					0.074^{c}	0.077^{b}		
					(0.039)	(0.036)		
- Domestic ordinary							0.079^{b}	0.075^{b}
							(0.035)	(0.031)
- Domestic processing							-0.013	-0.011
Export							(0.022)	(0.022)
sophistication: - Foreign ordinary					0.010	0.002	0.006	0.002
					(0.018)	(0.019)	(0.018)	(0.021)
- Foreign processing					-0.002	-0.016	0.004	-0.007
					(0.024)	(0.024)	(0.022)	(0.025)
Investment rate	-0.005	-0.001	-0.006	0.001	-0.013	-0.009	-0.009	-0.002
	(0.012)	(0.017)	(0.011)	(0.018)	(0.013)	(0.018)	(0.012)	(0.018)
Human Capital	0.025	0.022	0.019	0.012	0.037^{c}	0.033	0.023	0.021
	(0.015)	(0.016)	(0.016)	(0.015)	(0.020)	(0.019)	(0.024)	(0.023)
Openness rate	0.007	0.002	0.011^{b}	0.004	0.010^{c}	0.002	0.012^{b}	0.005
	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.007)
FDI over GDP		0.001		0.002		0.002		0.003
		(0.005)		(0.004)		(0.005)		(0.005)
Inner Mongolia	0.068^{a}	0.069^{a}	0.067^{a}	0.072^{a}	0.064^{a}	0.069^{a}	0.068^{a}	0.073^{a}
	(0.007)	(0.008)	(0.006)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Number of policy zones		0.002		0.003^{c}		0.003		0.003
		(0.002)		(0.002)		(0.002)		(0.002)
Province-level city dummy		0.015		0.020^{b}		0.024^{c}		0.021^{c}
		(0.011)		(0.008)		(0.012)		(0.010)
Observations	30	30	30	30	29	29	29	29
R^2	0.613	0.641	0.654	0.707	0.641	0.707	0.680	0.736

Heteroskedasticity-robust standard errors are shown in parentheses: ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels respectively. All of the control variables refer to the beginning of the sample period.

The third step further decomposes export sophistication by trade regime and firm ownership. In Columns 5 and 6 of each table, foreign-firm export sophistication is decomposed into its processing and ordinary components. We thus test if foreign sophistication whether in ordinary or processing has an effect on subsequent economic growth. Finally, in the last two columns (7 & 8), export sophistication is split into its four components of processing and ordinary trade, separately for domestic and foreign entities.[21]

The results consistently show that the sophistication of foreign firms' exports has no direct impact on growth, even when distinguishing exports by assembly/ordinary sector. The upgrading of production capabilities by foreign producers does not then generate positive externalities, even when they use China for ordinary trade and produce the major part of their value-added there. The growth premium seems to be generated exclusively by domestic firms, operating in the ordinary trade regime.

These findings bring new light to the so-called sophistication debate regarding China. A number of pieces of work have suggested that export sophistication in China is closely linked to the assembly-trade sector and the presence of foreign firms (Wang and Wei, 2008; Xu and Lu, 2009). Our results are entirely consistent with this pattern, as shown by the casual observation of province-level statistics on export sophistication and structure (see Table I.1). The main driver of China's export sophistication between 1997 and 2007, accounting for 75% of the rise, is upgrading in processing trade from foreign firms. We show, however, that the increase in and upgrading of processing exports may not have generated growth benefits. Decomposing China's export sophistication by trade regime and firm type reveals that the highest export growth and greatest upgrading did not coincide with the highest growth benefits. Only upgrading of ordinary exports by domestic firms is positively and significantly associated with subsequent economic growth, despite

[21] By doing so we lose some observations, due to the absence of some export categories in some regions. In the province-level sample, Qinghai is dropped when foreign export sophistication is split into processing and ordinary trade, as in 1997 no foreign firm operated in processing trade there. The number of observations is lower in Tables I.6 and I.7 for similar reasons.

its limited role in the rise in Chinese overall export sophistication. This is consistent with Koopman et al. (2008), who find that exports from domestic firms embody the greatest domestic value-added share; wholly foreign-owned firms have the lowest share of domestic value-added (28% compared to 82% for private domestic firms in 2006). They note that the share of domestic content is negatively correlated with reliance on processing exports.

In this sense, we are in line with the literature arguing that processing and ordinary trade cannot be mixed together. Our results suggest that these two differ intrinsically with respect to their characteristics and their potential benefits. Ordinary export sophistication seems to reflect genuine technology adoption and capacity building, in contrast to processing-export sophistication. Trade regimes and firm types therefore need to be distinguished with respect to the growth implications of technological progress.

It should be noted however that we do not think that the absence of a direct effect of foreign firms' export sophistication on economic growth, once that of domestic firms is taken into account, proves that foreign-owned firms, or even processing trade, has no positive growth impact at all. The rationale behind China's FDI attraction policy was the hope of spillovers from foreign-owned to domestic firms. That the upgrading of domestic firms' exports, which has positive growth effects, comes about due to such spillovers, is a possibility that we have not examined here. While some recent work has found only little evidence of such technological spillovers in China (e.g. Blonigen and Ma (2007)), there may still be room for indirect effects of foreign on domestic firms via emulation or export spillovers, as suggested by (Mayneris and Poncet, 2010). These results together with ours do call for more research on the real growth benefits of China's foreign investment policy.

Table I.6: Decomposing export sophistication: panel fixed-effect regressions on provinces (3× 4-year sub-periods)

Explained variable	Province real GDP per capita growth 1997-2009, (3× 4-year sub-periods)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial Real GDP per capita	-0.141^a	-0.137^a	-0.123^a	-0.120^a	-0.130^a	-0.122 ^{a}	-0.124^a	-0.115^a
	(0.036)	(0.035)	(0.032)	(0.033)	(0.029)	(0.028)	(0.027)	(0.027)
Export sophistication	0.147^a	0.155^b						
	(0.053)	(0.061)						
Import sophistication	0.005	0.007						
	(0.012)	(0.014)						
Ordinary export sophistication			0.082^c	0.086^c				
			(0.045)	(0.048)				
Processing export sophistication			0.019	0.019				
			(0.018)	(0.018)				
Share of ordinary trade in exports			0.052^a	0.054^a	0.045^a	0.047^a	0.062^a	0.066^a
			(0.012)	(0.013)	(0.008)	(0.008)	(0.012)	(0.013)
Domestic export sophistication:					0.120^b	0.131^a		
					(0.046)	(0.047)		
- Domestic ordinary							0.094^b	0.103^b
							(0.041)	(0.045)
- Domestic processing							-0.009	-0.011
Export							(0.013)	(0.014)
sophistication: - Foreign ordinary					0.031	0.034	0.023	0.026
					(0.024)	(0.024)	(0.023)	(0.022)
- Foreign processing					0.021	0.019	0.032	0.034
					(0.028)	(0.027)	(0.029)	(0.029)
Investment rate	0.076^a	0.078^a	0.065^a	0.064^a	0.067^a	0.066^a	0.072^a	0.076^a
	(0.012)	(0.012)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)	(0.011)
Human Capital	0.081	0.094	0.119^a	0.126^b	0.122^b	0.151^b	0.098	0.114
	(0.049)	(0.070)	(0.042)	(0.059)	(0.050)	(0.065)	(0.059)	(0.075)
Openness rate	-0.006	-0.003	0.007	0.009	0.009	0.015	0.014	0.020
	(0.009)	(0.015)	(0.009)	(0.013)	(0.009)	(0.011)	(0.010)	(0.014)
FDI over GDP		-0.001		0.001		0.001		-0.003
		(0.003)		(0.002)		(0.004)		(0.004)
Number of policy zones		-0.002		-0.002		-0.003		-0.003
		(0.004)		(0.003)		(0.003)		(0.003)
Fixed effects	Province fixed effects and year fixed effects							
Observations	90	90	90	90	88	88	88	88
R^2	0.809	0.810	0.831	0.832	0.851	0.855	0.847	0.850

Heteroskedasticity-robust standard errors are shown in parentheses. Standard errors are clustered at the province level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. All of the control variables refer to the beginning of the sample period.

Table I.7: Decomposing export sophistication: cross-section (prefectures)

Explained variable	Prefecture real GDP per capita growth 1997-2007							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Initial Real GDP per capita	-0.014^{c}	-0.012^{c}	-0.014^{b}	-0.012^{c}	-0.013^{c}	-0.010	-0.013^{c}	-0.010
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Export sophistication	0.029^{c}	0.030^{b}						
	(0.015)	(0.015)						
Import sophistication	-0.001	0.000						
	(0.009)	(0.009)						
Ordinary Export sophistication			0.046^{a}	0.047^{a}				
			(0.015)	(0.014)				
Processing Export sophistication			-0.005	-0.003				
			(0.010)	(0.010)				
Share of ordinary trade in exports			0.001	0.001	-0.001	-0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Domestic Export sophistication:					0.034^{b}	0.035^{b}		
					(0.015)	(0.014)		
- Domestic ordinary							0.041^{a}	0.042^{a}
							(0.014)	(0.013)
- Domestic processing							-0.006	-0.005
Export							(0.008)	(0.008)
sophistication: - Foreign ordinary					0.001	-0.001	-0.005	-0.006
					(0.010)	(0.010)	(0.010)	(0.011)
- Foreign processing					-0.010	-0.008	-0.008	-0.005
					(0.008)	(0.008)	(0.009)	(0.009)
Investment rate	0.016^{b}	0.016^{b}	0.015^{b}	0.015^{b}	0.016^{b}	0.015^{b}	0.016^{b}	0.016^{b}
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
Human Capital	-0.004	-0.003	-0.005	-0.003	-0.004	-0.002	-0.005	-0.002
	(0.005)	(0.006)	(0.005)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)
Openness rate	0.007^{a}	0.009^{a}	0.009^{a}	0.010^{a}	0.007^{a}	0.009^{a}	0.008^{a}	0.010^{a}
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
FDI over GDP		-0.003		-0.003		-0.004		-0.004
		(0.002)		(0.002)		(0.002)		(0.003)
Policy zone dummy		-0.002		-0.003		-0.004		-0.006
		(0.008)		(0.008)		(0.008)		(0.008)
Province-level city dummy		-0.009		-0.008		-0.005		-0.005
		(0.008)		(0.009)		(0.009)		(0.009)
Observations	181	181	176	176	172	172	159	159
R^2	0.178	0.192	0.196	0.209	0.179	0.198	0.175	0.198

Heteroskedasticity-robust standard errors are shown in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. All of the control variables refer to the beginning of the sample period.

4 Conclusion

We have here carried out a test of Rodrik (2006)'s conjecture that China's growth and export performance are linked to its capacity to upgrade its exports.

We adapt Hausmann *et al.* (2007)'s cross-country specification to study the link between sophistication of exports and subsequent growth across province and cities in China. We find that, even at the province and city level, there is considerable variation in export sophistication, controlling for the level of development, and that this variation in turn matters for growth. We find however that the growth gains from improved technology only come about when the latter is developed by domestic-owned firms and embedded in ordinary trade. This suggests that the different sources (export regime and firm type) of Chinese export upgrading must be distinguished for the true measurement of the improvement in technology and its implications for economic growth. In this respect, fruitful avenues for further research include the identification of the sectors which contribute to export sophistication, as well as the potential links between particular sectors with rising sophistication in different provinces and provincial regulations and export promotion activities.

I.A Appendix: additional specifications

Tables I.8 and I.9 further decompose import sophistication into its processing and ordinary components, in order to test whether a higher sophistication of imported inputs entering the production of exports lowers the sophistication-growth relationship. In theory, one would expect a negative sign to capture the fact that the sophistication of exported *value-added* should matter for growth. Then, for a given level of export sophistication, a lower level of sophistication of inputs used in the production of exports should signal that domestic valued-added contributes more to the sophistication of the final good. However, note that our data do not allow us to observe inputs entering the in the production of exports: in particular, ordinary imports are not decomposed into final goods, inputs entering production sold domestically, and inputs entering export production. This is likely to explain the absence of significant impact on the ordinary import sophistication variable.

Table I.8: Decomposing import sophistication: provinces

	Real GDP p.c. growth: average 1997-2009		4-year average growth rate	
Initial Real GDP per capita	-0.030^b	-0.032^b	-0.141^a	-0.137^a
	(0.012)	(0.015)	(0.037)	(0.038)
Export sophistication	0.063^b	0.043^c	0.147^a	0.155^b
	(0.025)	(0.024)	(0.052)	(0.065)
Import sophistication:	0.014	0.006	-0.008	-0.006
Ordinary	(0.019)	(0.020)	(0.014)	(0.012)
Import sophistication:	-0.021	-0.032^b	0.002	0.000
Processing	(0.013)	(0.013)	(0.017)	(0.018)
Investment rate	-0.014	-0.008	0.074^a	0.076^a
	(0.011)	(0.015)	(0.012)	(0.013)
Human Capital	0.026^c	0.020	0.079	0.091
	(0.013)	(0.013)	(0.050)	(0.077)
Openness rate	0.009^b	0.001	-0.008	-0.005
	(0.004)	(0.004)	(0.008)	(0.016)
FDI over GDP		0.004		-0.001
		(0.004)		(0.003)
Inner Mongolia	0.059^a	0.064^a		
	(0.007)	(0.008)		
Province-level city dummy		0.022^c		
		(0.011)		
Number of policy zones		0.003		-0.001
		(0.002)		(0.005)
			period fixed-effects	
Observations	30	30	90	90
R^2	0.651	0.712	0.809	0.810

Standard errors in parentheses

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Specification as in columns 1-2 of tables I.6 and I.5. Import sophistication is computed on ordinary and processing imports separately.

Table I.9: Decomposing import sophistication: prefectures

	(1)	(2)
	Real GDP growth	
Initial Real GDP per capita	-0.014^{c}	-0.012^{c}
	(0.007)	(0.007)
Export sophistication	0.032^{b}	0.033^{b}
	(0.016)	(0.016)
Import sophistication: ordinary	0.002	0.002
	(0.007)	(0.007)
Import sophistication: processing	-0.005	-0.004
	(0.009)	(0.009)
Investment rate	0.016^{b}	0.016^{b}
	(0.007)	(0.007)
Human Capital	-0.005	-0.003
	(0.005)	(0.006)
Openness rate	0.008^{a}	0.010^{a}
	(0.002)	(0.003)
Policy zone dummy		-0.003
		(0.008)
Province-level city dummy		-0.009
		(0.008)
FDI over GDP		-0.003
		(0.002)
Observations	178	178
R^2	0.181	0.197

Standard errors in parentheses

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Specification as in columns 1-2 of table I.7. Import sophistication is computed on ordinary and processing imports separately.

I.B Appendix: Variable Definitions and Statistical Sources

Macro-level data at the provincial and prefecture level (GDP, investment, and human capital) are taken from China Data Online, provided by the University of Michigan.

Dependent variable GDP per capita: logarithm of real GDP per capita (deflated by annual CPI)

Explanatory variables

Sophistication: Export sophistication is measured by the logarithm of $EXPY$ as defined in Equation II.2. This is computed based on trade flows from the China Customs database. Measures based on domestic (foreign) firms only are referred to as domestic (foreign) export sophistication: measures based on ordinary (processing) trade flows only are referred to as ordinary (processing) export sophistication. We also use the share of high-tech products in exports (as defined by Lall (2000)).

Other Control variables:

Investment rate: the logarithm of the share of gross fixed investment in GDP.

Human Capital: the province-level variable is the logarithm of the share of population aged 6 and over declaring educational attainment of secondary level or above. This is a stock measure of higher-education attainment. It is computed using data collected in the yearly national sample survey on population change, as the sum of people who have attained the junior secondary, senior secondary or college and higher levels. Since these data are not available at the prefecture level, we there appeal to the ratio of student enrollment in regular secondary schools to the total population.

Share of state in investment: the logarithm of the share of state entities in total investment in fixed assets.

Openness rate: the logarithm of the ratio of exports plus imports to GDP.

FDI over GDP rate: the logarithm of the ratio of foreign direct investment inflows to GDP.

Policy zone: we here construct two measures using the description of policy zones (special economic zones, economic and technological development zones, high-tech

industrial zones, and export-processing zones) at the prefecture level (which varies over time) developed by Wang and Wei (2008). At the prefecture level, we construct an economic zone dummy for the prefecture hosting a policy zone in 1997. At the province level, we construct a time-varying measure of the number of policy zones in the province. Coastal province dummy: This equals one when the location lies on the coast (i.e. Fujian, Guangdong, Guangxi, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin and Zhejiang).

Table A-1: Summary statistics at the province level

Variable	Mean	Std. Dev.	Min	Max
Average Growth rate 1997-2007	0.113	0.019	0.080	0.176
Initial Real GDP per capita	0.310	0.180	0.100	0.956
Export Sophistication	10442	1088	8307	13030
Share of high-tech exports	0.09	0.07	0.01	0.34
Investment rate	0.333	0.088	0.224	0.589
Human capital	0.467	0.105	0.242	0.702
Openness rate	0.261	0.365	0.038	1.464
FDI over GDP	0.041	0.046	0.001	0.169
Share of state in investment	0.607	0.148	0.375	0.863
Number of Policy zones	2.533	2.177	0	10

The table shows the average value over the 30 provinces in 1997. See Appendix for precise definitions of all variables.

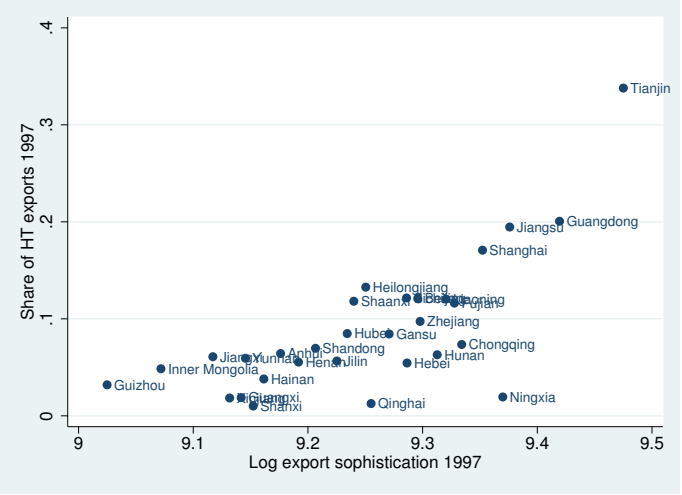

Figure I.4: Export sophistication and the share of HT in exports, 1997. Source: Authors' calculations based on Chinese Customs data.

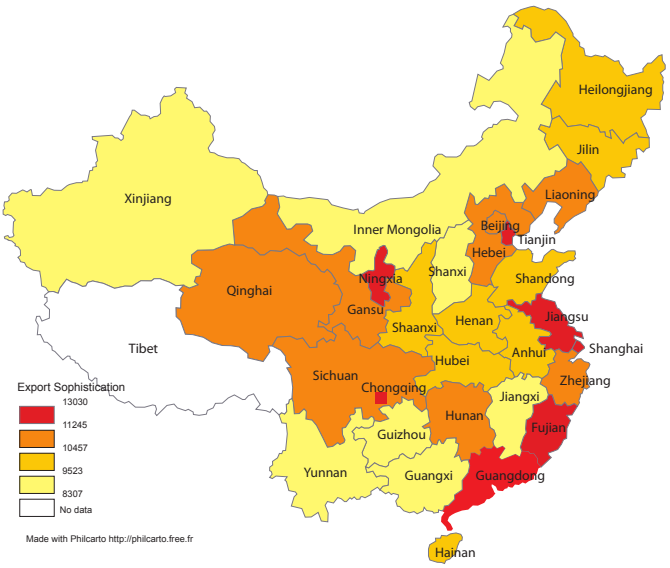

Figure I.5: Province-level export sophistication in 1997. Source: Authors' calculations based on Chinese Customs and China Statistical Yearbooks data.

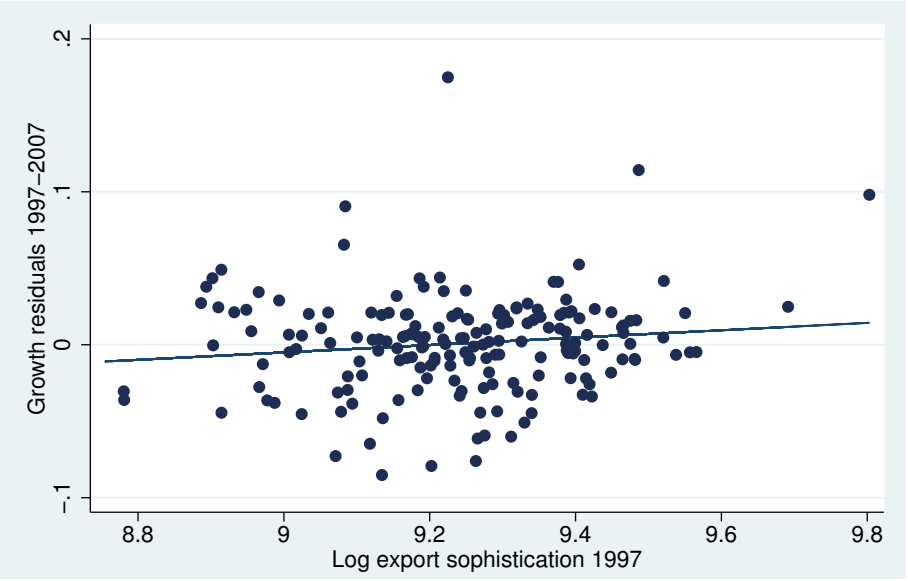

Figure I.6: Export sophistication and real GDP per capita growth (1997-2007) across China's prefectures after controlling for Ln GDP per capita in 1997. Note: The regression slope is 0.024 with a standard error of 0.015. Source: Authors' calculations based on Chinese Customs and China Statistical Yearbooks data.

*

Table A-2: Descriptive statistics: 6 products with highest 'PRODY' index exported by China in (1997)

Product name	Product code	PRODY	Most specialized countries	Exporting Provinces	Firm types	Export regime
Other wristwatches with automatic winding	910121	37339	Brunei, Switzerland	Guangdong	State, JV	Processing
Leucite, Nepheline and Nepheline syenite	252930	36682	Norway, Canada	Tianjin, Hainan Henan, Guangdong	State, JV, Col.	Ordinary
Butanal [Butyraldehyde, isomere normal]	291213	35344	United Arab E., Germany	Shanghai, Zhejiang, Inner Mongolia	State, JV	Ordinary
Wristwatches with precious metal box	910129	34906	Switzerland, Brunei	Guangdong, Fujian, Jiangsu, Shandong, Henan	State, JV, Foreign, Col.	Ordinary Processing
1-Cyanoguanidine	292620	33097	Norway, Germany	19 provinces	State, JV	Ordinary, Processing
Photographic film, width $>$ 105mm	370241	31937	US, France	Shandong	State	Ordinary

Values in dollars. Column 4 reports the two countries with the highest revealed comparative advantage in the product. See Equation (1). Firm types are classified in data into: State-owned, Collective, Private, Foreign, Joint-venture (JV), Others.

*

Table A-3: Descriptive statistics: 5 products with lowest 'PRODY' index exported by China in (1997)

Product name	Product code	PRODY	Most specialized countries	Exporting Provinces
Tanned or crust hides and skins of other animals	410612	987	Eritrea, Burkina Faso	Beijing Guangdong, Hebei, Henan, Jiangsu, Shandong
Jute and other textile bast fibres, raw or retted	530310	900	Bangladesh, Mali	Beijing Fujian, Jiangsu, Shandong, Tianjin, Xinjiang
Other oil seeds and oleaginous fruits	120792	895	Burkina Faso, Togo	Jiangxi
Coconuts, Brazil nuts and cashew nuts	080130	783	Guinea Bissau, Mozambique	Guangdong, Jilin, Zhejiang
Dried leguminous vegetables, shelled	071390	674	Myanmar, Malawi	22 provinces

Values in dollars.

Chapter II

Credit constraints, firm ownership and the structure of Exports in China[1]

1 Introduction

It is now well established that the functioning of the financial sector has an impact on trade. At the macro level, the impact of the financial system on the volume of trade, and on the structure of exports across sectors, has been identified in cross-country studies (Beck, 2002; Berthou, 2010; Manova, 2008a). These studies establish that the pattern of international trade flows is consistent with the hypothesis of financial development acting as a source of comparative advantage: countries with more advanced systems export more in the sectors where credit is most needed or harder to obtain. In parallel, firm-level studies have shown how the financial constraints faced by a firm impact its decision to enter export markets, as well as the volume it will be able to export on these markets (Greenaway *et al.*, 2007; Muûls, 2012; Berman and Héricourt, 2010). These studies find a positive impact of a firm's financial health on export activity, an impact which appears to be more robust in developing countries studies than in developed economies.

[1] This chapter is based on my paper entitled "Export Performance and Credit Constraints in China" co-written with Sandra Poncet.

Although these two strands of the literature yield consistent results, there remains a gap between the two scales of observation they adopt. Firm-level studies emphasize the heterogeneity which exists between firms within a country, in their access to credit. However, by ignoring the firm-level impact of financial constraints, cross-country studies remain silent about how the link they observe between financial development and aggregate exports is channeled. If firms within a country face heterogeneous financial conditions, depending on their status or on their region of localization, one can expect that a pattern of specialization emerges across regions and across firm types, as it emerges across countries.

This chapter studies this pattern in the case of China. The specific evolution of this country's financial system has created two sources of disparities in financial conditions faced by firms in the country: the region of operation, as well as the ownership status (whether a firm is private, state-owned or partly or fully foreign-owned) command very different conditions of access to credit for the firms. We study here how these disparities contribute to shaping the structure of exports across regions (Chinese provinces) and across firm ownership groups. We adopt a scale of observation in between the micro (firm-level) and macro levels: by using data on exports aggregated by regions and by firm types, we put aside the lower level of individual firm heterogeneity, and concentrate on these two macro-level sources of financial inequality. We first ask whether financial heterogeneity within the country leads to a pattern of specialization, as it is the case across countries. Second, we study the impact of the recent liberalization of the banking system on export patterns across regions and firm types, and ask if it reduced financial inequality across firms.

Our results can be summarized as follows. First, we show that the ownership of firms in China commands differences in export structures. Foreign firms export relatively more in sectors where finance is most needed, i.e. where larger investments are required and/or returns to investment take more time to materialize. Private domestic firms, by contrast, are the least active in these sectors, consistent with abundant evidence of them being excluded from some formal credit markets. State-

owned firms, long described as facing "soft budget constraints" in China, exhibited in 1997 an advantage in finance-dependent sectors which has considerably eroded over the period 1997-2004.

Second, we ask what impact the liberalization of the banking sector, which has been implemented in this period, had on this pattern of specialization. We exploit inter-regional differences in the degree of liberalization, as proxied by the share of banks under direct state control, and find that this liberalization is associated with a reduction of the gap in export structures between firm types, in particular between private and foreign firms. In other words, the disadvantage of private firms in finance-dependent sectors is less apparent in the provinces where banks have been liberalized the most. This suggests that one effect of the liberalization was to dampen the differences in access to credit between private and foreign firms.

The case of China provides a case study of a developing economy which has experienced a fast transformation of its financial system. Abundant research has shown this financial system to be deficient and ineffective in its role of allocating capital across the economy (Boyreau-Debray, 2003; Dollar and Wei, 2007; Li *et al.*, 2008); pointing in particular to the control by the State over most of the banking sector, which leads to interferences and distortions in the allocation of bank credit; and to underdeveloped financial markets, which fail to provide firms with alternative sources of finance. Yet the remarkable performance of the economy over the past 15 years, in terms of growth (close to 10% yearly) and of exports (around 25% yearly growth), has lead some authors to present the country as a counter-example to the view that a well-functioning financial sector is a necessary and inextricable component of the growth process in general Levine (2005), and of export development in particular (Manova, 2008a). One explanation proposed as been that alternative mechanisms, such as informal finance, or the reliance on internal finance, have mitigated the impact of the deficient financial system (Cull *et al.*, 2009; Guariglia *et al.*, 2011). Another compensating mechanism has been suggested by Manova *et al.* (2011), who found that access to credit varies greatly across firm

types in China, with foreign-owned firms much less credit-constrained than private domestic firms. They hence argue that FDI can make up for imperfections in the domestic financial system and alleviate their impact on trade.[2]

Our analysis relies on recent developments in the theory and empirical study of finance and trade interactions. Theoretical modeling predicts that the efficiency of the financial sector has a higher impact on growth and export performance in industries intrinsically more dependent on external finance. This heterogeneity in sector-level dependence on finance provides a robust methodology to detect credit constraints and measure their evolution, as first proposed by Rajan and Zingales (1998). The incorporation of financial frictions in a heterogeneous-firm trade model à la Melitz (2003) allows formalization of the intuition that, if financial development promotes growth biased towards financially dependent industries,[3] then this impact should be even more apparent on export growth, because access to export markets is more demanding in terms of external finance, due to the presence of fixed costs of entry. Models by Chaney (2005) and Manova (2008b) predict that the efficiency of the financial system should affect the export structure, with the most dependent sectors being disadvantaged in environments with high distortions, but benefiting relatively more from improvements in financial system efficiency. Such patterns of exports have been found empirically in cross-country regressions by Beck (2003), Manova (2008a) and Berthou (2010) among others. We adopt this methodology to the within-country context.

Our paper confirms results in Manova *et al.* (2011) who posit that the ownership status of Chinese firms provides a plausible proxy for firms' access to the financing needed for export activities in an environment that features relatively weak financial institutions. Firms with partial and full foreign ownership can indeed be expected to rely on internal sources of funding from their foreign companies, which may help

[2] This claim that FDI may be used to alleviate the costs associated with the inefficient banking sector is also found in Guariglia and Poncet (2008) and Héricourt and Poncet (2009).

[3] In the rest of the paper we refer interchangeably to financially dependent or financially vulnerable sectors.

them to alleviate the credit constraints faced in exporting. Contrary to Manova *et al.* (2011), we do not use firm-level data but exploit data aggregated by firm type and by province. The focus of our study is hence on the macro-level impact of regional variations in the structure of the credit allocation system. Note that this approach thus relies on the inference of credit constraints based on financial system characteristics, rather than direct measurement of credit constraints based on firms' balance sheet variables Berman and Héricourt (2010) or on shock transmission through bank-firm relationships (Amiti and Freund, 2010). Our results are instead informative about the allocation of resources at the aggregate level; in particular, they incorporate information about the self-selection of firms into sectors, by firm type. We use differences across provinces in the timing of banking liberalization, to investigate how credit constraints are mitigated by this liberalization. The period covered by the data - 1997-2004 - is pertinent in this regard as it corresponds to a period of substantial liberalization of the financial system in China, with a diminution of state control over the banking sector. Our key contribution is to exploit the cross-province variation in financial development using the share of banking sector activity that is not directly state-influenced. This allows us to assess whether the association between these within-country differences in financial development and patterns of export specialization is consistent with a causal impact of financial development on export behavior.

The rest of this article is structured as follows. In the following section we describe China's financial sector and explain how the various banks' activities differ depending on their ownership. In Section 3, we present our data and our indicators of financial development. Section 4 provides some descriptive statistics on the structure of Chinese exports across provinces and firm types. In Section 5, we present our empirical approach and our results, showing that they are robust to various robustness checks. Section 6 concludes.

2 China's Financial and Banking System

This section provides a short background on the evolution of China's financial system to help understand the meaning of the indicators used to proxy for financial liberalization in China.

Before 1979, China's financial system consisted of a single bank: the People's Bank of China (PBOC), a central government owned and controlled bank under the Ministry of Finance, which served as both the central bank and as a commercial bank. Almost all financial transactions were handled by it according to the "cash plan" and "credit plan" Allen *et al.* (2009). After 1979, the PBOC became a separate entity, while three newly created state-owned banks took over some of its commercial banking businesses: the Bank of China (BOC), the People's Construction Bank of China (PCBC), and the Agricultural Bank of China (ABC). A fourth state-owned bank, the Industrial and Commercial Bank of China (ICBC), was created in 1984 and took over the rest of the commercial transactions of the PBOC. These four banks have held the main share of banking activity, accounting for 55% of deposits and 51% of credit nation-wide in 2004. They were wholly-owned by the state, until 2005-2006, when three of them became listed on Shanghai and Honk-Kong stock exchanges, introducing minority private ownership in their capital structure[4].

Direct state control over these four largest banks implies that lending decisions are largely based on policy rather than commercial motives, creating distortions in capital allocation in China (Boyreau-Debray and Wei, 2005; Dollar and Wei, 2007). These banks favored lending to state-owned enterprises even against profitability criteria (Allen *et al.*, 2009; Park and Sehrt, 2001). These four banks have been widely documented as conducting non-market credit allocation decisions. These may include discriminatory lending (e.g. among private firms), excessive lending to state-controlled firms leading to soft budget constraints, etc. Some of these banks serve to

[4] China Construction Bank's initial public offering (IPO) on Hong-Kong stock exchange took place on October 27th, 2005. This was followed by Bank of China's listing on the same market on June 1, 2006, then by ICBC's listing on October 27th, 2006 (simultaneously on Shanghai and Hong-Kong stock markets). The ABC went public in 2010.

channel funds toward projects which may be more politically-oriented than profit-oriented; this has the consequence of diverting funds from other possible uses, thus creating credit constraints for firms with profitable projects but insufficient political support for them. The literature finds these big 4 state banks to be much less efficient (Yao *et al.*, 2007; Shih *et al.*, 2007; Chen *et al.*, 2005). This inefficiency has become apparent in the large amounts of non performing loans (NPLs) accumulated by these four banks by the end of the 1990s, forcing the state to recapitalize them several times (notably in 1997 and 2002), and finally to partially privatize them (2006-2007). In parallel, a number of smaller credit institutions were allowed to develop starting in 1993. Their share of total bank assets rapidly grew to about 45%. These include 13 joint-stock banks whose shares are owned by jointly by the state and private sectors and are generally seen as the most market-oriented (Lin and Sun, 2009); city commercial banks, owned by local governments and firms, and private shareholders; and urban and rural credit cooperatives, which were transformed into commercial banks in 1996-1998. Finally, foreign banks were gradually allowed to open branches in China after 1996.

An important distinction between the big 4 state-owned Commercial Banks (SOCBs) and other banks in China is their full ownership by the state, which ceased in 2005-2006 for three of them that were listed publicly. By contrast, other banks have had a mixed ownership structure, with shareholders including urban enterprises, citizens and local governments (joint-stock banks), and foreign ownership. Using data on 35 City Commercial Banks and other joint-stock banks, Ferri (2009) finds that these "New Tigers" in the banking sector outperform the four SOCBs, and attributes this to a fundamental difference in governance structure.

The direct state control over the SOCBs leads these four banks to respond to non-market incentives in their credit allocation decisions. Berger *et al.* (2009) report that they have "historically faced pressures and instructions from central and local governments to grant policy loans for political purposes, rather than for profit maximization." One consequence is that private companies have been discriminated

against in the allocation of credit by these four banks, which favored state-owned firms instead (Wei and Wang, 1997). Park and Sehrt (2001) show that inefficient policy lending by state-owned banks has not diminished significantly even after the reforms of the 1990s. Brandt and Li (2002) observe that private firms have to use more expensive trade credit as a result of their limited access to bank credit. Firth *et al.* (2009) find that state minority ownership in firms' capital helps obtain credit from state-owned banks, which they interpret as evidence that political connections matter in lending decisions by these banks. As a second consequence of direct state control, the four SOCBs have been less efficient than other banks with mixed ownership structure, a fact that has been consistently found empirically in numerous studies. Berger *et al.* (2009), using the profit efficiency method for 1994-2003 data, calculate that the "big 4" are less than half as efficient as other domestic banks, and three times less efficient than foreign banks. Chang *et al.* (2010) find no correlation between credit growth of SOCBs and economic growth at the regional level, and attribute this to the low efficiency of SOCBs. Fu and Heffernan (2009) also find that joint-stock banks were more X-efficient during the 1993-2002 period, while the 4 SOCBs are found to have been less efficient (Lin and Sun, 2009) and less profitable (Garcia-Herrero *et al.*, 2009). This gap between the 4 SOCBs and other banks explains that the reduction of the relative importance of SOCBs is associated with improved overall efficiency and profitability of the banking sector (Garcia-Herrero *et al.*, 2009).

These specificities of China's financial system - the dominance of the sector by the four inefficient SOCBs - explain that traditional indicators of financial development, which measure banking sector size (such as the ratio of loans to GDP) are typically found to have no, or even a negative, impact on growth (Boyreau-Debray, 2003; Chen *et al.*, 2005). For this reason, many authors have relied instead on measures of the 4-SOCBs' market shares, as an indicator of the level of distortions in the financial intermediation system, and found it negatively associated with growth (Boyreau-Debray, 2003; Chen *et al.*, 2005; Guariglia and Poncet, 2008; Lin and Sun, 2009).

In this study, we follow these authors and use the market shares of banks other than the four state-owned commercial banks (SOCBs) as China-specific indicators of liberalization in the banking sector at the province level.

3 Data and Indicators

The key data used in this paper are our measures of financial liberalization in Chinese provinces; sector-level financial vulnerability; as well as disaggregated export flows by province. Our sample consists of a panel of yearly observations for 30 provinces in mainland China.

3.1 Measures of financial liberalization

As underlined in Section 2, state control over financial intermediation is identified as one important source of distortions in capital allocation in China. In the empirical section, we apprehend the relative importance of finance devoid of state interventionism with the share of banks other than the four state-owned commercial banks (non 4-SOCBs) in total bank lending (non 4-SOCBs' share in credit) or in total bank deposits (non 4-SOCBs' share in deposits). These statistics were published in the Almanac of China Finance and Banking until 2004. As reported in Table II.12 in the Appendix, in 1990, the four state-owned commercial banks dominated the financial sector: they accounted for about 80 percent of the country's lending. Liberalization and reform efforts, notably in relation to the WTO accession, have greatly reduced this predominance and increased the share of banks other that the four SOCBs in deposits and credits, to nearly 35% in 1999 and 45% in 2004. Table II.13 in the Appendix indicates that the situation is however very diverse across China. While some provinces such as the North-Eastern provinces of Liaoning and Shandong have seen the share of the 4-SOCBs fall below 50% as early as the year 2000, other provinces (such as the far-Western provinces of Qinghai and Ningxia) still have state-dominated finance systems.

As argued above, the big-4 SOCBs stand out as less profitable, less efficient and have lower quality assets than the others. For these reasons, we believe that measures of the market share of these four fully state-controlled banks can be used as a measure of distortions in credit allocation.[5]. They are likely to be associated with stronger credit constraints for some firms. More precisely, we expect high state-owned banks shares to be associated with higher constraints for private-owned firms, based on abundant evidence of discriminatory lending policies against private firms by state-owned banks. It should be noted, however, that the Chinese financial system possibly continues to favor state-owned enterprises (SOEs), despite liberalization. Dollar and Wei (2007) find that although low efficiency SOEs represent a declining share of national output (40% in 2005 down from 53% in 1995) their borrowing accounts for more than half of the total lending by the banking system. This may be due to the fact that private firms, although more productive, are still considered by Chinese banks as riskier than their public peers, possibly due to their short credit history, or to a lower chance of being bailed out by the government. Concerning state-owned firms, conventional wisdom in China's economics has it that these firms often benefit from "soft budget constraints" on the part of state-owned banks, due to the fact that lending by state banks is still partly determined by political reasons, rather than by commercial motives (see e.g. Park and Sehrt (2001)). This would lead us to expect that credit constraints faced by state-owned firms tightened with improvements in the financial sector.

3.2 Measures of sector level reliance on external finance

We use three different measures of a sector's financial vulnerability, in line with other studies on the same topic.

[5] Note that we do not claim that non-4SOCBs banks are free from state pressure and operate fully according to market forces. The fact that they are not should not harm our identification strategy but make the finding of a significant impact of our proxy less likely as our indicator would overestimate the extent of market orientation. Unfortunately, alternative measures of financial development, such as the share of foreign-owned banks or the share of non-performing loans, for example, are not available by year and province in the Chinese context.

These variables are meant to capture technological characteristics of each sector which are exogenous to firms' financial environment, and determine the degree of reliance of each sector's firms on external finance. While firms in all industries may face liquidity constraints, there are systematic differences across sectors in the relative importance of up-front costs and the lag between the time production expenses are incurred and revenues are realized. We capture these differences with a measure of sectors' external finance dependence (*financial dependence*), constructed as the share of capital expenditures not financed out of cash flows from operations. For robustness, we also use an indicator of firms' liquidity needs (*liquidity needs*). This measure was developed by Raddatz (2006) and is the ratio of inventories over annual sales. It thus captures another dimension of a firm's dependence on access to external financing: the time lag between investments and the realization of corresponding revenues. As a third indicator, we follow Manova *et al.* (2011) who use the share of R&D spending in total sales ($R \ \& \ D$), based on the fact that as a long-term investment, research and development often implies greater reliance on external finance.

These indicators have been computed by Kroszner *et al.* (2007), using data on all publicly traded U.S.-based companies from Compustat's annual industrial files; the value of the indicator in each sector is obtained as the median value among all firms in each 2-digit ISIC sector. As is standard practice in the literature, we borrow these measures from these authors. As explained in Manova *et al.* (2011), the use of US data is not only motivated by the lack of data for most other countries, including China, but it has several advantages. Rajan and Zingales (1998) have pointed out that the United States have one of the most advanced and sophisticated financial systems, so that the values for US firms reflect the technology-specific component of external finance needs, or what can be called the finance content of an industry. It is likely that measuring these indices in the Chinese context would lead to different values, reflecting the fact that firms organize production differently in a credit-constrained environment. Thus, such measures would be endogenous to

financial development in China, whereas measures based on US firms' data can be seen as exogenous in this respect. In order to ensure that our measures of financial vulnerability do not simply reflect sectors' factor intensity, our regressions include sector-level indices for physical and human capital intensity from Braun (2003) [6]. Summary statistics of the various sector level indicators are presented in Table II.14 in the Appendix. Sectors are ranked in increasing order of their financial dependence. Tobacco stands out with the lowest reliance on external financing and plastic products for the highest. Interestingly, as indicated in the last column, the share of foreign exports for the latter sector is 2.5 times higher than for the former, which conforms with the argument by Manova *et al.* (2011) that financial imperfections grant an export performance premium to foreign firms relative to domestic firms.

3.3 Trade data sources

The main data source is a database collected by the Chinese Customs. It contains Chinese export flows aggregated by province, year, product and destination country,[7] over the 1997-2007 period.[8] In our empirical analysis, trade flows are aggregated up to the 27 3-digit ISIC sectors for which our indicators of sectors' financial vulnerability are available. We use a correspondence table between the international trade nomenclatures and the ISIC Rev. 2 categories, developed at the CEPII to match the Chinese HS 8-digit product codes with the ISIC 3-digit sector categories.[9]

[6] Similarly to the measures of financial dependence used, indices of physical and human capital intensity are computed by (Braun, 2003) using data for US firms.

[7] As the cross-destination dimension is not central to our analysis, we checked that all the results in the paper are robust to aggregating out the destination dimension.

[8] The original data is identified by an 8-digit code. As there were major reclassifications in the international HS 6-digit classifications in 1996 and 2002, we convert them to the same HS 6-digit classifications used in 1992, to avoid problems related to the reclassification of codes. In order to avoid classifying a product as a new variety, just because there has been a new product code or previous codes were split, we drop product lines that changed classification at the 6-digit level in the period, due to nomenclature changes.

[9] This table is used in the construction of the TradeProd dataset. Details are available at http://www.cepii.fr/anglaisgraph/bdd/TradeProd.htm.

The dataset also provides information on the ownership structure of firms, which makes it possible to distinguish between state-owned enterprises (SOEs),[10] private domestic firms, fully foreign-owned firms, and joint ventures (with foreign ownership less than 100%).

4 A First Glance at the Structure of Chinese Exports

There is tremendous systematic variation in export patterns across sectors at different levels of financial vulnerability and across provinces at different levels of state interference in finance. This section presents some simple correlations in the data which bode well for the empirical analysis to follow.

Figure II.1 ranks sectors by their external financial dependence, and plots the export value of China for the two extreme years of our trade data (1997 and 2007). Interestingly, the period 1997-2007 has seen a faster growth of exports in the most financially vulnerable industries. In light of the theoretical prediction that in presence of credit constraints, improvements in financial system's efficiency should benefit more the most finance-dependent sectors, this suggests that financial liberalization in China over this period has reduced credit constraints. Similar results are obtained when looking at variations across provinces. Figure II.2 compares the export structure of the two provinces of Shaanxi and Ningxia in 2000. These two provinces, as indicated in Table II.13 in the Appendix, have rather similar levels of GDP per capita and contributions in China's total exports; but they differ in the relative importance of SOCBs in their banking sectors, with the 4-SOCBs' share of deposits at 65% in Shaanxi, versus 75% in Ningxia, in 2000. Shaanxi has higher export sales overall than Ningxia, and its advantage is much more pronounced in sectors more dependent on external finance. This suggests that

[10] We define SOEs as including collectively-owned firms.

provinces with liberalized banking tend to show a greater export specialization in financially dependent sectors.

Our empirical approach will not only exploit variations across time and provinces but also variations across firm types as in Manova *et al.* (2011). In China, most of international trade is carried out by firms with partial or full foreign ownership. As shown in Table II.12 in the Appendix, they accounted for 59% of the exports in 2004. For clarity in the following graphs, foreign affiliates and joint ventures are combined into a single category, referred to as foreign. Figure II.3 indicates that beyond this average performance, foreign-owned firms capture a systematically bigger share of Chinese exports in industries with higher levels of financial vulnerability than do domestic firms (state-owned and private together). Figure II.4 focuses on Shandong, the province with the highest share of non 4-SOCBs in finance, in 2000. It shows that a pattern of specialization by financial dependence exists not only across provinces, but also among different firm types within a province: the distribution of foreign and state-owned firms' exports is more concentrated in high dependence industries than that of private firms. Interestingly, at least in the case of Shandong, the gap between the three firm types shrank significantly for the final year of our sample in 2004, as illustrated in Figure II.5, suggesting that inequalities in access to credit between firm types diminished.

Overall these summary statistics suggest that the structure of exports in China is distorted by financial system imperfections; that these distortions vary in severity across provinces and across firm types; and that they lessened over the period under study (1997-2007). These figures are consistent with China's financial distortions disproportionately hindering the export activity of private domestic firms that can only borrow in the local financial sector. Conversely, state interference in finance favors foreign firms and to a lesser extent state-owned firms, suggesting that foreign ownership secures funds from parent companies, while state ownership facilitates financing from domestic banks (whether state-owned or not). An important question is therefore whether differences between firm types have compensated the impact of

financial constraints, in the sense that the presence of less constrained foreign firms could have supplied the missing exports by domestic firms in the most finance-intensive sectors. We address this in Section 5.3.

5 Empirical analysis

Our empirical strategy follows two steps. First, we test if credit constraints vary across firm types, and how they evolved over the period. Second, we measure the impact of the reduction in the state interference in finance on the constraints faced by the different types of exporting firms.

5.1 The impact of firm ownership on credit constraints

We identify the presence of credit constraints in China through the study of how the finance content of exports varies by firm ownership type. After controlling for determinants of specialization at the province level, we test if firms of different types specialize in sectors characterized by different levels of financial vulnerability. Such a structure of specialization would provide indirect evidence for the fact that credit constraints vary across firm types. As argued above and in Manova *et al.* (2011), we expect the impact of credit constraints to be mitigated by foreign and state ownership. This expectation derives from the systematic finding by firm-level studies that private Chinese firms are credit constrained while state-owned firms and foreign-owned firms in China are not (Guariglia *et al.*, 2011; Héricourt and Poncet, 2009). One possible factor behind this could be that foreign affiliates have access to

internal capital from their parent companies.[11] Concerning state ownership, state-owned enterprises are thought to be more immune to credit constraints than private firms since they enjoy preferential treatment and access to external finance from the domestic banking system (Dollar and Wei, 2007; Boyreau-Debray and Wei, 2005).

We estimate the following equation:

$$\ln X_{ijkt}^{F} = \alpha_F D_F \times FinVuln_k + \eta^F + \theta_{ijt} + \lambda_{jk} + \epsilon_{ijkt}^{F} \quad \text{(II.1)}$$

where X_{ijkt}^{F} are the free-on-board export sales of firm type F in province i and industry k, for export destination j in year t. Firm types include private, state-owned firms, foreign firms and joint-ventures. Binary indicator variables, D^F, take the value of 1 for firm type F and 0 otherwise. Our regressions include province-country-year fixed effects θ_{ijt} and industry fixed effects λ_k. Firm-type effects α_F and η_F are measured with respect to a reference group, which we choose to be private firms. The main effect of financial vulnerability (lower worldwide sales in more financially vulnerable sectors) can not be observed, given industry fixed effects that control for systematic differences in firm exports across sectors and firm-type dummies that account for differences in average export performance between firms of different ownership type that are invariant across sectors. Hence, we focus on the comparison between firm type groups. Moulton (1990) shows that regressions with more aggregate indicators on the-right hand side could induce a downward bias in the estimation of standard-errors. All regressions are thus clustered at the province/country level.

[11] In unreported results (available upon request from the author), we explore an alternative explanation for the comparative advantage of foreign firms over their private counterparts in financially vulnerable industries. Another story suggested by an anonymous referee would be that a large component of the need for external financing comes from the fixed cost of learning about destination markets and complying with their specific regulations and that foreign firms face a lower fixed cost of exporting compared to private firms, simply because they have better pre-existing knowledge of export market conditions. However in contrast to this story, we find that the export performance premium of foreign firms in financially vulnerable sectors (compared to private firms) is lower in more difficult markets, with difficulty proxied for by distance. Also, our main result (i.e. of a reduction of the gap between private and foreign firms in conjunction with improved functioning of the financial sector) is robust to the control of this export-costs-difference story (through adding interactions between country-level proxies of trade costs, financial vulnerability and firm ownership types).

Table II.1 displays the regression results using in turn each of our three indicators of sector-level financial vulnerability. Specifications in odd columns include country-industry fixed-effects; those in evencolumns include province-industry fixed-effects, and thus control for provincial patterns of specialization. All regressions also include province-country-year fixed effects.

They also include the interactions of the three firm ownership dummies with sectors' physical and human capital intensity as provided by Braun (2003). [12]

[12] These results were obtained by running our estimations after differentiating each variable in our specification with respect to its mean, within a sector-country, or sector-province cell since including sector-country/sector-province fixed-effects proved computationally difficult because of their large number.

Table II.1: Credit constraints and export values

Explained variable:	Log exported value (province/country/ISIC/year)					
Financial vulnerability measure	Financial dependence		Liquidity needs		R&D	
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign x Fin. Vulnerability	0.85[a]	0.62[a]	1.04	0.32	13.79[a]	10.31[a]
	(0.24)	(0.19)	(2.63)	(2.18)	(4.76)	(3.93)
JV x Fin. Vulnerability	0.32	0.26	1.08	1.44	11.28[c]	9.49
	(0.28)	(0.27)	(2.82)	(2.83)	(6.07)	(5.87)
State-owned x Fin. Vulnerability	-0.18	-0.10	1.78	2.58	-0.91	0.37
	(0.18)	(0.18)	(1.62)	(1.57)	(3.78)	(3.76)
Foreign-owned	-0.54[b]	-0.48[b]	-0.79	-0.57	-0.33	-0.33
	(0.26)	(0.21)	(0.69)	(0.57)	(0.29)	(0.23)
Joint venture	-0.66[a]	-0.62[a]	-0.90	-0.93	-0.50[a]	-0.48[a]
	(0.23)	(0.18)	(0.70)	(0.69)	(0.19)	(0.16)
State-owned	0.33	0.48[b]	-0.05	-0.06	0.32	0.49[b]
	(0.24)	(0.24)	(0.40)	(0.39)	(0.26)	(0.25)
Foreign x hum. cap. intensity	0.39	0.38	0.55	0.52	-0.20	-0.06
	(0.38)	(0.34)	(0.47)	(0.39)	(0.53)	(0.45)
JV x hum. cap. intensity	0.71[b]	0.71[a]	0.74[a]	0.72[a]	0.17	0.26
	(0.28)	(0.26)	(0.27)	(0.25)	(0.29)	(0.29)
State x hum. cap. intensity	0.68[c]	0.52	0.57	0.40	0.68	0.47
	(0.35)	(0.35)	(0.38)	(0.36)	(0.42)	(0.41)
Foreign x phys. cap. intensity	-7.82[c]	-7.71[a]	-4.40	-5.78	-2.37	-3.72
	(4.04)	(2.92)	(5.33)	(3.94)	(4.00)	(3.05)
JV x phys. cap. intensity	-2.95	-3.97	-0.91	-1.75	0.37	-1.24
	(2.40)	(2.67)	(4.56)	(4.66)	(2.58)	(2.83)
State x phys. cap. intensity	-2.36	-2.76	-0.72	-0.08	-2.91	-2.84
	(3.33)	(3.28)	(4.29)	(4.10)	(3.66)	(3.54)
Observations	1185431					
R^2	0.04	0.04	0.04	0.04	0.04	0.04
Fixed effects	Province-country-year triad					
Industry-country fixed effects	yes	no	yes	no	yes	no
Province-industry fixed effects	no	yes	no	yes	no	yes

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and sector levels. [a], [b] and [c] indicate significance at the 1%, 5% and 10% confidence levels.

The potential limiting effect on exports of credit constraints is identified from the variation across firm types. The main coefficients of interest are hence those on the three interaction terms α_F. If credit constraints are more severe for some firm types (e.g. private firms) than others, then the distortionary effect of financial markets imperfections on exports of these firms should be more apparent than for less constrained firms. Thus, compared to the private firms, the sensitivity of their exports to financial vulnerability should be higher. Since we rely on export data summed up by sector and firm type groups and look at the distribution of total exports of each firm type across sectors, we measure the result of two effects, the selection of firms into exporting, and the export value of selected firms. Theoretically, both margins should be affected by credit constraints. A positive coefficient α_F would be consistent with both a reduced relative presence of private firms in finance-intensive sectors (selection effect) and a lower value of their exports when they are present.

Our results are in line with previous findings. Positive coefficients on financial vulnerability for foreign firms are consistent with an advantage to foreign firms in high vulnerability sectors, relative to all other types of firms. Firms with different ownership types possibly self-select into sectors characterized by different levels of financial constraints. In addition, foreign firms in finance-dependent sectors may be able to export more. Our coefficient captures the overall effect of these two channels, without distinguishing between the two margins.

Hence, foreign ownership is associated with a significant specialization in "finance-intensive" industries. Interestingly, State-owned firms do not appear to have an advantage in those sectors, contrary to what could be expected in a largely state-controlled financial environment. Note that these aggregate results are likely to encompass important variations within firm type categories, and are thus not inconsistent with some State-owned firms facing "soft budget constraints".

These findings are robust to the inclusion of interactive terms between firm ownership dummies and sectors' physical and human capital intensity.

We see these results as evidence of credit constraints faced by exporting firms in China, with the severity of the constraints varying with the ownership structure of firms. Foreign firms have easier access to external finance, which provides them with an advantage in the most finance-dependent sectors. In contrast, domestic firms suffer from higher costs of credit so that a smaller fraction of them survives in those sectors, and those who do export less. These effects may be reinforced by competition effects, in the sense that domestic firms may be further crowded out from finance-intensive sectors, by the competitive advantage enjoyed by foreign firms in those sectors. At this point we are not able to discriminate between the two effects.

Tables II.2 and II.3 investigate how our results evolve over time. In Table II.2 we run Equation II.1 on every year of our sample, using our benchmark indicator of sector finance intensity (*External dependence*). A declining trend in the differences of finance specialization across firm types appears very clearly. We show, however, that the pattern of credit constraints across firm types has significantly evolved over the 10-year period.

Table II.2: Credit constraints and export values: by year

Explained variable:	Log exported value (province/country/ISIC/year)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
State-owned x Fin. Vulnerability	2.10^{a}	0.58^{c}	0.31	0.22	0.26	0.43^{b}	0.17	-0.13	-0.12	-0.24	-0.35^{c}
	(0.42)	(0.33)	(0.32)	(0.26)	(0.25)	(0.17)	(0.13)	(0.19)	(0.18)	(0.20)	(0.19)
JV x Fin. Vulnerability	2.73^{a}	1.10^{a}	0.66^{b}	0.54^{b}	0.46	0.64^{a}	0.48^{b}	0.22	0.24	0.16	0.06
	(0.44)	(0.33)	(0.31)	(0.27)	(0.28)	(0.25)	(0.23)	(0.32)	(0.34)	(0.36)	(0.32)
Foreign x Fin. Vulnerability	3.13^{a}	1.55^{a}	1.02^{a}	0.92^{b}	0.83^{b}	0.92^{a}	0.65^{a}	0.44^{b}	0.54^{a}	0.56^{b}	0.58^{a}
	(0.56)	(0.45)	(0.39)	(0.37)	(0.35)	(0.24)	(0.16)	(0.20)	(0.20)	(0.22)	(0.19)
State-owned	4.77^{a}	4.30^{a}	3.22^{a}	2.54^{a}	2.05^{a}	1.03^{a}	0.66^{a}	-0.06	-0.47^{c}	-0.89^{a}	-1.34^{a}
	(0.68)	(0.55)	(0.46)	(0.31)	(0.28)	(0.19)	(0.18)	(0.25)	(0.25)	(0.24)	(0.20)
Joint venture	3.80^{a}	3.17^{a}	1.93^{a}	1.29^{a}	0.84^{a}	-0.18	-0.43^{b}	-1.20^{a}	-1.40^{a}	-1.76^{a}	-2.02^{a}
	(0.70)	(0.50)	(0.33)	(0.25)	(0.30)	(0.24)	(0.20)	(0.20)	(0.22)	(0.23)	(0.22)
Foreign-owned	3.55^{a}	3.11^{a}	2.02^{a}	1.33^{a}	0.88^{a}	-0.14	-0.39^{c}	-0.86^{a}	-1.06^{a}	-1.23^{a}	-1.40^{a}
	(0.79)	(0.62)	(0.42)	(0.34)	(0.33)	(0.26)	(0.21)	(0.20)	(0.21)	(0.23)	(0.25)
Observations	58016	64080	70725	78389	86004	100200	116444	135705	147486	158743	165204
R^2	0.096	0.109	0.132	0.116	0.113	0.102	0.073	0.047	0.035	0.035	0.036
Controls	Pairwise interactions between industries' factor intensity and the firm ownership dummies										
Observations	58595	64605	71208	78847	86466	100600	116791	136029	147775	159013	165502
R^2	0.096	0.105	0.123	0.105	0.099	0.092	0.067	0.046	0.034	0.031	0.030
Fixed effects	Province-country pair and province-industry pair										

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and sector levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels.

Access to credit appears to have significantly improved for the firms which were initially most constrained (private domestic firms), reducing specific advantages enjoyed by firms with partial or whole foreign ownership as well as state-owned firms. To illustrate these results we can compare the reduction in the specific advantage of foreign firms, relative to private firms for sectors at the 25^{th} and 75^{th} percentiles of the distribution of financial vulnerability. Taking the values of external dependence at the 25^{th} and 75^{th} percentiles of total exports of China in 1997 (corresponding to the sectors of 'Apparel' and 'Machinery' respectively), we obtain 0.03 and 0.45 respectively (Table II.14 in the Appendix). Using coefficients from Columns 1 and 11 in Table II.2, this means that in 1997, all things being equal, the ratio of foreign firms to private firms exports is higher at the 75^{th} percentile of financial dependence than at the 25^{th} percentile, by a factor 3.72 $[exp((0.45-0.03)\times 3.13)]$. In 2007, this value is down to 1.27 $[exp((0.45-0.03)\times 0.58)]$.

We find that the degree of specialization of state-owned firms in finance-intensive sectors, relative to private firms, exhibits a clear downward trend. This is consistent with Manova *et al.* (2011), who find using firm-level data for the year 2005 that state-owned firms do not seem to benefit from an advantage over private firms in finance dependent sectors, despite their alleged easier access to finance through state-owned banks. Results in Tables II.2 and II.3 shed light on this apparent paradox, by showing that this advantage existed at the end of the 1990s but that it diminished over the period, and then reversed after 2004. The coefficient attracted by our financial vulnerability indicator for state firms is significant and positive for the years until 2002, suggesting that soft budget constraints no longer provided an advantage to state firms over private firms at the end of the 1990s. In the next section we will confirm the association between the diminution of state control over the banking sector and the diminution of the relative advantage of state over private firms.

Table II.3 confirms that the time evolution highlighted above is found consistently with the three indicators of financial vulnerability. In the regressions, the interactive terms between financial vulnerability and firm type are further interacted with a

Table II.3: Credit constraints and export values over time

Explained variable:	Log exported value (province/country/ISIC/year)					
Financial vulnerability measure	Financial dependence		Liquidity needs		R&D	
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign x Fin. Vuln. x trend	-0.247^a	-0.252^a	-2.854^a	-2.859^a	-2.907^b	-2.950^b
	(0.074)	(0.074)	(0.541)	(0.543)	(1.261)	(1.277)
JV x Fin. Vuln. x trend	-0.251^a	-0.250^a	-2.903^a	-2.926^a	-2.905^b	-2.890^b
	(0.073)	(0.073)	(0.534)	(0.537)	(1.260)	(1.264)
State x Fin. Vuln. x trend	-0.249^a	-0.248^a	-2.988^a	-3.000^a	-3.041^b	-3.033^b
	(0.075)	(0.076)	(0.570)	(0.572)	(1.323)	(1.326)
Fin. Vuln. x trend	0.309^a	0.309^a	2.710^a	2.717^a	3.707^b	3.705^b
	(0.077)	(0.077)	(0.575)	(0.577)	(1.494)	(1.499)
Foreign x Fin. Vuln.	2.743^a	2.862^a	25.765^a	24.627^a	36.041^a	36.583^a
	(0.721)	(0.704)	(5.320)	(5.303)	(12.688)	(13.053)
JV x Fin. Vuln.	2.581^a	2.504^a	25.709^a	26.185^a	37.358^a	35.563^a
	(0.692)	(0.687)	(5.501)	(6.097)	(13.355)	(13.289)
State x Fin. Vuln.	2.238^a	2.175^a	27.158^a	27.886^a	30.505^b	27.967^b
	(0.731)	(0.729)	(5.630)	(5.859)	(12.798)	(12.956)
Foreign x trend	-0.173^a	-0.170^a	0.206^b	0.205^b	-0.192^a	-0.189^a
	(0.040)	(0.040)	(0.100)	(0.101)	(0.036)	(0.037)
JV x trend	-0.201^a	-0.204^a	0.183^c	0.184^c	-0.221^a	-0.223^a
	(0.043)	(0.043)	(0.100)	(0.100)	(0.040)	(0.040)
State-owned x trend	-0.243^a	-0.245^a	0.152	0.151	-0.260^a	-0.262^a
	(0.045)	(0.045)	(0.103)	(0.104)	(0.044)	(0.044)
Foreign	0.924^b	0.921^b	-2.343^b	-2.339^b	1.065^a	1.240^a
	(0.371)	(0.385)	(1.004)	(1.061)	(0.334)	(0.345)
JV	1.468^a	0.977^a	-1.830^c	-2.567^b	1.524^a	1.284^a
	(0.370)	(0.379)	(1.014)	(1.251)	(0.349)	(0.349)
State	2.743^a	2.352^a	-0.878	-1.467	2.836^a	2.515^a
	(0.390)	(0.432)	(0.979)	(1.049)	(0.402)	(0.472)
Observations	1180996	1180996	1180996	1180996	1180996	1180996
R^2	0.060	0.062	0.064	0.065	0.060	0.060
Controls$^\alpha$	no	yes	no	yes	no	yes
Fixed effects	Province-country-year triad & industry-country pair					

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country level. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. $^\alpha$ Controls are pairwise interactions between industries' factor intensity and the firm ownership dummies.

trend (equal to 1 for 1997, 2 for 1998 an so on).

Our fixed effects empirical approach accounts for the fact that firms of different ownership structures in China (as elsewhere) vary along many dimensions other than access to finance. The empirical literature applied to Chinese firms has consistently found foreign firms to be bigger, more efficient, more export-oriented, etc. while state-owned firms have been found to lag behind (Xu and Wang, 1999). According to {OECD} (2010), these differences are however shrinking in conjunction with the reforms. To control for the time-varying firm-type specific export performance, our

regressions in Table II.3 include double interaction terms involving the time trend variable and firm ownership status. The negative coefficients attracted by the triple interactive terms between financial vulnerability, firm type and trend corroborate the declining trend in the differences of finance specialization across firm types. The relative disadvantage of private firms in finance-intensive sectors has declined over the period, which is consistent with the gradual improvement in financial institutions seen in China, as is shown more thoroughly in the next section.

5.2 Banking liberalization and credit constraints

Baseline

We now ask if recent developments in the capital allocation system in China, namely, reductions in the degree of state intervention in this sector, can account for the reduction in the export performance gap between foreign and private firms found above.

As firms of different ownership structures apparently face different levels of access to credit, we expect financial liberalization to affect these groups differently. We test if an increasing share of bank activity outside the 4-state-owned banks in a province's total credits or deposits is associated with a rebalancing of exports toward finance-intensive sectors, in any of the four firm type groups (private, state-owned, foreign-owned, and joint ventures). As before, we look at sector-level bilateral (province-country) export values by firm types, considering private firms as the reference group and using interactive terms for the other three groups to measure how they differ. We use the following specification:

$$\begin{aligned}\ln X^F_{ijkt} &= \alpha_F D_F \times FinVuln_k + \beta FinDevt_{it} \times FinVuln_k + \beta_F D_F \times FinDevt_{it} \times FinVuln_k \\ &+ \gamma_F D_F \times FinDevt_{it} + \zeta^1 k_{it} \times K_k + \zeta^2 h_{it} \times H_k + \theta_{ijt} + \lambda_{ikF} + \epsilon^F_{ijkt} \qquad \text{(II.2)}\end{aligned}$$

where X^F_{ijkt} is the export value from province i to country j in sector k at year t, by firm type F. $FinDevt_{it}$ corresponds to province i's financial development, which

we proxy for using the share of non 4-SOCBs in total bank activity (apprehended alternatively by credits or deposits) introduced in log. $FinVuln_k$ is one of our three indices of financial vulnerability at sector level k. We use a within estimator with respect to province/country/year and province/industry/firm-type groups. Differencing variables within province/industry/firm-type groups, in particular, allows to control for regional patterns of specialization.

We further account for differences in endowments with $k_{it} \times K_k$ and $h_{it} \times H_k$. They correspond to the interactions of measures of physical/human capital intensity at sector level with province-level endowments of each factor. Provincial endowment in human capital h_{it} is measured by the average number of years of schooling, while that in physical capital k_{it} is proxied by the per capita stock of capital.[13] All coefficients relating to differences in endowments will be allowed to vary by firm types. Hence our preferred specification will include all pairwise interactions between sectors' factor intensity, regions' factor endowments, and the ownership dummies. We allow firm type exports to differ in sector finance vulnerability (α_F), as we observed to be the case in Tables (1) to (3); and we also allow financial liberalization to affect firm types' exports differently (γ_F). In this way, any variable correlated with banking liberalization, which could impact the balance of export activity across firm types, will be captured by these controls, but should not affect our coefficients of interest β and β_F, unless its effect runs through a financial channel. We thus adapt the methodology first used in Rajan and Zingales (1998), which consists in filtering the impact of financial liberalization by the sector-level index $FinVuln_k$. [14]

All regressions are clustered at the province/country level (Moulton, 1990).

[13] It is computed as the accumulation of fixed investment using the permanent inventory method.

[14] Note that this methodology does not rule out the possibility of reverse causality in the relationship we observe. Banking liberalization might have been driven partly by the growth of private firms activity in finance-intensive sectors. As we do not have an instrument for banking liberalization, we remain careful about the direction of causality. However, the literature suggests that the political weight of private firms and entrepreneurs has been weak (Huang, 2008), leading private firms to use alternative sources of finance, in reaction to their limited access to the public banking sector (Allen *et al.*, 2005). Financial reform in China is generally presented as a centrally planned process rather than as a response to political demand by private entrepreneurs (Lin and Sun, 2009).

Tables II.4 and II.5 display results from estimations of Equation II.2, using the non 4-SOCBs' shares in credits and in deposits respectively. Across our three indicators of financial vulnerability, we observe consistently that the impact of financial liberalization on exports varies importantly across firm types. It is measured by β for private firms and $\beta + \beta_F$ for the three other firm types. Findings of a positive and significant β suggest that the State's withdrawal from the banking system significantly reduces credit constraints for private firms, as evidenced by the fact that it causes these firms' exports to grow substantially more in sectors where finance is most needed. The negative coefficients (β_F) attracted by the interactive terms between financial development and financial vulnerability for state, foreign and joint-venture firms indicate that this mitigating effect of financial liberalization on credit constraints is less present for firms with state ownership and even more so for those with foreign ownership. For these firms, credit access appears to have been less affected by changes in the domestic banking structure.

In most cases, the constraint-reducing impact of liberalization is significantly lower for State-owned firms, indicating that private firms are the first beneficiaries of a reduced market share of SOCBs in finance.

Control variables for provincial factor endowments interacted with sector factor intensity and firm type dummy variables rule out the possibility that our estimates reflect a mere pattern of firm types specialization by factor (capital/human capital) intensity, which would be correlated with financial characteristics.[15]

Tables II.10 and II.11 in the appendix display the results of similar regressions run on the sample split by firm type. Results are consistent with those in Tables II.4 and II.5: they show that the export structure of private firms has been the most impacted by banking liberalization; while the impact for other firm types is smaller or absent.

[15] In unreported results, we test the robustness of our findings to the exclusion of Shanghai (the major banking center in China).

Table II.4: Financial liberalization and export structure distortions (non 4-SOCBs' share in credits)

Explained variable:	Log export value (province/country/ISIC/year)		
Financial vulnerability measure	Financial dependence	Liquidity needs	R&D
	(1)	(2)	(3)
Financial Development x Financial Vulnerability (β)	4.78^a (1.38)	32.33^a (3.19)	77.83^a (24.34)
State-owned x Fin. Devt. x Fin. Vulnerability	-4.57^a (1.38)	-31.61^a (3.97)	-74.43^a (23.62)
JV x Fin. Devt. x Fin. Vulnerability	-4.20^a (1.37)	-27.02^a (5.68)	-67.58^a (25.39)
Foreign x Fin. Devt. x Fin. Vulnerability	-4.47^a (1.37)	-26.30^a (7.44)	-62.79^a (23.96)
State-owned x Fin. Devt.	1.27^a (0.39)	3.04^a (0.61)	1.25^a (0.33)
JV x Fin. Devt.	-0.26 (0.39)	0.86 (0.98)	-0.30 (0.35)
Foreign x Fin. Devt.	-0.41 (0.51)	0.52 (1.39)	-0.63 (0.43)
K/L x physical capital intensity	54.37^a (4.73)	49.44^a (4.32)	54.64^a (4.90)
H/L x human capital intensity	0.50 (1.59)	1.40 (1.52)	0.45 (1.62)
State-owned x K/L x physical capital intensity	-42.85^a (5.11)	-37.94^a (4.96)	-43.05^a (5.33)
JV x K/L x physical capital intensity	-39.23^a (6.37)	-33.72^a (5.89)	-39.31^a (6.46)
Foreign x K/L x physical capital intensity	-37.39^a (5.60)	-31.93^a (5.42)	-37.62^a (5.84)
State-owned x H/L x human capital intensity	0.12 (2.24)	-0.76 (2.13)	0.15 (2.28)
JV x H/L x human capital intensity	-0.03 (2.32)	-0.98 (2.18)	-0.06 (2.30)
Foreign x H/L x human capital intensity	-0.35 (1.98)	-1.18 (1.89)	-0.40 (1.98)
Observations	709563	709563	709563
R^2	0.058	0.061	0.059

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. All regressions include province-country-year and firm-type-province-industry fixed effects. K/L, H/L are proxies for factor endowments at the province level. Physical and human capital intensity indices at sector level are taken from Braun (2003) and are computed on US firms data. Coefficients on interaction terms of firm type dummies with province factor endowments variables K/L, H/L are not reported here.

Table II.5: Financial liberalization and export structure distortions (non 4-SOCBs' share in deposits)

Explained variable:	Log export value (province/country/ISIC/year)		
Financial vulnerability measure	Financial dependence	Liquidity needs	R&D
	(1)	(2)	(3)
Financial Development x Financial Vulnerability (β)	1.80^{c} (1.00)	16.68^{a} (3.00)	36.85^{b} (17.77)
State-owned x Fin. Devt. x Fin. Vulnerability	-2.02^{b} (0.97)	-16.36^{a} (3.34)	-38.16^{b} (15.93)
JV x Fin. Devt. x Fin. Vulnerability	-1.44 (1.07)	-14.36^{a} (5.42)	-30.42 (22.31)
Foreign x Fin. Devt. x Fin. Vulnerability	-1.59^{c} (0.93)	-11.81^{b} (5.82)	-23.64 (17.72)
State-owned x Fin. Devt.	0.97^{b} (0.38)	1.89^{a} (0.55)	0.98^{a} (0.37)
JV x Fin. Devt.	-0.40 (0.36)	0.40 (0.96)	-0.35 (0.37)
Foreign x Fin. Devt.	-0.74^{c} (0.43)	-0.42 (1.16)	-0.88^{b} (0.42)
K/L x physical capital intensity	55.80^{a} (5.05)	53.11^{a} (4.84)	55.69^{a} (5.13)
H/L x human capital intensity	0.65 (1.77)	1.90 (1.81)	0.74 (1.78)
State-owned x K/L x physical capital intensity	-44.08^{a} (5.45)	-41.56^{a} (5.36)	-44.04^{a} (5.53)
JV x K/L x physical capital intensity	-40.55^{a} (6.60)	-37.70^{a} (6.28)	-40.38^{a} (6.60)
Foreign x K/L x physical capital intensity	-38.76^{a} (5.88)	-35.75^{a} (5.68)	-38.70^{a} (5.96)
State-owned x H/L x human capital intensity	-0.06 (2.41)	-1.28 (2.43)	-0.14 (2.42)
JV x H/L x human capital intensity	-0.14 (2.52)	-1.46 (2.50)	-0.23 (2.51)
Foreign x H/L x human capital intensity	-0.44 (2.16)	-1.73 (2.19)	-0.44 (2.15)
Observations	709563	709563	709563
R^2	0.058	0.059	0.058

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. All regressions include province-country-year and firm-type-province-industry fixed effects. Coefficients on interaction terms of firm type dummies with province factor endowments variables K/L, H/L are not reported here.

To give an idea of the magnitude of the impacts measured here, we consider a 20% increase in the non-big-four state banks share in credits (corresponding approximately to one standard deviation increase, as shown in Table II.15 in the Appendix). As a consequence of this liberalization, exports by all firm types grow relatively more in financially dependent sectors, implying a rebalancing of exports across industries. Measuring, as before, external dependence at the 25^{th} and 75^{th} percentile of the distribution of Chinese exports in 1997, we find values of 0.03 and 0.45 (for 'Apparel' and 'Machinery', respectively). All things being equal, a liberalization of the scale considered here (+20%) results in a growth differential of 40.1%[16] (for private firms at the 75^{th} percentile of dependence, relative to the 25^{th} percentile). Foreign firms also see their exports grow relatively more in dependent sectors, but the growth differential is of only 2.6%.[17] Over the period, this brings the distribution of private firms' exports closer to that of foreign firms, as observed in the previous section. We can compute that the ratio of private firms' to foreign firms' exports grows faster at the 75^{th} percentile sector, than at the 25^{th}, by 37.5%.

Robustness checks

One potential concern is that the effects identified above are not really attributable to financial liberalization, but rather to broader economic variables likely to be correlated with it.[18] Our strategy in face of this endogeneity issue has been to measure the differential impact of financial development across sectors, depending on their degree of dependence on finance, so that to produce our results, an omitted variable would need to exhibit not only a positive impact on exports, but a differential impact across sectors ordered by financial dependence. We nevertheless ran additional regressions corresponding to Equation 2, controlling for two important province level macro indicators (real GDP per capita and ratio of FDI over GDP)

[16] This figure is computed as $0.2 \times \beta \times 0.42$ based on $\beta = 4.78$ in Column 1 of Table II.4.
[17] This figure is computed as $0.2 \times (\beta + \beta_F) \times 0.42$ based on $\beta = 4.78$ and $\beta_F = -4.47$, in Column 1 of Table II.4.
[18] We thank two anonymous referees for suggesting the tests performed in this section.

and their interactions with our financial dependence indicators. Most clearly, the difference in the effects of liberalization on private and state firms remains large and significant. Tables 6 and 7 report the results for our three indicators of financial vulnerability measuring financial liberalization based on credits and deposits respectively.

Economic development, as proxied by GDP per capita in particular, indeed has an impact on the structure of exports. However, the impact of banking liberalization identified earlier does not vanish when including this control, indicating that this effect is not merely driven by such an omitted determinant.

Table II.6: Robustness checks (province): Financial liberalization and export structure distortions

Explained variable:	Log exported value (province/ISIC/country/year)					
Financial liberalization measure:	non 4-SOCBs' share in credits					
	(1)	(2)	(3)	(4)	(5)	(6)
Province control indicator:	GDP per capita			FDI over GDP		
Financial vulnerability measure:	Fin. dep	Liq	R&D	Fin. dep	Liq	R&D
Province Fin. Devt	2.24^a	5.87^b	24.58^b	9.79^a	44.93^a	139.80^a
x Sector Financial Vulnerability	(0.67)	(2.51)	(10.82)	(1.78)	(3.48)	(40.56)
State-owned x Fin. Devt x Fin. Vuln.	-2.40^a	-6.41^b	-24.98^b	-9.55^a	-42.47^a	-136.44^a
	(0.68)	(2.71)	(10.59)	(1.75)	(3.62)	(40.24)
JV x Fin. Devt x Fin. Vuln.	-1.24^c	-3.14	-10.90	-8.73^a	-37.69^a	-126.35^a
	(0.73)	(4.19)	(10.90)	(1.61)	(4.64)	(39.05)
Foreign x Fin. Devt x Fin. Vuln.	-1.54	-5.62	-6.04	-9.19^a	-38.50^a	-124.04^a
	(1.06)	(6.16)	(11.54)	(1.72)	(6.29)	(39.98)
Prov. control x Fin. Vuln.	7.36^a	35.69^a	104.40^a	-0.05	0.61	-2.38
	(1.42)	(2.83)	(34.23)	(0.14)	(0.95)	(2.70)
State-owned x Prov. control x Fin. Vuln.	-6.70^a	-30.76^a	-97.99^a	-0.10	-1.12	0.44
	(1.27)	(3.40)	(32.44)	(0.14)	(1.12)	(2.32)
JV x Prov. control x Fin. Vuln.	-7.28^a	-30.40^a	-103.41^a	0.02	-0.69	0.22
	(1.22)	(3.65)	(32.01)	(0.15)	(1.53)	(2.29)
Foreign x Prov. control x Fin. Vuln.	-7.40^a	-30.67^a	-106.29^a	0.00	0.90	0.85
	(1.30)	(3.74)	(32.69)	(0.19)	(1.39)	(4.17)
State-owned x Prov. control	-1.04^a	0.12	-1.18^a	0.05	0.24^c	-0.00
	(0.36)	(0.56)	(0.33)	(0.06)	(0.14)	(0.06)
JV x Prov. control	-0.69^c	0.27	-0.90^b	0.04	0.19	0.04
	(0.41)	(0.70)	(0.36)	(0.08)	(0.24)	(0.08)
Foreign x Prov. control	-0.15	0.84	-0.34	-0.06	-0.21	-0.09
	(0.43)	(0.72)	(0.39)	(0.09)	(0.22)	(0.09)
State-owned x Fin. Devt.	1.69^a	1.36^a	1.52^a	0.66	2.26^a	0.45
	(0.27)	(0.36)	(0.26)	(0.44)	(0.56)	(0.37)
JV x Fin. Devt.	1.35^a	0.84	1.27^a	0.53	1.60^c	0.39
	(0.37)	(0.73)	(0.38)	(0.47)	(0.82)	(0.41)
Foreign x Fin. Devt.	1.38^a	1.19	1.11^b	1.04^c	2.11^c	0.71
	(0.51)	(1.13)	(0.48)	(0.58)	(1.23)	(0.47)
K/L x physical capital intensity	13.22^a	14.39^a	16.24^a	13.71^a	12.76^a	14.60^a
	(4.27)	(3.63)	(4.64)	(3.82)	(3.61)	(3.98)
H/L x human capital intensity	2.15^b	-1.14	1.81^c	1.31	1.13	1.11
	(0.96)	(0.85)	(0.97)	(0.89)	(0.87)	(0.92)
Observations	709563	709563	709563	709563	709563	709563
R^2	0.016	0.026	0.014	0.008	0.011	0.007

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. Regressions include province-country-year and firm-type-province-industry fixed effects.

Table II.7: Robustness checks (province): Financial liberalization and export structure distortions

Explained variable:	Log exported value (province/ISIC/country/year)					
Financial liberalization measure:	non 4-SOCBs' share in deposits					
	(1)	(2)	(3)	(4)	(5)	(6)
Province control indicator:	GDP per capita			FDI over GDP		
Financial vulnerability measure:	Fin. dep	Liq	R&D	Fin. dep	Liq	R&D
Province Fin. Devt x Ind. Fin. Vuln.	-0.44	-4.46^{c}	-15.39	5.68^{a}	27.88^{a}	90.59^{a}
	(0.51)	(2.29)	(10.15)	(1.43)	(3.30)	(27.63)
State-owned x Fin. Devt x Fin. Vuln.	-0.01	4.28^{c}	11.81	-5.80^{a}	-26.03^{a}	-90.92^{a}
	(0.45)	(2.39)	(8.09)	(1.41)	(3.47)	(27.02)
JV x Fin. Devt x Fin. Vuln.	1.03	5.19	24.59^{c}	-4.95^{a}	-24.08^{a}	-79.97^{a}
	(0.67)	(4.24)	(12.63)	(1.30)	(4.42)	(28.71)
Foreign x Fin. Devt x Fin. Vuln.	0.88	6.14	30.78^{a}	-5.25^{a}	-23.18^{a}	-75.52^{a}
	(0.83)	(5.07)	(9.49)	(1.27)	(5.29)	(27.72)
Prov. control x Fin. Vuln.	8.03^{a}	38.37^{a}	115.05^{a}	-0.50^{a}	-2.68^{a}	-9.09^{b}
	(1.52)	(2.97)	(36.89)	(0.19)	(0.88)	(3.69)
State-owned x Prov. control x Fin. Vuln.	-7.33^{a}	-33.55^{a}	-107.95^{a}	0.32^{c}	1.92^{b}	6.90^{b}
	(1.38)	(3.42)	(35.10)	(0.18)	(0.95)	(3.23)
JV x Prov. control x Fin. Vuln.	-7.81^{a}	-32.51^{a}	-112.03^{a}	0.37^{b}	1.93	5.79^{c}
	(1.32)	(3.47)	(34.68)	(0.18)	(1.45)	(3.21)
Foreign x Prov. control x Fin. Vuln.	-7.97^{a}	-33.57^{a}	-114.83^{a}	0.39^{c}	3.57^{b}	6.25
	(1.40)	(3.70)	(35.58)	(0.22)	(1.65)	(4.81)
State-owned x Prov. control	-0.88^{b}	0.35	-1.02^{a}	-0.01	-0.04	-0.04
	(0.37)	(0.56)	(0.33)	(0.07)	(0.11)	(0.07)
JV x Prov. control	-0.61	0.32	-0.81^{b}	-0.01	-0.03	0.00
	(0.41)	(0.66)	(0.35)	(0.09)	(0.24)	(0.09)
Foreign x Prov. control	-0.02	1.07	-0.22	-0.15	-0.47	-0.15
	(0.44)	(0.72)	(0.38)	(0.11)	(0.29)	(0.11)
State-owned x Fin. Devt.	1.31^{a}	0.70^{b}	1.14^{a}	0.57^{c}	1.40^{a}	0.51^{c}
	(0.20)	(0.30)	(0.19)	(0.31)	(0.44)	(0.26)
JV x Fin. Devt.	1.30^{a}	0.89	1.20^{a}	0.63^{c}	1.43^{c}	0.62^{c}
	(0.30)	(0.68)	(0.30)	(0.36)	(0.76)	(0.33)
Foreign x Fin. Devt.	1.10^{a}	0.46	0.82^{b}	0.85^{c}	1.40	0.65^{c}
	(0.38)	(0.88)	(0.34)	(0.43)	(1.02)	(0.37)
K/L x physical capital intensity	13.22^{a}	14.51^{a}	16.28^{a}	14.29^{a}	13.79^{a}	14.59^{a}
	(4.28)	(3.64)	(4.65)	(3.95)	(3.79)	(3.98)
H/L x human capital intensity	2.10^{b}	-1.29	1.73^{c}	1.35	1.30	1.27
	(0.99)	(0.86)	(0.99)	(0.92)	(0.90)	(0.91)
Observations	709563	709563	709563	709563	709563	709563
R^2	0.016	0.026	0.014	0.006	0.008	0.006

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. Regressions include province-country-year and firm-type-province-industry fixed effects.

Table II.8: Robustness checks (industry): Financial liberalization and export structure distortions

Explained variable:	Log exported value (province/ISIC/country/year)					
Financial liberalization measure:	non 4-SOCBs' share in credits					
	(1)	(2)	(3)	(4)	(5)	(6)
Industry control indicator:	VA/output			Employment/output		
Financial vulnerability measure:	Fin. dep	Liq	R&D	Fin. dep	Liq	R&D
Province Fin. Devt x Ind. Fin. Vuln.	1.44	20.60^{a}	0.25	4.10^{a}	33.10^{a}	59.60^{a}
	(1.02)	(7.48)	(11.27)	(1.12)	(5.72)	(14.03)
State-owned x Fin. Devt x Fin. Vuln.	-1.06	-17.58^{b}	4.25	-3.74^{a}	-30.52^{a}	-55.35^{a}
	(0.99)	(6.88)	(10.73)	(1.12)	(5.47)	(13.59)
JV x Fin. Devt x Fin. Vuln.	-0.32	-12.65	15.04	-3.14^{a}	-26.64^{a}	-47.26^{b}
	(1.29)	(8.18)	(16.90)	(1.16)	(6.85)	(18.84)
Foreign x Fin. Devt x Fin. Vuln.	-0.82	-13.46	15.58	-3.42^{a}	-27.93^{a}	-38.77^{a}
	(1.51)	(11.54)	(12.90)	(1.18)	(9.72)	(14.35)
Industry control x Fin. Devt.	-1.56^{a}	-0.95^{a}	-1.65^{a}	-9.18^{a}	-3.24^{b}	-9.47^{a}
	(0.17)	(0.31)	(0.17)	(1.33)	(1.59)	(1.33)
State-owned x Ind. control x Fin. Devt.	1.53^{a}	0.84^{b}	1.63^{a}	9.28^{a}	3.45^{b}	9.53^{a}
	(0.23)	(0.39)	(0.23)	(1.35)	(1.64)	(1.43)
JV x Ind. control x Fin. Devt.	1.54^{a}	0.66	1.70^{a}	10.15^{a}	4.57^{b}	10.19^{a}
	(0.33)	(0.51)	(0.32)	(1.60)	(1.89)	(1.54)
Foreign x Ind. control x Fin. Devt.	1.12^{a}	0.26	1.33^{a}	9.08^{a}	3.40	8.49^{a}
	(0.43)	(0.50)	(0.44)	(2.22)	(2.42)	(2.25)
State-owned x Fin. Devt.	2.59^{a}	1.78	2.67^{a}	2.56^{a}	2.39^{a}	2.57^{a}
	(0.95)	(1.51)	(1.00)	(0.59)	(0.74)	(0.63)
JV x Fin. Devt.	2.54	0.15	2.92^{c}	3.07^{a}	2.62^{b}	2.98^{a}
	(1.57)	(2.58)	(1.53)	(0.74)	(1.14)	(0.81)
Foreign x Fin. Devt.	1.06	-1.23	1.52	2.90^{a}	2.51	2.11^{c}
	(1.88)	(2.66)	(1.91)	(1.11)	(1.87)	(1.24)
K/L x physical capital intensity	10.79^{a}	11.91^{a}	11.22^{a}	11.35^{a}	12.73^{a}	11.62^{a}
	(3.38)	(3.55)	(3.42)	(3.46)	(3.55)	(3.48)
H/L x human capital intensity	1.46	1.22	1.36	1.41	1.08	1.34
	(0.92)	(0.90)	(0.93)	(0.93)	(0.90)	(0.94)
Observations	709563	709563	709563	709563	709563	709563
R^2	0.011	0.011	0.011	0.011	0.011	0.011

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. Regressions include province-country-year and firm-type-province-industry fixed effects.

Table II.9: Robustness checks (industry): Financial liberalization and export structure distortions

Explained variable:	Log exported value (province/ISIC/country/year)					
Financial liberalization measure:	non 4-SOCBs' share in deposits					
	(1)	(2)	(3)	(4)	(5)	(6)
Industry control indicator:	VA/output			Employment/output		
Province Fin. Devt x Ind. Fin. Vuln.	0.10	5.20	-4.83	1.66^{c}	15.10^{a}	31.81^{b}
	(0.52)	(4.44)	(13.21)	(0.90)	(4.48)	(13.38)
State-owned x Fin. Devt x Fin. Vuln.	-0.20	-3.17	4.51	-1.78^{b}	-13.32^{a}	-32.49^{a}
	(0.42)	(4.28)	(10.84)	(0.87)	(4.45)	(11.02)
JV x Fin. Devt x Fin. Vuln.	0.64	-1.54	16.26	-1.08	-12.16^{b}	-23.90
	(0.76)	(5.18)	(20.96)	(0.92)	(5.18)	(21.12)
Foreign x Fin. Devt x Fin. Vuln.	0.30	1.20	19.45	-1.26^{c}	-10.81	-14.12
	(0.74)	(6.80)	(15.07)	(0.67)	(6.86)	(14.81)
Industry control x Fin. Devt.	-1.02^{a}	-0.84^{a}	-1.04^{a}	-6.02^{a}	-3.14^{a}	-6.01^{a}
	(0.13)	(0.21)	(0.14)	(0.92)	(1.12)	(0.94)
State-owned x Ind. control x Fin. Devt.	0.99^{a}	0.76^{a}	1.02^{a}	6.12^{a}	3.15^{a}	6.10^{a}
	(0.17)	(0.24)	(0.17)	(0.95)	(1.12)	(1.01)
JV x Ind. control x Fin. Devt.	1.11^{a}	0.78^{c}	1.19^{a}	6.98^{a}	4.34^{a}	6.80^{a}
	(0.25)	(0.43)	(0.26)	(1.24)	(1.54)	(1.27)
Foreign x Ind. control x Fin. Devt.	0.59	0.17	0.74^{c}	6.39^{a}	3.61^{c}	5.52^{a}
	(0.37)	(0.43)	(0.40)	(1.71)	(1.91)	(1.74)
State-owned x Fin. Devt.	1.81^{a}	1.12	1.79^{a}	1.84^{a}	1.47^{a}	1.84^{a}
	(0.65)	(1.00)	(0.65)	(0.42)	(0.55)	(0.42)
JV x Fin. Devt.	2.50^{b}	1.34	2.78^{b}	2.56^{a}	2.46^{b}	2.51^{a}
	(1.23)	(2.56)	(1.22)	(0.70)	(1.14)	(0.83)
Foreign x Fin. Devt.	0.15	-2.06	0.59	2.36^{b}	1.85	1.56
	(1.71)	(2.07)	(1.79)	(0.99)	(1.35)	(1.08)
K/L x physical capital intensity	12.34^{a}	12.73^{a}	12.42^{a}	12.79^{a}	13.37^{a}	12.72^{a}
	(3.78)	(3.82)	(3.75)	(3.81)	(3.81)	(3.76)
H/L x human capital intensity	1.71^{c}	1.60^{c}	1.69^{c}	1.60^{c}	1.43	1.62^{c}
	(0.97)	(0.96)	(0.96)	(0.95)	(0.92)	(0.94)
Observations	709563	709563	709563	709563	709563	709563
R^2	0.008	0.008	0.008	0.007	0.008	0.008

Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province/country and industry levels. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence levels. Regressions include province-country-year and firm-type-province-industry fixed effects.

A related concern is that our measure of financial vulnerability can capture other sector characteristics that would be associated with export performance. For example, we may fear that financially vulnerable sectors happen to be the ones most favored by provincial governments and that our $FinDevt_{it}$ variable acts as a proxy for industrial policies through which a provincial government might seek to boost production and exports in favored sectors. To verify this issue, we check that our results in Tables 4 and 5 are globally robust to the further inclusion of $FinDevt_{it} \times CONTROL_k$ by firm type (and their associated double interactions) where $CONTROL_k$ captures the rationale for an interventionist strategy by the provincial authorities. We consider two reasons for provincial authorities' favoritism: value-added and employment. It is indeed likely that preferential treatment is granted to high value-added content and employment content sectors as local officials are concerned by growth and employment maximization. Tables 8 and 9 report the results of Equation 2 after adding these additional interactions. Results suggest that State-owned and foreign firms have generally increased their presence in high-VA, high-employment sectors, relatively to private firms. However, the differential impact of financial liberalization on exports across sectors ordered by financial dependence is still significant, in particular between State-owned and private firms; consistently with this effect running through financial mechanisms, and not through other sector characteristics.

6 Conclusion

We investigate how the export performance of Chinese firms in China is influenced by credit constraints. Using panel data from Chinese customs for 1997-2007, we show that credit constraints restrict international trade flows and affect the sectoral composition of firms' activity. We confirm that credit constraints provide an advantage to foreign-owned firms and joint ventures over private domestic firms in sectors with higher levels of financial vulnerability, measured by three different indicators. We find however that these distortions were lessened but not eliminated over the period in conjunction with the improved functioning of the financial sector.

II.A Appendix: additional specifications

This section considers the regressions of table 4 and 5 run on the sample split by firm type. In each regression, the variable of interaction between financial liberalization, measured at province level, and financial vulnerability at sector level, thus measures the impact of liberalization on the structure of exports of the firms of the type considered. Results are consistent with those from tables 4 and 5, indicating that the impact of liberalization is generally strongest on private firms, while being smaller or non significant for other firm types.

Table II.10: Financial liberalization and export structure distortions (non 4-SOCBs' share in deposits) (Table 4 split by firm type)

Dependent variable	Log exported value (province/country/ISIC/year)											
Financial vulnerability measure	Financial dependence				Liquidity needs				R&D			
Firm-ownership type	Private	State	JV	Foreign	Private	State	JV	Foreign	Private	State	JV	Foreign
Financial Devt. x Fin. Vuln.	1.20^{c}	1.39^{a}	0.60	1.26^{a}	22.39^{a}	12.29^{a}	7.56^{b}	7.13^{c}	22.47^{a}	12.18^{c}	3.29	11.21^{a}
	(0.67)	(0.43)	(0.41)	(0.38)	(4.89)	(2.83)	(3.38)	(4.14)	(7.06)	(6.44)	(9.85)	(4.17)
K/L x phys. cap. intensity	6.76^{a}	3.99^{b}	5.33^{b}	12.02^{a}	9.45^{a}	4.66^{a}	5.44^{b}	12.16^{a}	7.25^{a}	4.30^{a}	5.46^{b}	12.12^{a}
	(2.03)	(1.61)	(2.55)	(1.79)	(2.02)	(1.63)	(2.54)	(1.75)	(2.02)	(1.64)	(2.54)	(1.74)
H/L x hum. cap. intensity	-0.75	0.39	4.73^{a}	5.28^{a}	-0.78	0.22	4.79^{a}	5.19^{a}	-0.85	0.29	4.73^{a}	5.27^{a}
	(1.56)	(1.31)	(1.29)	(1.61)	(1.50)	(1.32)	(1.30)	(1.64)	(1.57)	(1.32)	(1.27)	(1.61)
Observations	102145	359995	136025	98954	102145	359995	136025	98954	102145	359995	136025	98954
R^2	0.005	0.005	0.007	0.016	0.014	0.007	0.008	0.015	0.005	0.003	0.007	0.015

Notes:Heteroskedasticity-robust standard errors are reported in parentheses. Two-way clustering with standard errors clustered at the province/country level and sector level. ^{a}, ^{b} and ^{c} respectively indicate significance at the 1%, 5% and 10% confidence levels.

Table II.11: Financial liberalization and export structure distortions (non 4-SOCBs' share in credit) (Table 5 split by firm type)

Dependent variable	Log exported value (province/country/ISIC/year)											
Financial vulnerability measure	Financial dependence				Liquidity needs				R&D			
Firm-ownership type	Private	State	JV	Foreign	Private	State	JV	Foreign	Private	State	JV	Foreign
Financial Devt. x Fin. Vuln.	1.44^{c}	1.71^{a}	0.64	0.20	20.78^{a}	10.31^{a}	3.11	0.24	19.47^{b}	15.91^{b}	2.59	-0.64
	(0.82)	(0.46)	(0.47)	(0.41)	(4.86)	(3.55)	(3.33)	(4.78)	(8.19)	(7.54)	(9.27)	(6.44)
K/L x phys. cap. intensity	6.92^{a}	4.01^{b}	5.39^{b}	12.17^{a}	8.74^{a}	4.58^{a}	5.43^{b}	12.19^{a}	7.39^{a}	4.35^{a}	5.48^{b}	12.19^{a}
	(2.04)	(1.61)	(2.55)	(1.74)	(2.02)	(1.65)	(2.55)	(1.74)	(2.01)	(1.64)	(2.54)	(1.73)
H/L x hum. cap. intensity	-0.88	0.30	4.69^{a}	5.14^{a}	-0.67	0.31	4.74^{a}	5.15^{a}	-0.99	0.19	4.72^{a}	5.15^{a}
	(1.56)	(1.30)	(1.28)	(1.62)	(1.57)	(1.33)	(1.29)	(1.62)	(1.56)	(1.34)	(1.26)	(1.63)
Observations	102145	359995	136025	98954	102145	359995	136025	98954	102145	359995	136025	98954
R^2	0.005	0.005	0.007	0.015	0.008	0.004	0.007	0.015	0.004	0.003	0.007	0.015

Notes:Heteroskedasticity-robust standard errors are reported in parentheses. Two-way clustering with standard errors clustered at the province/country level and sector level. ^{a}, ^{b} and ^{c} respectively indicate significance at the 1%, 5% and 10% confidence levels.

II.B Appendix: graphs and descriptive statistics

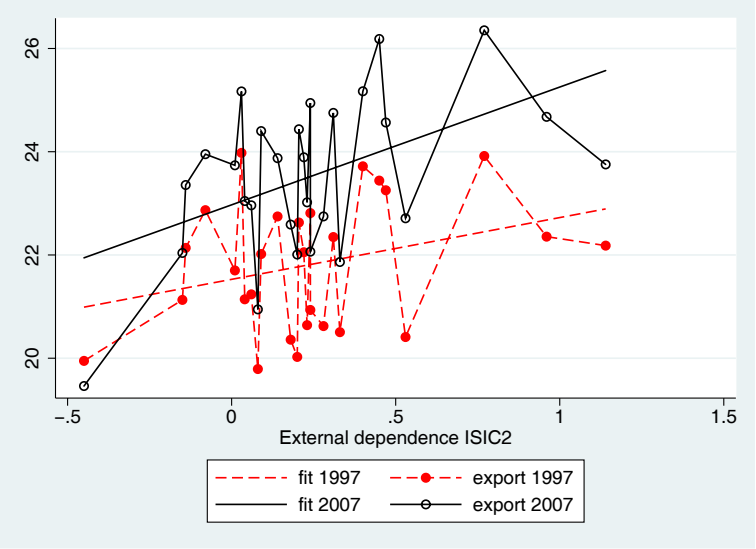

Figure II.1: Time evolution: Export value and external finance dependence (1997 and 2007). Source: Chinese customs.

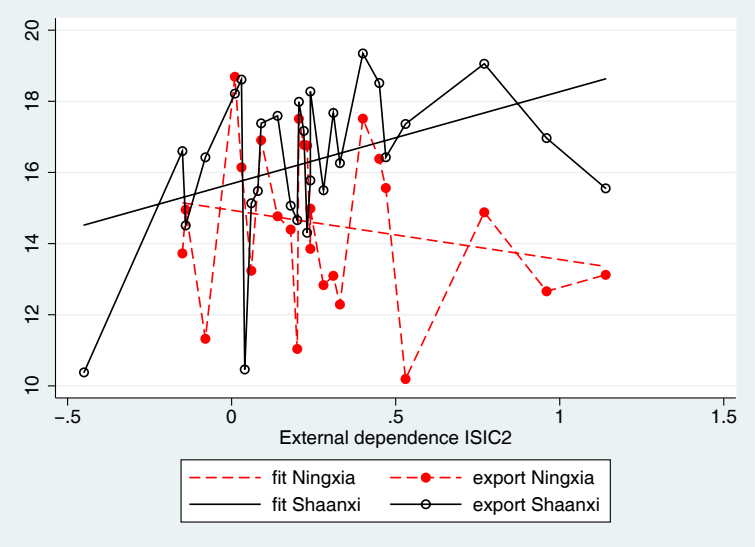

Figure II.2: Spatial heterogeneity: Export value and external finance dependence in Shaanxi and Ningxia in 2000. Though having similar GDPs per capita and shares in China's exports, Shaanxi is much more financially developed than Ningxia. Source: Chinese customs.

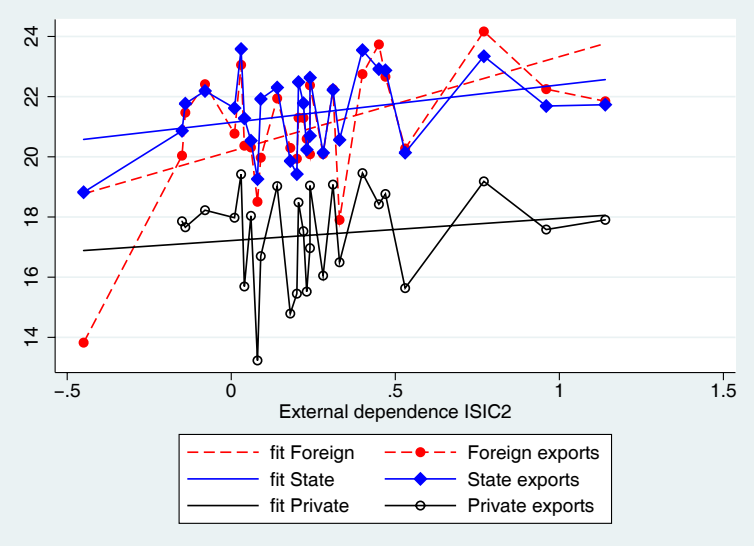

Figure II.3: Firm type heterogeneity: Export value and external finance dependence (private, foreign + JV and state) in 2000. Source: Chinese customs.

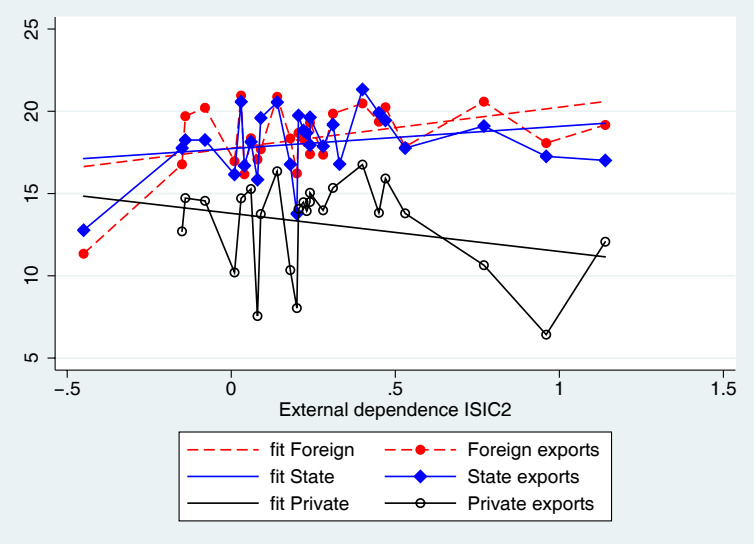

Figure II.4: Firm type heterogeneity in Shandong in 2000: Export value and external finance dependence (private, foreign + JV and state). Source: Chinese customs.

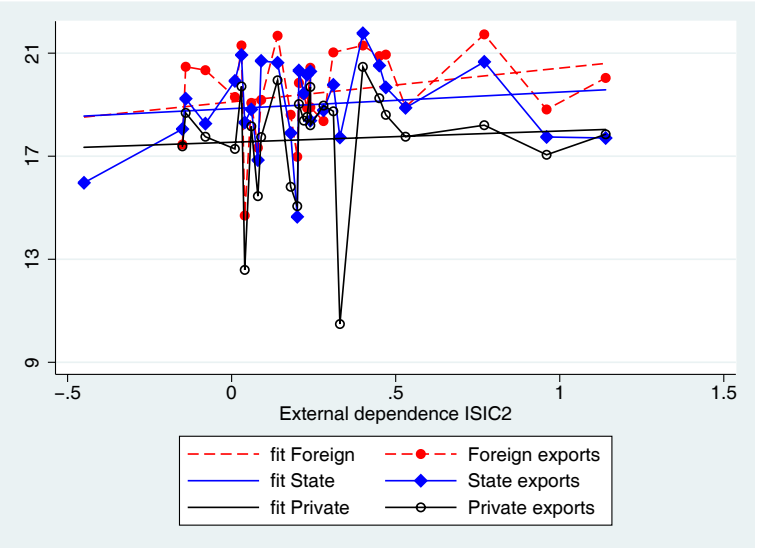

Figure II.5: Firm type heterogeneity in Shandong in 2004: Export value and external finance dependence (private, foreign + JV and state). Source: Chinese customs.

Table II.12: Summary statistics: evolution over time

year	Share non Big 4 State-Owned Banks$^{\beta}$		Share of Foreign entities$^{\gamma}$
	in deposits	in credits	in exports
1990	0.25	0.18	
1991	0.25	0.19	
1992	0.27	0.21	
1993	0.34	0.25	
1994	0.35	0.36	
1995	0.39	0.40	
1996	0.39	0.39	
1997	0.39	0.41	0.24
1998	0.38	0.38	0.25
1999	0.34	0.37	0.27
2000	0.35	0.41	0.29
2001	0.37	0.41	0.30
2002	0.38	0.42	0.31
2003	0.39	0.43	0.30
2004	0.41	0.45	0.31

Yearly average across Chinese provinces. $^{\beta}$ Non Big 4 State-Owned Banks correspond to banks other than the four main State-Owned Banks (the Bank of China, the People's Construction Bank of China, the Agricultural Bank of China and the Industrial and Commercial Bank of China). $^{\gamma}$ Foreign entities are defined here as firms with partial or full foreign ownership. Source: Almanacs of China's Finance and Banking and Chines customs.

Table II.13: Summary statistics: cross-province heterogeneity

province	GDP per capita 2000	Share non-SOCBs in deposits 2000	Share non-SOCBs in credits 2000	Foreign export share 1997-2007	Share in China's exports 1997-2007
Beijing	17936	0.25	0.49	0.40	0.037
Tianjin	16375	0.29	0.30	0.84	0.032
Hebei	7625	0.39	0.43	0.39	0.012
Shanxi	5061	0.33	0.48	0.16	0.004
Inner Mongolia	5905	0.24	0.38	0.20	0.002
Liaoning	11017	0.49	0.53	0.61	0.031
Jilin	6791	0.33	0.47	0.38	0.003
Heilongjiang	8545	0.29	0.47	0.10	0.007
Shanghai	27187	0.43	0.39	0.66	0.115
Jiangsu	11713	0.40	0.41	0.73	0.148
Zhejiang	13410	0.47	0.48	0.35	0.097
Anhui	4840	0.37	0.45	0.26	0.007
Fujian	11496	0.41	0.40	0.61	0.048
Jiangxi	4828	0.33	0.35	0.26	0.004
Shandong	9518	0.51	0.54	0.55	0.060
Henan	5415	0.41	0.52	0.19	0.006
Hubei	7175	0.36	0.45	0.31	0.006
Hunan	5626	0.37	0.49	0.16	0.005
Guangdong	12911	0.42	0.47	0.62	0.340
Guangxi	4315	0.29	0.32	0.23	0.004
Hainan	6814	0.40	0.33	0.42	0.002
Chonqing	5142	0.38	0.47	0.13	0.003
Sichuan	4770	0.34	0.44	0.18	0.007
Guizhou	2645	0.30	0.29	0.16	0.001
Yunnan	4610	0.28	0.31	0.09	0.004
Shaanxi	4558	0.35	0.35	0.14	0.004
Gansu	3846	0.26	0.37	0.16	0.001
Qinghai	5103	0.15	0.26	0.03	0.001
Ningxia	4791	0.25	0.23	0.15	0.001
Xinjiang	7388	0.31	0.39	0.03	0.006

Source: China's statistical yearbooks, Almanacs of China's Finance and Banking and China's customs.

Table II.14: Summary statistics: sector-level characteristics

	Name of sector	ISIC	Hum. cap. intensity	Phys. cap. intensity	External dependence	Cumul. share 1997	Cumul. share 2007	Liquidity needs	R & D intensity	Foreign share
25^{th} percentile	Tobacco	314	1.3539	0.0181	-0.45	0.003	0.000	0.25	0	0.20
	Pottery	361	0.8041	0.0546	-0.15	0.012	0.003	0.17	0.02	0.24
	Leather	323	0.6869	0.0324	-0.14	0.036	0.015	0.27	0.01	0.42
	Footwear	324	0.5328	0.0181	-0.08	0.087	0.037	0.23	0.01	0.60
	Non-ferrous metal	372	1.0982	0.1012	0.01	0.102	0.054	0.17	0.01	0.20
	Apparel	322	0.5017	0.0189	0.03	0.256	0.126	0.21	0	0.33
	Refineries	353	1.6558	0.1955	0.04	0.265	0.135	0.07	0	0.07
	Non-metal products	369	0.9522	0.0684	0.06	0.275	0.143	0.14	0.01	0.36
	Beverages	313	1.1345	0.062	0.08	0.277	0.144	0.11	0	0.20
	Iron and steel	371	1.251	0.1017	0.09	0.299	0.177	0.16	0.01	0.10
	Food products	311	0.8117	0.0616	0.14	0.343	0.197	0.1	0.01	0.39
	Paper products	341	1.1392	0.1315	0.18	0.347	0.202	0.12	0.01	0.45
	Printing & publishing	342	0.9339	0.0515	0.2	0.350	0.205	0.08	0.01	0.64
	Other chemicals	352	1.2089	0.0597	0.22	0.413	0.260	0.15	0.02	0.31
	Rubber products	355	0.9854	0.0656	0.23	0.418	0.268	0.14	0.02	0.59
	Furniture	332	0.6984	0.039	0.24	0.425	0.326	0.15	0.01	0.34
	Metal products	381	0.9144	0.0531	0.24	0.473	0.329	0.18	0.01	0.35
	Wood products	331	0.7409	0.0653	0.28	0.478	0.336	0.12	0.01	0.39
	Transport equipment	384	1.3221	0.0714	0.31	0.509	0.383	0.19	0.02	0.41
	Petroleum and coal	354	1.1531	0.0741	0.33	0.513	0.386	0.12	0.01	0.08
	Textiles	321	0.6881	0.0726	0.4	0.632	0.458	0.17	0.01	0.30
75^{th} percentile	Machinery	382	1.1187	0.0582	0.45	0.721	0.657	0.22	0.02	0.66
	Other manufacturing	390	0.7553	0.0393	0.47	0.796	0.697	0.22	0.02	0.44
	Glass and products	362	1.0121	0.0899	0.53	0.800	0.703	0.15	0.02	0.49
	Electrical machinery	383	1.0636	0.0765	0.77	0.944	0.938	0.2	0.07	0.65
	Professional equipt	385	1.2341	0.0525	0.96	0.975	0.982	0.21	0.09	0.56
	Plastic products	356	0.8274	0.0883	1.14	1.000	1.000	0.13	0.02	0.53

Source: Rajan and Zingales (1998), Braun (2003) and Krosner *et al.* (2007).

Table II.15: Summary statistics: key variables

Variables	Mean	Standard deviation	Min	Max
Share of non 4-SOCBs in credits	0.375	0.097	0.088	0.603
Share of non 4-SOCBs in deposits	0.410	0.087	0.159	0.621
Export value (in US $ billion)	9.66	22.7	0.0764	190
Foreign share in export value	0.293	0.215	0.0098	0.88

Summary statistics are computed based on 240 observations (30 provinces over the years 1997-2004). Source: China's statistical yearbooks and Chines customs. Foreign share computes the share of exports performed by fully foreign and JV firms.

Chapter III

Regional fragmentation, mobility of workers, and the setting of immigration policy

1 Introduction

Most existing theoretical studies of the labor market impacts of immigration model the receiving country as a one-region, unified labor market (Borjas, 2003, 2009; Ottaviano and Peri, 2008, 2012). This classic framework generally considers immigration as an exogenous labor supply shock in the receiving country, in which the labour market is forced to absorb additional workers, which occurs through adjustment of wages (Borjas, 2003), employment (D'Amuri *et al.*, 2010), or tasks (Peri and Sparber, 2009), depending on the characteristics of the labor market. However, these approaches all have in common to consider a perfectly spatially integrated labor market, and thus ignore the existence of regional markets linked together by frictional movements of labor. They should thus be valid for small, well integrated host countries but not for most destination countries, which are generally composed of fragmented regional markets. In the latter case, the impact that immigration has on income and welfare of native workers will depend on location choices of immigrants, on the amplitude of regional disparities, and on the degree of

mobility of natives between regions. Interestingly, although the regional dimension of immigration has long been adressed in empirical studies, taking into account the endogeneity of immigrants' location choices [1] and identifying the possibility of natives' mobility response (Card, 1990), there has been, to our knowledge, little theoretical work on the associated theoretical effects (see below for exceptions).

Yet it is intuitive that the impact of immigration should depend importantly on regional integration and workers mobility. First, if incoming workers allocate themselves to places where they are most productive, efficiency of the productive system at country level should increase, compared to any other allocation rule. Second, one can think that immigrants should in general have a lower cost of mobility than natives, based on the idea that immigrants are by definition a population self-selected on low mobility costs. This implies that an inflow of immigrants should also yield an efficiency gain, if less costly immigrant mobility can substitute to natives' mobility, saving the latter the need to move across regions to equalize factor returns. Third, the gains accruing to native owners of immobile factors in each region - the so-called immigration surplus (Borjas, 1995) - also depend on location choices of immigrants. Fourth, in the presence of risk aversion, the presence of mobile workers may help to reduce the amplitude of fluctuations, yielding a gain in welfare.

This paper studies how natives' welfare gains, and their distribution, vary with workers' mobility and with regional fragmentation. It also looks at the impact of these variables on the political equilibrium for immigration policy.

We build a simple theoretical framework to examine these questions, based on a two-region model with two types of labor, skilled and unskilled.

We start by a static analysis. The propensity of immigrant workers to settle in regions with best economic conditions upon arrival will be called spatial mobility or

[1] Altonji and Card (1989) being the first to use an instrument for immigration inflows into regions, based on a study of network effects by Bartel (1989), which later was frequently used in empirical studies.

flexibility. [2] Our initial setting considers the case of an immobile native population for simplicity. In this setting, the flexibility of immigrant workers is shown to increase the size of the "immigration surplus", the net income gain accruing to native from immigration flows.

This is because a more flexible immigrant population will concentrate more in the high-wage regions, improving efficiency. However, this additional net gain also comes with a more unequal distribution of gains and losses, benefiting to owners of the complementary factor in the rich, attractive region, while unskilled workers are, on average, more negatively impacted by foreign labor's competition. Within each skill group, the polarization of these impacts across regions also increases.

Next, we study the impact of immigrant workers' mobility on the political equilibrium of immigration policy. We consider a setting with both special interests and social welfare entering the government's objective function; this choice is motivated by the abundant evidence for the role of lobbying groups in shaping policy (Goldsborough, 2000; Hanson, 2009; Hatton and Williamson, 2006; Facchini *et al.*, 2011). We thus borrow from the literature on the political economy of trade and migration, and model the shaping of immigration policy in the framework of the Grossman and Helpman (1994)'s standard model. A comparative statics exercise reveals that restrictions to immigration increase with the mobility of foreign workers. This is a consequence of the regional polarization of the impacts of immigration on factor returns, which leads the group most negatively affected - unskilled labor in the most attractive region - to increase its contributions by more.

Finally, we consider an extension of the model to the case where native workers are also mobile across regions in response to disparities in factor returns. In this case, the mobility of foreign workers acts as a substitute to that of native workers of similar skill level, reducing internal migration rates among those natives. The relation between foreign worker's mobility and the equilibrium policy continues to

[2] Flexibility depends on determinants of migration decisions, on the variance of migration costs across regions, and on network and location-specific amenities; we discuss these determinants below.

hold in this case.

Regional fragmentation varies across developed economies. For example, it has been shown that US workers have a high mobility across regions, responding to regional fluctuations by changing location, a mechanism that contributes to reducing regional business cycles (Blanchard and Katz, 1992). By contrast, this mechanism is absent in Europe, with workers in European countries being less mobile across regions (Decressin and Fatas, 1995). Fragmentation is even more obvious within some particular European countries such as Italy, with wide regional inequalities persisting. Results of this paper suggest that immigration may partly substitute for native mobility between regions, increasing efficiency and thus yielding welfare gains beyond the classical immigration surplus. However, due to a higher polarization of the gains and losses among the native population, it may be that political opposition to immigration will increase, absent redistributive mechanisms.

This paper relates to several strands of literature. One contribution of this paper is to extend the classic median voter framework to a two-region setting. This has been done in Giuranno (2009) in a different manner. This author considers two regions electing representatives who will then bargain in a centralized legislature over policy. Conversely we model a country-level election where a policy is adopted when one half of the population supports it, with one region being more supportive of the policy than the other. More generally, the political economy analysis in this paper also relates to the seminal work by Meltzer and Richard (1981) on the relation between inequality and government spending. Their model sheds light in particular on the role played by the distance from median to mean voter on the policy. Consistently with their work we find in this paper that the distance from median to mean voter is what matters for the choice of the immigration policy, with an increase in inequality leading to a more restrictive policy.

Several papers have examined the formation of immigration policy in an political

equilibrium setting, generally focusing on the interaction between immigration and redistribution. Dolmas and Huffman (2004) derive the consequences of voters forecasting future votes by immigrants. Ortega (2005, 2010) considers voters taking into account the perspective of immigrants voting in the next period. Armenter and Ortega (2010) also a considers the link between internal migration and policy formation, focusing on redistributive policies. By contrast, this paper ignores this aspect, focusing on the medium-term up to which only natives are voting. These papers adopt a one-country setting.

We present the model in the next section and characterize the internal migration equilibrium. Section 3 derives the implications of mobility in terms of welfare and of political equilibrium. Section 4 extends the analysis to the case with mobility of natives. Section 5 concludes.

2 Internal migration equilibrium

This section presents the model in static form and describes the internal migration equilibrium.

We adopt a simple framework to model a host country composed of two regional markets. Both regions produce the same good, the price of which is set exogenously on world markets. We normalize this price to 1. The good is produced using the same 2-factor technology in both regions, employing unskilled and skilled labor. Total factor productivity differs across regions. Internal migration of workers is costly, preventing the equalization of factor prices across regions.

The native population N is composed of a number N_U of unskilled workers and a number N_S of skilled workers. Skilled and unskilled natives are initially equally split between the two regions, with a population of $N/2 = N_U/2 + N_S/2$ natives in each region. We will start the analysis by making the hypothesis of no mobility of

natives across regions, i.e., that natives remain in their region of origin. In a second stage, we will lift that hypothesis (section 4).

To keep the analysis simple, we assume that immigration involves unskilled labor only.[3] Immigrant workers are perfect substitutes to native workers in the production system. We denote by I the total inflow of immigrants into the country. The supply of native and foreign unskilled labor and of skilled labor is inelastic. The total unskilled labor input in region j is thus $U_j = N_U^j + I^j$ with N_U^j, I^j the numbers of natives and immigrants residing in region j. The skilled labor input in each region is noted N_S^j.

The production of the final output uses skilled and unskilled labor as complementary factors, with a constant returns to scale technology. Given our hypotheses,the production function can be written as: $Y_j = \theta_j F(N_U^j + I^j, N_S^j)$,

in region $j = A, B$. θ_i is a parameter capturing total factor productivity.

We introduce regional inequality in the form of shocks impacting productivity θ_i. Without loss of generality, we assume that region A has initially drawn a positive productivity shock $\theta = 1 + \bar{\epsilon}$, while region B has drawn a negative shock $\theta = 1 - \bar{\epsilon}$. This difference in productivity creates a regional gap in factor returns, which will be partially compensated by the internal migration of workers.

Productivity gaps ϵ will be assumed to be relatively small throughout the paper. This implies that the situations that will be studied all represent small departures from the symmetric equilibrium given by $N_U^j = N_U/2$, $N_S^j = N_S/2$ and $I^j = I/2$. Therefore, we will use this symmetric equilibrium as a benchmark and derive results by linearization of demand curves around this equilibrium.

Immigration consists of a quota of immigrants $\hat{I}$ which is decided by the central government, then enforced using a costly technology; the cost of enforcement is financed using a lump-sum tax. The per-capita cost is expressed as $c(I_{max} - \hat{I})$,

[3] In most developed countries, the debate on immigration policy is in large part concerned with unskilled immigration and its labour market impacts. We focus on this issue and abstract from the question of skilled immigration, viewing it as a distinct phenomenon in its determinants and its effects. Therefore, we only consider quantity policies for immigration (quotas), while selective policies are not considered.

with I_{max} the maximal number of immigrants willing to enter the country, and c a positive convex function. Function c encompasses administrative and infrastructure costs of enforcing a given immigration quota, due to border control, in-country controls, expelling illegal migrants, etc. These costs are convex, due to decreasing returns in quota enforcement. We further assume that the conditions: $c'(I_{max}) = \infty$ and $c'(0) = 0$ are verified: in other words, the cost of driving immigration down to 0 is prohibitive; while the marginal cost of enforcement is negligible in the free immigration ($I = I_{max}$) regime.[4] Importantly, the enforcement cost depends on country-level immigration, not on the number of foreigners settling in one's region of residence.

Natives derive a linear utility from their level of consumption of the final good, given by their income net of the taxes which are levied to finance the cost of immigration control[5]

$$U_s^j = u(c_s^j) = w_s^j - c(I_{max} - \hat{I}) \tag{III.1}$$

with w_s^j the wage level for labor of type $s = U, S$ in region j.

Upon entry into the country, foreign-born workers choose one region of residence based on a comparison of wage levels and amenities across regions. Region-specific amenities include network connections and information that newcomers may have, as well as personal preferences. The cost of settlement in one region (including difficulties for finding a job, housing, etc.) varies with individual access to those amenities, which is heterogenous across foreigners.

We use a Hotelling-like framework to model this heterogeneity. Immigrants are distributed uniformly along a [0 1] interval, with 0 being the position with the highest relative access to amenities in region A (see figure III.1). The position D of an individual measures his relative access to amenities in B.The cost of settling in region A (region B) is thus given by γD ($\gamma.(1 - D)$, respectively). γ is the cost

[4] Note that this cost function can also be thought of as including the altruistic benefit to natives from accepting immigrants.

[5] We set savings at zero and assume that all income net of tax is consumed at every period.

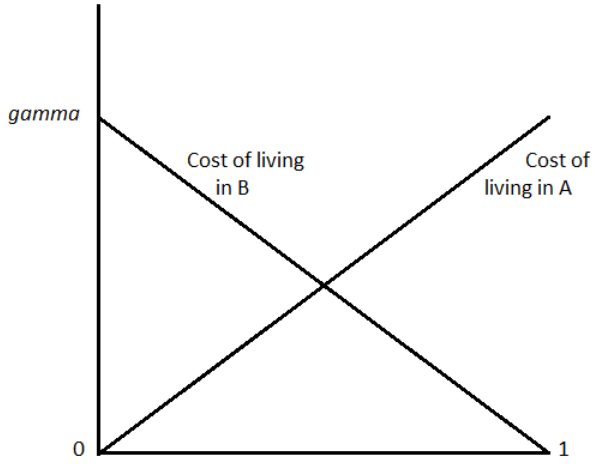

Figure III.1: Settlement costs.

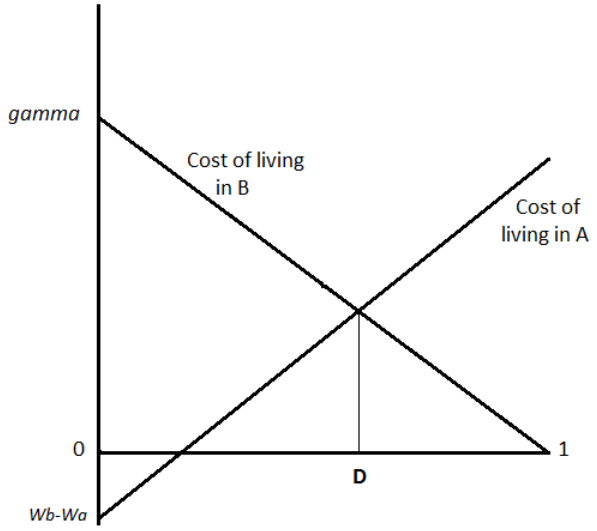

Figure III.2: Location choices: in the case with a higher wage level in region A.

in wage units of residing in A for the individual identified by $D = 1$, and can be thought of as an inverse measure of an immigrants' spatial flexibility.

In this setting, if wages are equal across regions, then the population of incoming immigrants splits equally between the two regions of residence. By contrast, if there is a wage premium in region A, a higher proportion $D > 1/2$ of the immigrant population will settle in A, with some individuals trading off their better access to amenities in B against a higher wage in A (see figure III.2).

This framework is intended to capture frictions in the mobility of foreign workers

across regions. These frictions imply that the regional wage gap will be reduced only in part by workers' internal mobility. The parameter γ captures the degree of frictions: a low γ characterizes a population more spatially flexible, which will display a more scattered pattern of settlement across regions, for a given level of wage disparities. A large γ denotes that access to amenities will carry a large weight in the location decision.[6]This parameter will be used to perform comparative static analysis.

Similarly as for natives, foreign workers are assumed to derive linear utility from consumption, with all their income being consumed at each period. A foreign-born worker j's utility is thus given by:

$u_j = w_U^A - \gamma.D_j$

if he resides in A, and by

$u_j = w_U^B - \gamma.(1 - D_j)$

if he lives in B. At every period, entering migrants choose their region of residence by comparing their utility levels in the two locations.

The internal migration equilibrium consists of a threshold value D_I of the immigrant worker who is indifferent between settling in A or B; and of a value of the unskilled wage gap $\Delta w_U = w_U^A - w_U^B$ consistent with immigrants workers' location choices.

The threshold value of D_I satisfies the condition:

$$w_U^A - \gamma.D_I = w_U^B - \gamma(1 - D_I) \tag{III.2}$$

Labor demand curves in each region then set wage levels as a function of labor inputs:

$$w_U^A = (1 + \epsilon).\left[w_U^N - 2\mu i(D_I - 1/2)\right] \tag{III.3}$$

[6] We assume that the distribution of D is fixed among entering immigrants I and not affected by economic conditions in the regions. This will be the case if the wage difference prompting migration into the country is large compared to economic disparities across regions: thus regional fluctuations are not going to affect individual decisions to migrate.

$$w_U^B = (1-\epsilon).\left[w_U^N + 2\mu i(D_I - 1/2)\right] \tag{III.4}$$

where w_U^N is the wage level in the benchmark case with unit productivity ($\theta_A = \theta_B = 1$) and equal foreign workers' population in each region. μ is the unskilled wage-unskilled labor elasticity, and i the immigration-unskilled labor ratio $i = \frac{I}{N_U+I}$.

Taken together, these conditions yield the following equilibrium:

$$D_I = 1/2 + \frac{\epsilon w_U^N}{\gamma + \mu w_U^N i} \tag{III.5}$$

$$\Delta w_U = \frac{2\epsilon w_N}{1 + \mu\frac{w_N}{\gamma} i} \tag{III.6}$$

This leads to the following result:

Proposition 2.1. *The polarization of foreign-born workers in the high-productivity region is increasing with the productivity differential, with the spatial flexibility of immigrants, and decreasing with the wage elasticity. The wage gap in equilibrium is higher when immigrants are less flexible.*

In other words, immigrant workers contribute to reducing regional wage inequality by settling relatively more in the high-wage region; the amplitude of this effect is higher, the more spatially flexible these workers are (low γ).

Let us take a numerical example to illustrate this result. We take the following parameter values: $\epsilon = 1\%$, meaning a 2% gap in productivity between regions. $\frac{\gamma}{w_N} = 0.5$: this means that the maximum value of mobility costs (i.e. the cost of living in region B for the individual most attached to region A) is of the order of half the wage. In other words, an individual who has access to network and specific information concerning jobs, housing, etc., in region A, and no such access in region B, would have an expected income in region B that is half of his expected income in A. For the wage elasticity μ, we follow Borjas (2003) and take a value of 0.4. Finally we take $i = 5\%$, consistent with the average value in OECD countries (Dumont and

Lemaître, 2008). Overall this gives: $D - 1/2 = 1.92\%$. This means that, with our assumptions, about 52% of the immigrant population would settle in the rich region A. The corresponding value of $\frac{\Delta w}{w_N}$ is 1.92%, meaning that the mobility of foreign workers reduces the wage gap by 4%.

Thus a more flexible foreign population leads to a lower equilibrium wage gap. This is raising total output at the country level, by allocating more workers to the higher-productivity region. As will be shown in the next section, native residents also benefit from this efficiency improvement.

3 Welfare and policy implications

3.1 Welfare impact

We consider here how the welfare of native residents in the host country depends on the number of foreign-born workers, and on the way they locate across the territory.

We start by looking at natives' welfare level in each region. Aggregate native welfare in each region can be written as :

$$W_A = W_A^{sym} + (1+\epsilon)\mu \frac{w_U^N}{N_U + I}(D_I - 1/2).I^2 \tag{III.7}$$

$$W_B = W_B^{sym} - (1-\epsilon)\mu \frac{w_U^N}{N_U + I}(D_I - 1/2).I^2 \tag{III.8}$$

and total native welfare as:

$$W_A + W_B = W_A^{sym} + W_B^{sym} + \epsilon\mu \frac{w_U^N}{N_U + I}(D_I - 1/2).I^2 \tag{III.9}$$

where W_A^{sym} and W_B^{sym} are the welfare levels of natives in each region in the symmetric equilibrium with $D_I = 1/2$; note that this equilibrium is observed in the case of zero spatial flexibility of foreign workers, i.e. $\gamma = \infty$. In this case, unskilled wage levels in each region are given by $w_U^A = (1+\epsilon)w_U^N$ and $w_U^B = (1-\epsilon)w_U^N$, which

defines the benchmark wage level w_U^N. [7] D_I is the threshold level characterizing the foreign worker who is indifferent between settling in region A or B, as computed in equation III.5.

These equations express, in the context of this two-region setting, the well-known fact that immigration of labor generates a net surplus for native residents (Borjas, 1995). They lead us to the following proposition:

Proposition 3.1. *Aggregate native welfare is increasing with the mobility of foreign workers ($1/\gamma$) and with regional inequality ϵ.*

Proof: this result comes directly from the fact that total native surplus III.9 is increasing in D_I, the share of foreign workers settling in region A, and in ϵ. As equation III.5 shows, D_I is increasing with $1/\gamma$ and with ϵ.

For a given level of immigration I in the country, an increase in flexibility (i.e. a decrease in γ) yields a welfare gain to native residents in A, and a loss to those in B. Overall, the net effect is positive: there exists a 'flexibility surplus', i.e. a additional welfare gain that materializes when foreign-born workers concentrate in the high-productivity region (i.e. when $D > 1/2$). This surplus is increasing with the concentration of immigrants in one region (the share D of foreigners settling in A). Thus, for a given number of immigrants in the country, the welfare gain to natives increases when immigrant workers' location choices are more responsive to regional wage disparities. This surplus is also increasing with the productivity gap ϵ: for a given level of workers' mobility, aggregate natives' welfare increases with regional inequality.

This native surplus from flexibility is due to two effects, efficiency and surplus sharing.

First, native residents benefit from the efficiency improvement resulting from the allocation of labor to the high-productivity location. Second, natives also capture an increasing share of additional product due to foreign workers, when those workers are

[7] The welfare level W_A^{sym} is thus given by $W_A^{sym} = \frac{1+\epsilon}{2}(N_U w_U^N + N_S w_S^N) - \frac{N_U+N_S}{2}c(I_{max} - I)$, with w_S^N the benchmark level of the skilled wage defined similarly as for w_U^N.

concentrated in one market; this is reflected by the quadratic form of the immigration surplus in immigration flows, and is due to the fact that additional inflows further decrease the price of labor, thus increasing profits[8].

For this reason, natives' gain is maximal when immigration is polarized in one region[9], in this case in the high-productivity region A. It is reduced when immigrants tend to split equally between regions (as is the case when foreigners' spatial flexibility is low).

How are those gains distributed among natives? In a framework with one integrated labor market, the inflow of unskilled workers has a net positive effect on natives' welfare, resulting from a gain to skilled workers (due to their complementarity with unskilled labor) and a loss incurred by unskilled workers. In order to study how these distributive effects are modified in a two-region framework, we compute separately the welfare levels of unskilled and skilled natives. The per-capita average welfare levels of unkilled and skilled native workers, respectively, can be written as:

$$W_U = W_U^{sym} - \epsilon\mu \frac{w_U^N}{N_U + I}(D_I - 1/2)I \tag{III.10}$$

and

$$W_S = W_S^{sym} + \epsilon\mu \frac{w_U^N}{N_S}(D_I - 1/2)I \tag{III.11}$$

where W_U^{sym} and W_U^{sym} are the welfare levels of each group in the symmetric equilibrium[10]

These equations lead us to the following result:

Proposition 3.2. *An increase in foreign workers' mobility, or an increase in regional inequality, increases the welfare level of skilled natives and decreases the*

[8] Note that this effect is also present in an imperfect labor market with imperfect substitution of foreign and native workers, if worker's bargaining power depends on the unemployment level.

[9] This result has also been obtained in Borjas (2001).

[10] These levels are expressed as $W_U^{sym} = w_U^N - c(I_{max} - I)$ and $W_S^{sym} = w_S^N - c(I_{max} - I)$.

welfare of unskilled natives.

This result comes from observing that welfare levels W_U and W_S are respectively decreasing and increasing in D_I, the spatial polarization of foreign workers. In turn, D_I is increasing in foreigner's spatial flexibility (increasing in γ) and in ϵ, as shown by equation III.5.

The distributive effect of immigration in a one-labor market setting are well-known: in the case of unskilled immigration, an inflow of foreign workers reduces the income of unskilled labor and increases that of skilled labor. Proposition 3.2 amounts to saying that the flexibility of foreign labor reinforces the distributive effects of immigration. In a country with higher inter-regional inequality, or where foreign workers are more reactive to economic disparities across regions, the benefits accruing to natives from immigration are both higher in total, and more unequally distributed.

3.2 Political equilibrium

An large literature has emphasized the role of interest groups and lobbies in shaping policy, including trade policy (Grossman and Helpman, 1994), and public investment and redistribution (Alesina and Rodrik, 1994). In the context of immigration policy, there is abundant anecdotal evidence for the role of lobbying groups in shaping policy (Goldsborough, 2000; Hanson, 2009; Hatton and Williamson, 2006); while Facchini *et al.* (2011) have provided systematic evidence for the United States that both business groups and labor unions directly influence the number of temporary work visas[11].

In face of this evidence, we now consider how regional fragmentation and the mobility of immigrant workers modifies immigration policy in a framework where this policy is being shaped by interest groups. The framework developed by (Bernheim and Whinston, 1986) and Grossman and Helpman (1994) models the

[11] See also Hanson and Spilimbergo (2001) for indirect evidence on the impact of business lobbying on border enforcement.

strategic interaction between interest groups and the government as a common agency problem. We follow Facchini and Willmann (2005), in adopting a similar setting to study the formation of immigration policy.

We consider the case where unskilled workers in each region have their interests represented by a political support group; each of these groups makes financial contributions to the government which are contingent on the immigration policy.[12]

Each lobby group, indexed by $j = A, B$, proposes the government a contribution scheme $C^j(I)$ which is contingent on the enforced immigration quota I. This scheme maximizes the members' welfare, net of contributions:

$$\max_I W_U^j - C^j(I) \tag{III.12}$$

where W_U^j denotes the welfare level of unskilled natives in region j.

This implies that the marginal contribution made by each lobby equals the marginal impact of immigration flows on the welfare level of the members:

$$C_U^{j\,\prime}(I) = \frac{N_U}{2}\left(\frac{\partial w_U^j}{\partial I} + c'(I_{max} - I)\right) \tag{III.13}$$

The governments' objective is to maximize a weighted sum of the financial contributions received from lobbies, and of the welfare level of the entire native population. Thus, it chooses to enforce an immigration quota $\hat{I}$, which maximizes the following objective function:

[12] We do not consider in detail the case where both skilled and unskilled workers are represented by an interest group. In this case, the government's solution consists in maximizing the welfare of the whole native population, as all groups in the population make contributions which the government weights equally. Here, this would lead the government to choose a free immigration policy ($\hat{I} = I_{max}$). Therefore, one needs to assume that interest groups of unskilled workers carry a larger weight in the government's decision than skilled workers' groups, in order have a model consistent with the restrictions on immigration flows. In the setting adopted here, assuming that contributions by skilled workers' lobbies have a lower weight a' than those of unskilled workers' lobbies in the government's objective function is equivalent to assuming no representation of skilled workers' interests and adjusting the relative weight a.

$$\max_I a\left[C_U^A(I) + C_U^B(I)\right] + (N_U/2).[w_U^A + w_U^B] + (N_S/2).[w_S^A + w_S^B] - Nc(I_{max} - I) \tag{III.14}$$

Using equation III.13, and using the demand curves for unskilled and skilled labor, the government's first-order condition can be written as:

$$-\frac{\alpha}{2}N_U\left(a - \frac{I}{N_U}\right)[1 + \epsilon(2D-1)] + [(a+1)N_U + N_S]\,c'(I_{max} - I) = 0 \tag{III.15}$$

This equation shows the existence of an interior solution to the government's problem, $0 < \hat{I} < I_{max}$, in the case where the weight a of the lobbies' contributions is not smaller than the ratio $\frac{I}{N_U}$. In other words, when the political weight of unskilled workers is sufficiently large, the government restricts immigration.

This equation leads us to the following proposition:

Proposition 3.3. *An increase in foreign workers' mobility, or an increase in regional inequality, decreases the level of the immigration quota enforced by the government.*

Proof: this result obtains from considering the effect of a change in D or in ϵ, in condition III.15. Starting from a given equilibrium policy $\hat{I}$, an increase in immigrant's mobility (a decrease in γ) implies a higher D (proposition 2.1). This increases the first term of III.15 in absolute value, which expresses the fact that contributions decrease more steeply with immigration, when flexibility is higher. Therefore the new equilibrium is at a lower quota level. An increase in ϵ has the same effect.

Proposition 3.3 is a consequence of the fact that wage levels are more responsive to immigration in the high-productivity region. Thus, in a process where interest groups compete to influence political decisions, organized labor in region A is willing to contribute more in order to curb immigration, because it is facing higher costs

from the entry of additional workers on the local wage level.

This section shows that the spatial flexibility of foreign workers has a positive impact on natives' welfare, and a negative impact on the politically admissible level of immigration, under the political setting considered here. This result is essentially a consequence of the fact that a higher flexibility of immigrant workers implies a polarization of immigration impacts on factor prices. In an integrated labor market, immigration of unskilled workers implies a gain to skilled labor and a loss for unskilled labor. In a fragmented market, both these gain and cost are unevenly distributed across regions, with natives in the most attractive region facing the largest impacts. In a political setting where organized unskilled labor carries a larger weight in the setting of immigration policy, this implies that unskilled workers in the attractive region will be willing to raise more their contributions to limit inflows.

4 Extension: the case with mobility of natives

We now modify the model in order to allow for the mobility of native workers across regions. This is an important addition to our basic analysis, as it allows to capture how the impact of immigration may depend on the natives' own degree of mobility, which exhibits significant differences across developed countries. In particular, it is well established that Europeans generally move less across regions in their country of residence than Americans do (Faini *et al.*, 1997; Gregg *et al.*, 2004; Borjas *et al.*, 1992).

Adding native mobility makes the analytics of the model more complex by adding a second source of heterogeneity among natives. Natives of each type are heterogeneous in their propensity to move across regions, which is summarized by a variable $D \in [0,1]$. As for immigrants, the variable D is assumed to be distributed uniformly on $[0,1]$ among natives. A native i's cost of living in region A (respectively in B) is $\gamma_N D_i$ (resp. $\gamma_N(1-D_i)$). We now denote by γ_I the mobility cost parameter

of immigrant workers. Results from the empirical literature are ambiguous about the sign of $\gamma_N - \gamma_I$[13]; therefore we remain agnostic about it. We will essentially focus our analysis on the effects of a change in the mobility ratio $\frac{\gamma_N}{\gamma_I}$.

4.1 Migration equilibrium

The migration equilibrium is now described by one threshold condition for each group of the population:

$$\gamma_N(2D_S - 1) = \Delta w_S \quad \text{(III.16)}$$

$$\gamma_N(2D_U - 1) = \Delta w_U \quad \text{(III.17)}$$

$$\gamma_I(2D_I - 1) = \Delta w_U \quad \text{(III.18)}$$

with $D_S.N_S$ and $D_U.N_U$ being the shares of the skilled and unskilled native populations, respectively, who choose to settle in region A in equilibrium; D_S and D_U denote the value of the variable D for the indifferent skilled and unskilled natives, respectively, who would obtain the same utility from settling in either region. As before, D_I is the share of immigrants settling in A; $\Delta w_U = w_U^A - w_U^B$ the unskilled wage gap, and $\Delta w_S = w_S^A - w_S^B$ the skilled wage gap.

To solve for equilibrium values of wage gaps Δw_U and Δw_S and the corresponding internal migration patterns, requires to impose the relations between wage gaps and regional factor inputs, which derive from the demand curves for skilled and unskilled labor. These can be written as:

[13] Two recent studies directly estimate the difference in internal mobility between immigrants and natives. Schündeln (2007) finds a higher mobility of immigrants for Germany, while Boman (2011), in the case of Sweden, finds that immigrants' mobility is higher, but only after controlling for the effect of enclaves.

$$\Delta w_U = 2\epsilon w_U^N + \beta.(2D_S - 1)N_S - \alpha\left[(2D_I - 1)I + (2D_U - 1)N_U\right] \quad \text{(III.19)}$$

$$\Delta w_S = 2\epsilon w_S^N + \beta\left[(2D_I - 1)I + (2D_U - 1)N_U\right] - \delta.(2D_S - 1)N_S \quad \text{(III.20)}$$

These equations express the fact that, due to the complementarity of the factors of production, the unskilled wage gap is decreasing with the share of skilled workers settling in region A, and decreasing with the shares of unskilled workers (native and foreign) choosing A as region of residence. The effects are reversed for the skilled wage gap.

w_U^N and w_U^N denote the wage levels in the symmetric equilibrium, in which productivity equals 1 in both regions ($\epsilon = 0$), implying $D_U = D_S = D_I = 1/2$. α, β and δ are all positive and denote the derivatives of wages with respect to labor inputs. [14]

Solving for the equilibrium defined by system III.16 to III.19, yields the following result:

Proposition 4.1. *Defining the mobility ratio m as $m = \frac{\gamma_N}{\gamma_I}$, one has: $\frac{\partial(\Delta w_U)}{\partial m} < 0$, $\frac{\partial D_U}{\partial m} < 0$ and $\frac{\partial(\Delta w_S)}{\partial m} > 0$. Thus an increase in the mobility of immigrants relative to natives causes a decrease in the regional unskilled wage gap, a decrease in native unskilled workers' internal migration, and an increase in the skilled wage gap.*

See Appendix for proof.

Proposition 4.1 indicates that, if incoming foreign-born workers are more mobile (for a given level of natives' mobility), their settlement pattern will contribute more to reducing the unskilled wage gap. This implies that native workers will migrate less across regions, in equilibrium (D_U decreases): internal migration of native and foreign unskilled workers are substitutes. Conversely the skilled wage gap and skilled

[14] These relations obtain from a first order linear development of the demand curves around the symmetric equilibrium. The derivatives $\beta = \frac{\partial^2 F}{\partial U \partial S}$, $\alpha = -\frac{\partial^2 F}{\partial U^2}$ and $\delta = -\frac{\partial^2 F}{\partial S^2}$ are taken at the symmetric equilibrium. The linear development is valid for small values of the population imbalances $D_U - 1/2$,$D_S - 1/2$ and $D_I - 1/2$.

workers' internal migration (D_1) increase, a consequence of the complementarity between the two labor inputs.

4.2 Welfare impact of flexibility

Following the same progression as in the previous section, we first ask how the impact of immigration on natives' welfare varies with the degree of spatial flexibility of foreign-born workers. Beside impacting factor returns, immigration is now also changing migration patterns for natives: this impacts their welfare, through the costs of mobility.

The average welfare level of native unskilled workers living in the two regions is given by:

$$W_U = \underbrace{D_U w_A + (1 - D_U) w_B}_{income} - \underbrace{\frac{\gamma_N}{2}\left(D_U^2 + (1 - D_U)^2\right)}_{mobility\ costs} \tag{III.21}$$

Using equilibrium conditions, the income part of this welfare function can be rewritten as:

$$W_U^{income} = \gamma_N(2D_U - 1)D_U + \gamma_N(1 - \epsilon)D_U + (1 - \epsilon)^2 w_U^N \tag{III.22}$$

This last expression is increasing in D_U. Thus, proposition 4.1 implies that a higher flexibility of foreign workers *decreases* the average income of native unskilled workers W_U^{income}. This result is the equivalent of proposition 3.2, in the context of this section. As in the previous setting, a more flexible immigrant population will concentrate more in the high-productivity region A, thus increasing the downward pressure on the unskilled wage there. This reduces regional wage inequality but also the country's average unskilled wage.

Conversely, mobility costs are clearly minimized when native workers are equally split between the two regions ($D_U = 1/2$): thus, immigrant flexibility raises native

workers' welfare in this respect, by saving some of them the costs of moving from their preferred location.

Overall, total native workers' welfare can be written as:

$$W_U = \gamma_N \left[D_U^2 + \gamma(1-\epsilon) D_U - 1/2 \right] + (1-\epsilon)^2 w_U^N \tag{III.23}$$

This expression is increasing in D_U. This leads to the following result:

Proposition 4.2. *A higher flexibility of immigrant workers is detrimental to native workers. It decreases average wages for those workers, while reducing mobility costs incurred by them. The net welfare effect is negative.*

We now turn to the welfare of native skilled workers. For this group, the effects are reversed: a higher concentration of unskilled workers increases average skilled wages, by bringing more labor into the high-productivity region A. This causes more skilled workers to move to that region, which raises total mobility costs for this part of the population.

More precisely, the average level of welfare of skilled workers in the country can be written as:

$$W_S = \underbrace{D_S w_S^A + (1-D_S) w_S^B}_{income} - \underbrace{\frac{\gamma_N}{2} \left(D_S^2 + (1-D_S)^2 \right)}_{mobility\ costs} \tag{III.24}$$

which , using equilibrium conditions, can be expressed as:

$$W_S = \gamma_N (2D_S - 1)(D_S + 1 - \epsilon) + (1-\epsilon)(1-2\epsilon) w_S^N - \frac{\gamma_N}{2} \left[D_S^2 + (1-D_S)^2 \right] \tag{III.25}$$

We thus have the following result:

Proposition 4.3. *A higher flexibility of immigrant workers is beneficial to native skilled workers. It increases the country average of skill returns, while increasing mobility costs incurred by them. The net welfare effect is positive.*

See appendix for proof.

4.3 Political equilibrium

We now turn to studying the outcome of the political process, which we model here as being influenced by interest groups. As in section 3.2, we assume that unskilled native workers in each region organize in a group to exert influence on the government for the choice of immigration policy.

We further assume that workers are represented by the support group of their region of residence.[15] Each group proposes a contribution schedule to the government, which maximize the group members' welfare net of contributions. The important difference with the previous case is that the government now takes into account, via the contributions, the impact that immigration flows have on the mobility costs incurred by natives, as well as on the population sizes of each interest group.

Under these hypotheses, we obtain the following result:

Proposition 4.4. *An increase in the mobility ratio m, or in regional inequality ϵ, results in a more restrictive immigration policy in equilibrium.*

See Appendix for proof.

This result confirms the one established in the case without native mobility. A higher mobility ratio m or a higher productivity gap ϵ can, again, be thought of as both increasing polarization of the effects of immigration on factor prices. In a political process where workers in each region can influence policy in proportion with their interests at stake, via their contributions, unskilled workers in the attractive region are willing to pay more to reduce the immigration level (relative to unskilled workers in B, whose opposition to immigration decreases).

[15] This is motivated by the fact that, in the case of labor unions, workers ar typically represented by the union in their firm of employment, therefore in the region where they work.

5 Conclusion

This paper studies how immigration impact on native residents depends on the degree of regional fragmentation of the host country. A simple model is proposed, integrating native heterogeneity into a 2-region, 2-factor framework, and modeling immigrant and native internal mobility in a Hotelling-like model of location preferences. This model shows that the 'immigration surplus' - the gain in welfare accruing to native factors from an inflow of additional workers - is increasing with regional fragmentation, i.e. with regional disparities, and with foreign workers' flexibility, that is their propensity to exploit such regional differences. However, the distribution of these gains also becomes more polarized, more unequal across factors and across regions for each factor. How does the political equilibrium of immigration policy change as a result depends on the political process. In a referendum-like system of voting, immigration policy gets more open when fragmentation and immigrant mobility increase. Conversely, restrictions increase if unskilled labor interests become organized. These results are confirmed when extending the framework to allow for native mobility.

III.A Appendix

Section 4: Case with natives mobility.

Proof of proposition 4.1:

Equations III.16 express the migration rates D_U, D_S and D_I as a fonction of wage gaps Δw_S and Δw_U. Plugging these into the system III.19, we obtain a two-equation linear system in (Δw_S, Δw_U). The solution of this system is given by:

$$\Delta w_U = \frac{2\epsilon \bar{w}_U}{1 + (1+mi)\frac{\alpha N_U}{2\gamma_N + \beta(N_U+I)}} \tag{III.26}$$

and

$$\Delta w_S \left(1 + \frac{\beta(N_U+I)}{2\gamma_N}\right) = 2\epsilon \bar{w}_S + 2\epsilon \bar{w}_U \frac{\beta N_U}{2\gamma_N} \frac{1+mi}{1 + \frac{\alpha N_U}{2\gamma_N + \beta(N_U+I)}(1+mi)} \tag{III.27}$$

with $m = \frac{\gamma_N}{\gamma_I}$ the mobility ratio, $i = I/N_U$ the immigrants to unskilled workers ratio, $\alpha = -\frac{\partial w_U}{\partial L_U}$ and $\beta = \frac{\partial w_S}{\partial L_U}$ are the derivatives of the unskilled and skilled wage, respectively, with respect to the unskilled labor supply. We have been using the relation $\beta = \frac{N_U+I}{N_S}\alpha$, which comes from the property of homogeneity of degree one of the production function.

These expressions show that, holding population sizes N_U,N_S I, and native mobility γ_n, constant, the impact of an increase of m (i.e., a higher mobility of foreign workers relative to natives) on the wage gap Δw is negative, and is positive on the skilled wage gap Δw_S. From equations III.16, one immediately sees that the migration rate of native unskilled workers decreases, while that of skilled workers increases as a result.

All else being constant, a more mobile foreign population will settle in larger part in region A. This will reduce the migration rate of native unskilled workers (D_U decreases) and increases that of skilled workers (D_S increases). Overall, the unskilled wage gap decreases, the skilled wage gap increases.

Proof of proposition 4.3:

Differentiating W_1 yields: $dW_1 = dD_1.(1 - \epsilon + D_1)$.

Therefore W_1 is increasing with D_1. An increase in mobility ratio m increases D_1 (since Δr increases), thus is beneficial to skilled workers N_1.

Proof of proposition 4.4:

Each interest group maximizes its welfare net of its contributions. This characterizes the contribution schedules: the marginal contribution of each group equals the marginal impact of I on the aggregate welfare of the group. The schedules can thus be characterized as follows:

$$C_U^{A\prime}(I) = -N_U D_U \alpha(1+\epsilon) D_I + N_U \frac{\partial D_U}{\partial I}[w_U^A - \gamma_N D_U] \quad \text{(III.28)}$$

$$C_U^{B\prime}(I) = -N_U(1-D_U)\alpha(1-\epsilon)(1-D_I) - N_U \frac{\partial D_U}{\partial I}[w_U^B - \gamma_N(1-D_U)] \quad \text{(III.29)}$$

(III.30)

Summing the two expressions, and using the fact that $\Delta w_U = \gamma_N(2D_U - 1)$, one obtains that the last terms cancel out together; this is because for the marginal native moving from one region to the other, the marginal change in the wage gap exactly compensates the marginal cost of mobility. Thus, one obtains:

$$C_U^{A\prime}(I) + C_U^{B\prime}(I) = -\alpha N_U \left[(1+\epsilon) D_U D_I + (1-\epsilon)(1-D_U)(1-D_I)\right] \quad \text{(III.31)}$$

The government then maximizes the weighted sum of the contributions and of aggregate native welfare. Thus the governments' FOC can be written as:

$a\left[C_U^{A\prime}(I) + C_U^{B\prime}(I)\right] + \frac{\partial W}{\partial I} = 0.$

The marginal impact of I on native welfare can be written as:

$$\frac{\partial W}{\partial I} = \sum_{i,l} D_{i,l} N_l \frac{\partial w_l^i}{\partial I} + \frac{\partial D_U}{\partial I}.\left[\Delta w_U - \gamma_N(2D_U - 1)\right] + \frac{\partial D_S}{\partial I}.\left[\Delta w_S - \gamma_N(2D_S - 1)\right] + Nc'(I_{max} - I) \tag{III.32}$$

where $i = A, B$ and $l = U, S$. The terms in $\frac{\partial D_U}{\partial I}$ and $\frac{\partial D_S}{\partial I}$ simplify to 0 for the same reason as for the case of the marginal contributions shown above: in other words, when considering native welfare the government can ignore the natives' mobility response to its policy and do as if native groups were fixed. Thus, the marginal welfare impact reduces to the sum of the changes in the four wage levels w_l^i ($i = A, B$, $l = U, S$), weighted by the population sizes.

The marginal impact of I on the unskilled wage in region A is given by:

$$\frac{\partial w_U^A}{\partial I} = -\alpha(1 + \epsilon) D_I \tag{III.33}$$

Here we neglect the indirect impact that I has on wages via its impact on natives' location choices. Marginal impacts of I on w_U^B,w_S^A and w_S^B are computed similarly. Overall, the marginal welfare change obtains as:

$$\begin{aligned} \frac{\partial W}{\partial I} &= \alpha(1 + \epsilon) D_I \left[(N_U + I) D_S - N_U D_U\right] \\ &+ \alpha(1 - \epsilon)(1 - D_I) \left[(N_U + I)(1 - D_S) - N_U(1 - D_U)\right] + Nc'(I_{max} - I) \end{aligned} \tag{III.34}$$

Note that we have been using the relation $\beta = \alpha \frac{N_U + I}{N_S}$ between the elasticities of skilled and unskilled wage with respect to the unskilled labor input.

Rearranging the terms, the government's FOC can be reexpressed as:

$$- (a + 1)\alpha N_U \left[(1 + \epsilon) D_U D_I + (1 - \epsilon)(1 - D_U)(1 - D_I)\right] \tag{III.35}$$

$$+ \alpha(N_U + I) \left[(1 + \epsilon) D_I D_S + (1 - \epsilon)(1 - D_I)(1 - D_S)\right] + Nc'(I_{max} - I) = 0 \tag{III.36}$$

This expression shows that the government choses a quota level I which balances the costs incurred by native unskilled workers (first term, negative) with the benefits to skilled workers (second term, positive) and the benefits in terms of spared costs of enforcement (third term, positive). Plugging the equilibrium values of internal migration rates D_I,D_U and D_S obtained from equations III.26 and III.27, one obtains that the derivative of the right-hand side of the FOC with respect to m is negative; this means that a higher m shifts the political equilibrium $\hat{I}$ to the left (lower quota level).

Chapter IV

Determinants of Trade Policy[1]

1 Introduction

Preferential trade agreements (PTAs) are growing fast in number, while multilateral trade negotiations are stalling. From 1995 through 2010, the number of PTAs increased fourfold to reach 300 PTAs presently in force (WTO, 2011); the geographical coverage of PTAs has expanded both within and between continents, and with the participation of developed and developing countries. At the same time, negotiations to open trade multilaterally have not made significant progress in recent years.

Given the non-optimality of preferential trade liberalization, and the distorsions associated to it, these facts are worrying. They raise the question of why countries favor discriminatory trade opening, when theory suggests a unilateral and non-discriminatory opening of trade to be optimal. We examine this question by looking at the immediate gains countries may expect from alternative trade policies. These gains are of two types: market access gains, which benefit producers, and real income gains, which benefit consumers by lowering prices. Results show that the former are a stronger determinant of trade policy than the latter.

Our approach consists in letting the data on trade policies talk about what guides countries' decisions. We use an exhaustive database of tariff protection for the period

[1] This chapter is based on my paper entitled "Who decides on Trade Policy?" co-written with José de Sousa and Sami Bensassi.

2001-2007, and rely on a simple model of international trade based on Armington differentiation to compute the implied changes in trade, income and welfare for world countries. We find large variation in the treatment effects of PTAs on trade, with trade creation varying between 4 and 80%. However, these treatment effects are barely visible, because the multiplicity of concurrent trade policy changes reduces substantially trade creation between partners. Overall, the average trade creation among all the active PTAs we consider is of 16.5%, and is of less than 10% for one third of them.

This result is in line with previous insights from the literature on diversion effects of preferential agreements (Carrère, 2006) as well as on the impact of preferential margins on trade (Hoekman and Nicita, 2011); it shows in particular that the "proliferation" of PTAs generally weakens the impact of each single agreement.[2] However, in contrast to this literature, we do not estimate trade creation and diversion effect ex-post using a gravity model, but instead compute structural estimates of the trade effects implied by observed changes in trade costs. This allows us to quantify, for each PTA, how much diversion is attributable to parallel trade agreements, and to multilateral tariff reductions implemented by partner countries. Results indicate that the parallel preferential and multilateral tariff reductions each reduce trade creation by about one third.

Second, we characterize each country's trade policy in our period of interest, measuring the impacts of this policy all else equal. We ask in particular if these trade policies tend to reinforce distorsions in the trade structure of countries, by making trade more preferential. Results show disparities across countries: about half the countries in our sample have had a policy which made their trade *more* multilateral, all else equal. This runs counter to the intuition that the overwhelming trend in recent years has been toward more preferentialism, as suggested by the

[2] Fugazza and Nicita (2011) also emphasize the impact of PTA proliferation on trade flows. However their method is based on augmenting a gravity model with two indices of multilateral trade costs. By contrast we structurally estimate the changes inrelative trade costs. Piermartini *et al.* (2005) also document the erosion of preferences for developing countries following multilateral trade liberalization.

multiplication of PTAs. Rather, our analysis suggests that some countries tend to favor one or the other modes of liberalization, depending on the relative gains they expect from each process.

This observation naturally leads us to ask about the determinants of trade policy choices of countries. Do countries choose to engage in PTAs, or to open trade across the board, in their own interest? Previous literature has emphasized that the choice of trade policy results from confronting different interests (Grossman and Helpman, 1995): producers in different sectors tend to favor or oppose an agreement depending on the structure of protection and productivity differences between potential partners, causing them to expect market access gains, or increased import competition. Consumers expect real income gains through lower prices, however they may also expect losses by diversion if distorsions in the tariff structure become important. Computing the impacts of alternative trade policy choices for producers and for consumers, we confront these impacts with the list of actually signed agreements. Results are reassuring: expected real income gains from signing a PTA predict actual PTAs; moreover, potential gains from multilateral opening reduce the probability of signing, which confirms the existence of a tradeoff between the two modes of liberalization. However, we also find that the two gains do not have the same weight in a country's trade policy: producer gains have an impact that is about two times larger on the probability of signing. Finally, we also show that the losses by diversion faced by countries are also a significant predictor of the signing of PTAs, which confirms a contagion or "domino effect" (Baldwin, 1993) being one of the main forces behind the proliferation of PTAs. In other words, countries sign PTAs also for the motive of avoiding the losses from non-preferential access to a partner's market.

Our approach focuses on terms-of-trade impacts of trade policy. By using a multi-sector model of international trade with imperfect competition, with an endowments economy as the simplest production structure, we restrict the analysis to short-term effects of trade barrier changes, leaving aside long-term adjustements of the

production structure. Previous literature has shown these terms-of-trade motives to be predominant in driving trade policy (Baier and Bergstrand, 2004). Our results confirm this aspect, and more importantly, show that structural estimates of terms-of-trade have explanatory power for trade policy, above and beyond proxies based on distance and income levels. The use of the Armington endowments model is also justified by its good performance to explain trade data (Anderson and Yotov, 2010b, 2012). After exposing the model, we show how the impact of preferential tariff reductions on prices and trade varies with pre-FTA trade patterns. Then, we parameterize the model to quantify PTA effects, which boils down to estimating sector-level elasticities of substitution in preferences. We estimate these parameters using disaggregated bilateral applied tariff panel data. Once armed with these elasticity estimates and with our data on applied tariff changes, we compute PTA effects by counterfactual estimation. This allows us to compute the trade, income and Welfare impacts implied trade policies as implemented by world countries during the period. It also allows us to disentangle the effects of each country's trade policy from the externalities created by simultaneous trade policy changes, including PTA proliferation and multilateral tariff reductions by other countries. Finally, we use the method to confront the effects of actual trade policies to those of alternative policies, namely trade agreements and multilateral trade liberalizations.

A large literature has studied the determinants of trade policy. The seminal paper by Grossman and Helpman (1995) builds a political economy framework where governments take into account both voter's interests and industry special interests in deciding over trade agreements. By contrast, we do not enter into the political economy structure of countries, as we do not observe whether groups are organized into lobbies, nor whether there is coordination across sectors in trying to influence trade policy. Rather, we make the implicit hypothesis that net gains to each group, aggregated across sectors, should matter for the government's decisions. This should be the case if the possibility of transfers across groups exists, so that adversely impacted groups can be compensated for their losses. Our results indicate that

this is the case only in part. Our results are also related to those in Goldberg and Maggi (1999), who run an empirical test of the model by Grossman and Helpman (1994). These authors quantify the weight of welfare in the US government's objective function and find it to be very close to 1 (0.99), implying that the US government is close to being a perfect welfare maximizer in its design of tariff structure. By contrast, our analysis based on the signing of PTAs finds robust evidence that world countries' trade policies substantially differ from the welfare-maximizing, overweighting producers' interests over those of consumers.

The use of an endowments model of trade based on Armington differentiation and Dixit- Stiglitz preferences places our paper in the so-called "structural gravity" literature (Anderson and Yotov, 2011; Egger *et al.*, 2011)). This strand of the literature proposes to study the effects of bilateral trade barriers by using the "gravity" model of trade, but to solve it structurally, i.e. to treat multilateral prices in all world countries as endogeneous; in contrast to previous treatments of the gravity model, which used to ignore multilateral prices[3]. This makes this approach similar to the one used in computable general equilibrium (CGE) models (see DeRosa and Gilbert (2005) for a review). The difference, however, is that CGE models consider a much larger number of markets (e.g. labour and land markets) and sectors (e.g. services) and consider more complex production technologies. This makes CGE models both more complete, and heavier to handle; so that it is often difficult to trace the effects of a change in one exogenous variable, such as a trade cost, as these effects will run through all markets. In this sense, structural gravity models can be seen as one module of a CGE model[4], which is isolated in order to focus the analysis on the price and terms-and-trade effects of trade policy.

An important difference in our method is to rely on sector-level elasticity esti-

[3] See e.g. McCallum (1995). For instance, in the gravity equation used in McCallum (1995), $x_{ij} = a + by_i + cy_j + ddist_{ij} + e.Border_{ij} + uij$, the impact of a bilateral cost such as distance or a border on trade between two locations i and j is assumed to be the same across location pairs; while a model such as the one used in this paper shows that this impact depends on i's and j's multilateral terms, i.e., on relative and not on absolute trade costs.

[4] The structure of preferences used in these models is similar to the one in CGE models, except that CGE models typically consider more than one levels of substitution between goods.

mates instead of a single PTA parameter, which allows to account for heterogeneity in PTA effects de to the width and depth of tariff reductions.[5]

Our results are also related to Arkolakis *et al.* (2012), who derive an expression of welfare gains from trade liberalization as a function of the change in import penetration, a result holding in the Armington model as well as in a larger class of models. This result does not allow to predict the welfare change for a country implementing a preferential or multilateral trade barrier reduction, if one does not know the change in import penetration which will result from such a change. Our exercise focuses on predicting this change in import penetration, which in turn depends on pre-liberalization tariff levels, on the amplitude of tariff reductions, and on the resulting change in relative trade costs. For example, a country reducing tariffs with one PTA partner will increase its imports from that country, and reduce its share of imports from non-preferential partners, as well as of domestic production, in its expenditure. But to know by how much these shares will change requires the knowledge of the complete matrix of trade costs. Therefore, our results on the impacts of real and potential PTAs cannot be obtained with a restricted list of sufficient statistics, but require to solve the model in general equilibrium.

The rest of the paper is as follows. In section (2), we present the model and explores its implications for the effects of PTAs on trade, real income and welfare. In section (3), we estimate the model parameters. In section (4), we compute the trade impacts of all PTAs implemented during our period of study, as well as the impacts of countries' trade policy on their income and welfare. Then, in section (5), we study the determinants of the signing of PTAs. Section (6) concludes.

[5] Another difference is that we solve the model in full general equilibrium, allowing for export prices to affect trade through countries' income, contrary to antecedents in which trade changes are computed while implicitly keeping countries' income as fixed (Anderson and Wincoop, 2003; Anderson and Yotov, 2010a; Baier and Bergstrand, 2009; Egger *et al.*, 2011).

2 Model

We present the model and the method used for solving it, then we show its implications for the effects of preferential trade barrier reductions. We use a multi-sector model, in order to account for the variation of trade protection across sectors.

Model structure

Consumers demand varieties of each good from different countries, because they perceive them as different. We assume that each good is produced with a specific factor, and each country is endowed with a fixed supply of each factor. This hypothesis is essentially one of an endowments economy. This implies that the model focuses on the impact of trade policy on the allocation of goods across destinations (including the domestic country), ignoring feedback effects on production.

The structure of demand is assumed to be Cobb-Douglas on different goods, and Constant Elasticity of Substitution (CES) on varieties within each good/sector:

$$c_{ij}^k = (p_i^k)^{-\sigma_k}.\left(\frac{\tau_{ij}^k}{P_j^k}\right)^{1-\sigma_k}.E_j^k, \tag{IV.1}$$

where c_{ij}^k is the demand of country j's consumers for the i variety of good k, p_i^k is the f.o.b (free on board) price of that variety, τ_{ij}^k is the iceberg trade cost on trade from i to j in sector k, P_j^k is country j's price index in that sector and σ_k is the CES elasticity in that sector. E_j^k is country j's expenditure on good k, given by $E_j^k = \alpha_k.Y_j$, where α_k is the Cobb-Douglas parameter share of expenditure on good k and Y_j is country j's GDP.

Thus the nominal bilateral trade flow between i and j in sector k is given by

$$X_{ij}^k = \left(\frac{p_i^k.\tau_{ij}^k}{P_j^k}\right)^{1-\sigma_k}.E_j^k. \tag{IV.2}$$

The CES price index for j's consumers in country k is an aggregate of the prices

paid by them on all varieties of that good:

$$(P_j^k)^{(1-\sigma_k)} = \sum_i p_i^k . {\tau_{ij}^k}^{1-\sigma_k}. \tag{IV.3}$$

On the supply side, each country i produces a quantity Q_i^k of good k using a specific factor L_i^k which is in fixed supply. In perfect competition this factor is paid at its marginal price which is equal to the f.o.b price of the good:

$$w_i^k = p_i^k . f_i^{k\prime}(L_i^k), \tag{IV.4}$$

where w_i^k is the factor-specific wage in country i and f_i^k is the production technology of country i in sector k. The quantity produced of good k in country i is thus given by $Q_i^k = f_i^k(L_i^k)$. Finally, market clearing on the market for each variety pins down the equilibrium values of prices and wages. This condition is expressed as:

$$\sum_j X_{ij}^k = p_i^k . Q_i^k, \tag{IV.5}$$

which using equation (IV.2) yields

$$(p_i^k)^{\sigma_k} = \frac{1}{Q_i^k} . \sum_j \left(\frac{\tau_{ij}^k}{P_j^k} \right)^{1-\sigma_k} . E_j^k. \tag{IV.6}$$

This equation expresses the f.o.b price of one country's variety: this price is adjusted as to equalize the fixed supply of the good with the sum of internal and external demands. Thus, it is decreasing with the quantity of the good and each bilateral trade cost, while increasing with demand for that good and price indices in all countries.

The structural gravity equation

Anderson and van Wincoop (2003) define the aggregate of demand-weighted trade costs faced by an exporter as its 'multilateral resistance'. This multilateral price (we

use here both terms interchangeably) is given by

$$(\Pi_i^k)^{1-\sigma_k} = \sum_j \left(\frac{\tau_{ij}^k}{P_j}\right)^{1-\sigma_k} \frac{E_j^k}{Y_w^k}, \tag{IV.7}$$

where Y_w^k is the total nominal value of world production of good k. Using this definition, the relationship between f.o.b prices and multilateral resistance terms can be written as:

$$Y_i^k = p_i^k.Q_i^k = Y_w^k(p_i^k.\Pi_i^k)^{1-\sigma_k}. \tag{IV.8}$$

Bilateral trade value can thus be expressed as a function of exporter (Π_i^k) and importer (P_j^k) multilateral resistance terms, yielding the gravity equation for nominal trade flows:

$$X_{ij}^k = \left(\frac{\tau_{ij}^k}{P_j^k \Pi_i^k}\right)^{1-\sigma_k} . \frac{E_j^k Y_i^k}{Y_w^k}. \tag{IV.9}$$

Next, this expression can be used to express consumption price indices P_i^k as a function of trade costs and exporters' multilateral resistance terms Π_i^k:

$$(P_j^k)^{1-\sigma_k} = \sum_i \left(\frac{\tau_{ij}^k}{\Pi_i}\right)^{1-\sigma_k} \frac{Y_i^k}{Y_w^k}. \tag{IV.10}$$

Equations (IV.7) and (IV.10) can be solved together to express the equilibrium values of multilateral resistance terms P_j^k and Π_j^k as a function of the system of bilateral trade costs τ_{ij}, and nominal production $\left(\frac{Y_i^k}{Y_w^k}\right)$ and expenditure $\left(\frac{E_i^k}{Y_w^k}\right)$ country shares.

We impose equality between a country's expenditure and income:

$$E_j = \sum_k p_j^k.Q_j^k \tag{IV.11}$$

This constraint is necessary to account for potential adverse terms-of-trade effects of trade barriers reductions; omitting it would result in generally over-optimistic effects from trade barriers reductions as the need of a real depreciation to maintain

trade balance would disappear.[6]

Finally, world nominal production by sector is given by:

$$Y_w^k = \sum_j p_j^k . Q_j^k \tag{IV.12}$$

Solving for multilateral resistances

The model is now fully specified. Solving it requires to solve the system of equations (IV.7), (IV.8) and (IV.10), IV.11 and IV.12 in the endogenous variables $(P_j^k, \Pi_i^k, p_i^k, E_j, Y_w^k)$. Once the solution vector $(P_j, \Pi_i, p_i, E_j, Y_w^k)$ is obtained, nominal trade flows can be determined using equation (IV.2).

To solve this system we use an incremental method.[7] The system of multilateral prices P_j and Π_i is first solved for given values of countries' income and expenditure shares, and trade costs. Then, we consider the full general equilibrium effects, i.e., the further impacts of trade costs changes on a country's total income and expenditure share. To this purpose, a country's export f.o.b price (p_i) is obtained as a function of its exporter multilateral price index and of its production share, using equation (IV.8); then, each country's income is obtained as a function of its f.o.b. prices. This induces new values of countries' income and expenditure shares, which are used to update previous estimates. Note that the endogeneity of production and expenditure shares differentiates the model from the one used in previous papers using a gravity model, such as Anderson and Wincoop (2003); Anderson and Yotov (2010a), which treat them as fixed ("conditional general equilibrium" hypothesis).

In other words, starting from a given world equilibrium, a change in any trade cost has an impact on the average import and export trade costs of all countries (P_j and Π_i). Through market clearing, these multilateral price changes force exporters to adjust their f.o.b prices so as to clear the world market for their variety of the good. This, in turn, modifies a country's total income, which is the nominal value

[6] We thus account for long-term adjustments of the current account, and the consequences of these adjustments for real manufacturing GDP.

[7] We thank Scott Baier for his valuable advice on this step.

of its production of all goods. The second constraint, trade balance, then imposes further adjustment of export prices.

Implications for the effects of preferential tariff reductions

Here we derive the implications of the model for the effects of preferential tariff reductions on trade flows and prices. This illustrates the heterogeneity of PTA effects: price and trade impacts vary importantly with pre-PTA trade levels. This implies that some agreements are bound to generate much larger effects than others, even without taking into account externalities created by parallel trade policy changes.

We study the following case of preferential tariff reduction:

$$d\ln\tau_{ij} = \hat{\tau}_{ij} < 0, \tag{IV.13}$$

$$d\ln\tau_{kl} = \hat{\tau}_{kl} = 0, \forall (k,l) \neq (i,j), \tag{IV.14}$$

where j is the tariff reducing importer country and i its preferential exporter partner. We consider a generic good shipped from i to j and delete the k superscript for simplicity. To help clarify the different effects, we make another simplifying hypothesis: we suppose here no feedback effects on the f.o.b price of the importer.[8]

Differentiating the system of equations at first order[9] yields the following price changes:

$$\hat{P}_j = \frac{\omega_j - K.\omega_j\omega_i}{1 - K.\omega_j\omega_i}.\hat{\tau}_{ij}, \tag{IV.15}$$

$$\hat{p}_i = -K.\frac{\omega_i - \omega_i\omega_j}{1 - K.\omega_j\omega_i}.\hat{\tau}_{ij}, \tag{IV.16}$$

[8] This is the limit case if the openness ratio of the importer is very large (so only a small share of output is sold domestically).

[9] Under the hypothesis of small variations in tariffs.

where $\omega_j = X_{ij}/E_j$, $\omega_i = X_{ij}/Y_i$ and $K\left(=\frac{\sigma-1}{\sigma}\right) \in (0,1)$, which gets close to 1 as the elasticity σ grows. These equations give us the incidence of the bilateral trade cost change on each partner's price. They show, in particular, that the incidence[10] of a preferential tariff reduction depends primarily on the share of bilateral trade in each partner's multilateral trade.

Figure (IV.1) plots the incidence on the importer's price index (P_j) as a function of ω_i and ω_j. The importer's incidence is growing as a function of ω_j but decreasing as a function of ω_i. Thus, the gain from unilateral tariff reduction ($\hat{t}_{ij}$) for country j's consumers is higher when opening with important suppliers. It is lower when j's market power is high (high ω_i), as the exporter's price adjusts upwards.[11] One implication is that the classic result that small countries tend to gain more from trade liberalizations holds.

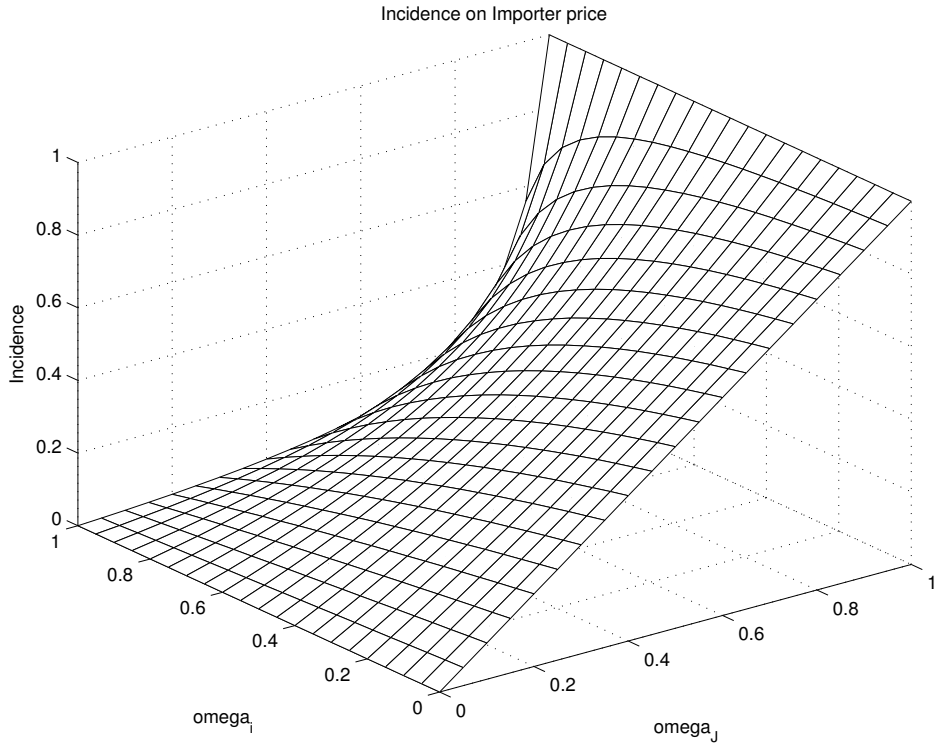

Figure IV.1: Incidence on importer's price index

[10] Incidence is defined here as the ratio of relative price change to relative trade cost change.

[11] This result is similar to the terms-of-trade hypothesis found in the literature on optimal tariffs (e.g. Broda, Limao and Weinstein 2008), where a country's tariff modifies the export f.o.b. price. This is due to the hypothesis of inelastic export supply.

The incidence on the exporter's f.o.b price (p_i) is shown in Figure (IV.2). It is negative (the figure displays the absolute value of the incidence): a reduction in bilateral trade costs results in an increase in the exporter's f.o.b price (limited pass-through), this transmission being lower than one. Symmetrically to the importer's incidence, one observes that the incidence on the exporter's f.o.b price is increasing with ω_i in absolute value, and decreasing with ω_j.

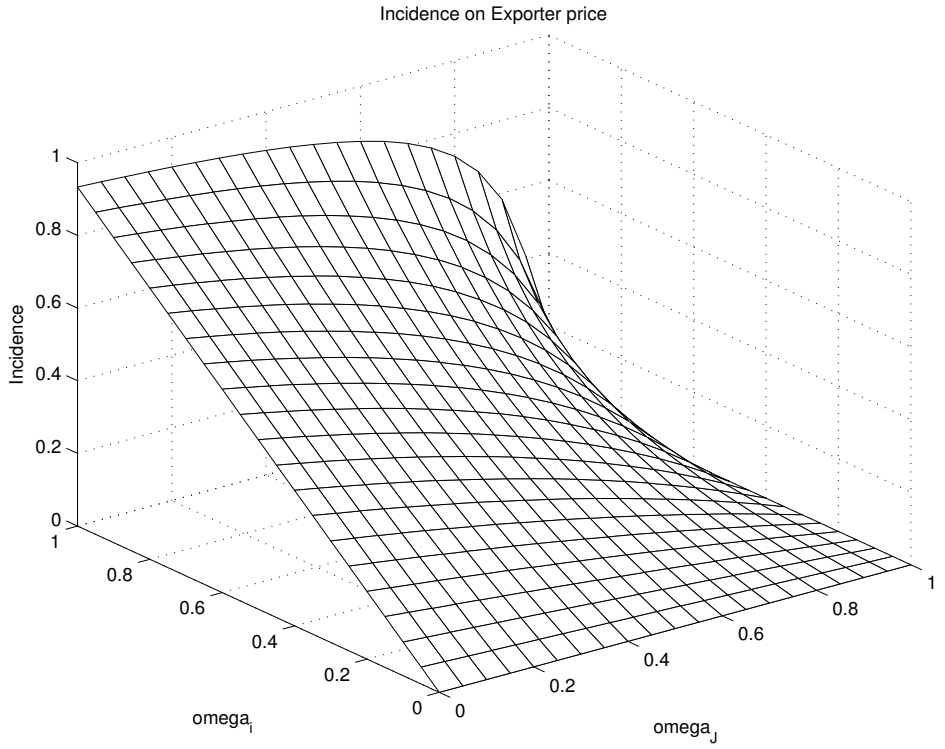

Figure IV.2: Incidence on exporter's f.o.b price

The resulting impact on trade between the preferential partners is given by

$$\hat{X}_{ij} = (1-\sigma).\frac{1-\omega_j - K.\omega_i + K.\omega_i\omega_j}{1-K\omega_i\omega_j}.\hat{\tau}_{ij} \tag{IV.17}$$

and shown in Figure (IV.3). This figure makes clear that trade creation is maximal when both ratios ω_i and ω_j are close to 0. In this case, the incidence of the PTA is minimal on prices in both countries; thus the trade cost reduction translates fully into trade creation.[12]

[12] Notice that in Anderson and van Wincoop (2003), multilateral resistance terms are unaffected in this case, thus the 'indirect effect' on trade is zero.

Equation IV.17 shows that, in the case of low values of trade shares ω_i andω_j, the change in trade reduces to:

$$\hat{X}_{ij} = (1 - \sigma).\hat{\tau}_{ij} \tag{IV.18}$$

In this limit case, trade creation only depends on the reduction in trade cost and on the Armington elasticity σ: in the terminology of Anderson and Wincoop (2003), it is equal to the *direct effect* of the trade cost change, and can thus be computed by ignoring the effect on the importer and exporter country's multilateral prices. In general, however, this results will not hold, and *indirect effects*, i.e. resulting from mutilateral price changes, need to be taken into account.

In particular, this is a source of heterogeneity in trade impacts across PTAs. Thus one needs to account for this heterogeneity when measuring PTA impacts.

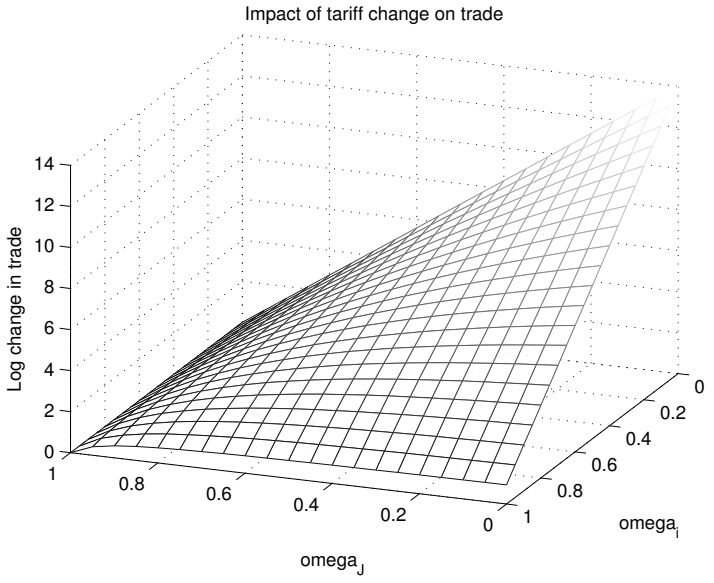

Figure IV.3: Impact of tariff changes on bilateral trade flows

Finally, the PTA impact on real (manufacturing) GDP[13] is displayed in Figure (IV.4). Computing real GDP changes in this model requires taking into account changes in import and export prices in the opening country, which occur as

[13] Real (manufacturing) GDP for country j is defined as $\frac{\sum_k^j p_k^j Q_k^j}{P_j}$.

country j's f.o.b prices are forced down due to import competition and to the trade balance constraint. Thus we now lift the hypothesis of fixed export price for the importer in order to compute its change in real GDP.

The figure shows that real GDP gains are always *positive* for the country opening unilaterally in this model; in other words, gains for the consumers always dominate over the losses for producers. In addition, it shows that real GDP gains increase with ω_j, and decrease with ω_i.

This result comes from the fact that changes in consumer prices are larger (in absolute value) than resulting changes in export prices. Thus the real GDP gain is maximized by maximizing the impact on the import price.

The negative link between ω_i and real GDP gains can be seen as a reformulation of the 'terms-of-trade hypothesis', in which tariffs enable countries to manipulate terms-of-trade. Thus, an importer should maintain tariffs with countries with which they have market power (i.e., high ω_i countries) as this forces down export prices in these countries; while they should liberalize trade preferentially with partners for which they have low market power.

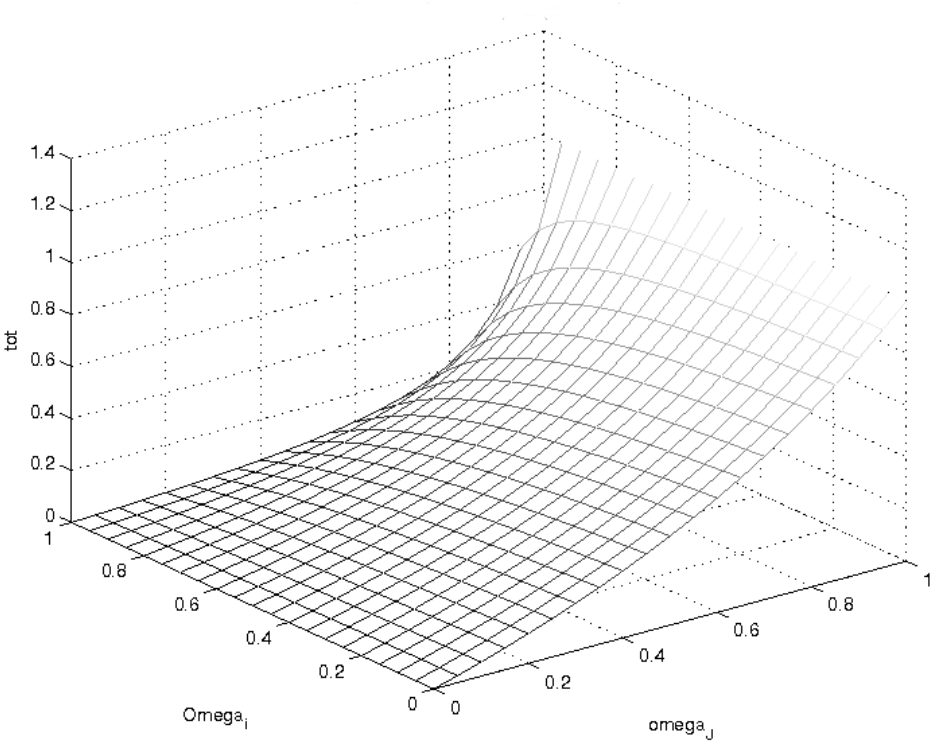

Figure IV.4: Importer's real manufacturing GDP changes

3 Estimation of sector elasticities

3.0.0.1 Empirical specification The estimation of the effects of PTAs is done in two steps. In this section we estimate elasticities of substitution at sector level to parametrize the model. Next we estimate the effects of trade policy changes. Taking the log of equation (IV.9) yields

$$\ln X_{ij}^k = \ln \frac{Y_i^k}{Y_W^k} + \ln \frac{E_j^k}{Y_W^k} + (1-\sigma^k).(\ln \tau_{ij}^k - \ln(P_j^k.\Pi_i^k)). \tag{IV.19}$$

A functional form of trade costs is needed to estimate this equation. In line with the common practice in the literature, we assume the following log-linear stochastic form:

$$\tau_{ij}^k = (1+\text{Tariff}_{ij}^k).d_{ij}^{\rho^k}.e^{\alpha^k \text{Contig}_{ij}}.e^{\beta^k \text{Comlang}_{ij}}.e^{\epsilon_{ij}^k}, \tag{IV.20}$$

where Tariff_{ij}^k is the ad-valorem equivalent of tariff barriers on i's products exported to j in sector k, d_{ij} is the distance between i and j and u_{ij}^k represent unobserved bilateral trade cost determinants. We also add two dummy variables: Contig_{ij}, which is unity if countries/regions i and j are contiguous, and Comlang_{ij}, which is unity if i and j share an official language.

Plugging the functional form of trade costs into (IV.19) and adding time subscripts to stress the point that some of the variables are time varying give us:

$$\begin{aligned} \ln X_{ijt}^k &= \ln \frac{Y_{it}^k}{Y_{Wt}^k} + \ln \frac{E_{jt}^k}{Y_{Wt}^k} + (1-\sigma^k).(\ln(1+Tarif_{ijt}^k) - \ln(P_{jt}^k) - \ln(\Pi_{it}^k)) \\ &+ (1-\sigma^k).(\rho^k.d_{ij} + \alpha Contig_{ij} + \beta Comlang_{ij}) + \epsilon_{ijt}^k, \end{aligned} \tag{IV.21}$$

where ϵ_{ijt}^k is the stochastic error term. This equation can be rearranged as:

$$\begin{aligned} \ln X_{ijt}^k &= (1-\sigma^k).\ln(1+Tarif_{ijt}^k) + (1-\sigma^k).(\rho^k.d_{ij} + \alpha Contig_{ij} + \beta Comlang_{ij}) \\ &+ \left[\ln \frac{Y_{it}^k}{Y_{Wt}^k} - (1-\sigma^k).\ln(\Pi_{it}^k))\right] + \left[\ln \frac{E_{jt}^k}{Y_{Wt}^k} - (1-\sigma^k).\ln(P_{jt}^k)\right] + \epsilon_{ijt}^k \end{aligned}$$

In this expression, the terms in brackets encompass the exporter and importer

income and expenditure shares, as well as the multilateral resistance terms. These variables are unobserved to us, but not controlling for them would result in a biased estimate of the trade elasticity $(1-\sigma^k)$, as shown in Anderson and Wincoop (2003), since it would amount to ignoring the effect of a change in bilateral cost on multilateral prices. Therefore, we control for these terms by estimating sector-level specifications and using exporter-time and importer-time fixed-effects. These allows us to estimate the sector-level elasticities of trade with respect to the variables $Tarif_{ijt}^k$, d_{ij}, $Contig_{ij}$ and $Comlang_{ij}$, which we observe in our data (see data section below).

Thus, our sector-level specification is the following:

$$\ln X_{ijt}^k = \beta^k \ln(1+\text{Tariff}_{ijt}^k) + \gamma^k \ln d_{ij} + \delta^k \text{Contig}_{ij} + \eta^k \text{Comlang}_{ij} + \lambda_{it}^k + \lambda_{jt}^k + \epsilon_{ijt}^k \tag{IV.22}$$

In this equation, coefficient β^k gives us directly the estimate of $(1-\sigma^k)$, while γ^k gives us the estimate of the product $(1-\sigma^k).\rho^k$, of which we can deduce ρ^k; we can similarly obtain the effects of contiguity and common language on trade costs.

3.0.0.2 Data We estimate the sector-level gravity equation using nominal bilateral trade values from the BACI trade database.[14] Trade data at product Harmonized System (HS)-6 digit level are aggregated at the International Standard Industrial Classification (ISIC) rev.2 level (75 sectors)[15]. We see this level of aggregation as consistent with the definition of sectors in the model.[16] All world trade is considered, aggregating flows into 68 countries/regions to keep the model tractable. This estimation strategy, which reduces the high dimensionality of data,

[14] The BACI trade data set is built by the CEPII (see www.cepii.fr/anglaisgraph/bdd/baci.htm).

[15] Sectors Isic 150 (" Hunting, trapping and game propagation including related service activities") and 402 ("Manufacture of gas; distribution of gaseous fuels through mains") have been excluded because of an insufficient number of trade observations to compute elasticity estimates.

[16] Recall that the model assumes a Cobb-Douglas structure of demand over sectors. Estimating the model at a product level (e.g. HS-6 classification) would thus implicitly impose a substitution elasticity of 1 over HS-6 products, while the fine level of detail of this classification implies that this elasticity is certainly higher.

is common in the literature (see Anderson and van Wincoop, 2003 and Anderson and Yotov, 2010).

Data on distance, contiguity and languages are taken from the distance CEPII database.[17] Tariff data are obtained from the CEPII MacMap database (Bouet *et al.*, 2008). This data set contains data on bilateral applied tariff protection for the years 2001, 2004 and 2007. Data on *ad-valorem* and specific tariffs, and on tariff quotas, are converted into *ad-valorem* equivalents using unit values data for the year 2001. Thus, our tariff variable is a comprehensive measure of applied tariff protection, which enables us to track changes in tariff protection due to preferential agreements.[18] Importantly, this enables us to observe precisely the content of PTAs, and to observe variations across PTAs in sector coverage, extent of tariff reductions and time period of implementation.[19] Note that running our estimates on three-year intervals allows us to obtain stable estimates, while the use of yearly data has been shown to yield unstable gravity estimates, due to delays in the adjustment to trade shocks (Olivero and Yotov, 2012). This also allows to filter out business cycle effects.

By running our estimations at sector level, we take into account the well documented heterogeneity in trade elasticities (Romalis, 2007; Hummels, 1999). Thus, we avoid the aggregation bias identified in Imbs and Mejean (2009), who show that constraining Armington eslaticities to homogeneity in the estimation leads to a systematic underestimation. However, two main sources of bais may still be at work in our estimates of trade elasticities β^k in equation IV.22. First, unobserved components of trade costs, such as non-tariff barriers, mean that we observe trade costs with error, which tends to attenuate our elasticity estimates. Alternatively, there may exist a negative correlation between our observed and unobserved components of trade costs, if some governments are using the two

[17] See http://www.cepii.fr/francgraph/bdd/distances.htm.

[18] Tariff values at product level are aggregated at the level of ISIC-sectors using the 'Regions of Reference' method, thus weighting tariff lines by trade values for the region to which the importer belongs. This mitigates biases in simple trade-weighted aggregates. For more on this see Bouet *et al.* (2008).

[19] Note that we also observe changes in applied tariffs which occur outside the framework of PTAs.

instruments are substitutes, as suggested e.g. in Yu (2000). This would also yield a bias of our estimates toward zero. Note, however, that this bias only exists if there is a bilateral component to those unobserved trade costs; if countries set uniform non-tariff barriers across partners, then this component is being controlled for by our importer-time fixed effects. Second, tariffs are potentially endogeneous to trade flows. If tariffs tend to be set high on imports from partners with higher export potential, then this will again tend to bias our elasticity estimates toward 0. This source of enedogeneity is partly mitigated by our panel estimates: if trade policy is designed to protect specific sectors uniformly across partners, this uniform component of tariffs across partners is controlled for.

Note also that our use of detailed tariff data allows for a more direct estimation of elasticities, in contrast to studies focusing on the effect of distance or borders on trade (see e.g. Anderson and Yotov (2011); Hummels (1999)). Here sector elasticities are directly obtained from the coefficients on tariff variables (the coefficients are $1-\sigma^k$), so that the knowledge of the elasticity of trade costs to distance and other variables is not needed.

3.0.0.3 Estimation method We use an Ordinary Least Squares estimator with Country-Year Fixed Effects (OLS-CYFE) to estimate the 72 sector-level elasticities. The country-year fixed effects (λ_{it} and λ_{jt}) control fully for importer and exporter time-varying variables: import price indices, exporter f.o.b prices, exporter and importer shares of production and expenditure demand in world total; and any other omitted variable such as those related to institutions.

3.0.0.4 Results. Table (IV.9) in appendix IV.B displays the estimation results. The table displays the value of the tariff coefficient (corresponding to $1-\sigma^k$ in the model), the associated standard error and the number of observations used for the estimation. Consistently with the CES preferences in our model, which imply that $\sigma^k \geq 1$ in all sectors, we find negative coefficients in all sectors.

The values we obtain are in the range [1,20; 13.9], with a mean value at 5.37. This is consistent with estimates from other studies; for instance, the Feenstra (1994) method applied to 56 ISIC sectors yields estimates ranging from 3.1 to 28, with mean 6.7 (Imbs and Mejean, 2009).

An additional check of the consistency of our sector-level estimates consists in comparing our results with the classification of traded goods in homogeneous versus differentiated goods, proposed by Rauch (1999). Indeed, the elasticity of substitution σ^k is in average 3.69 higher among homogeneous sectors than among the differentiated ones [20]

4 Trade and income impacts of PTAs, 2001-2007

Armed with our estimates of the parameters of the model, we will now use it for two purposes: first, to characterize the trade policy implemented by world countries during the last decade; second, to estimate the impacts of alternative trade policies.

4.1 Trade impact of PTAs

We start by asking what has been the impact of recently implemented PTAs on trade patterns. The question, "Do PTAs really increase trade between partners", has already been asked in the literature (e.g. Baier and Bergstrand (2007)). However, our approach to it is different. We do not use an estimation approach to infer PTA effects from observed trade changes. Instead, we start from actual trade barrier reductions (tariff reductions), as they have been implemented by PTA partners, at the sector level. Using our parametrized model, we then solve it to obtain trade changes are implied by those trade barrier reductions.

Tables IV.7 and IV.8 in appendix present the detailed trade impacts of our sample of PTAs for all PTAs, while table IV.1 summarizes the results.

Trade effects of PTAs are decomposed into:

[20] Our ISIC rev.2 sectors are classified as homogeneous if they contain more SITC products classified as homogenous than differentiated.

- the *treatment effect* of a PTA: this is the change in trade if a particular PTA were implemented alone, while all other world trade barriers were maintained constant.

- the diversion effect implied by concurrent PTAs: the other PTAs implemented by the importing country tend to reduce trade with a particular PTA partner.

- diversion implied by non-PTA reductions: most countries in our sample have also implemented tariff reductions outside of their agreements, e.g. in the form of multilateral reductions. This also induces a diversion of trade with every PTA partner.

- Global trade change: trade change implied by all world tariff changes in the period. In addition to all tariff changes implemented by the importing country considered, changes by other countries are also taken into account here.

We restrict our analysis to active PTAs, that is, those for which actual tariff reductions were implemented during the period of study (2001-2007)[21].

This table is informative in several aspects. First, these results show that the effect of tariff reductions is not small. By construction, the effects we compute are restricted to changes in trade flows resulting from observed tariff reductions, while reductions in other forms of trade costs (non-tariff barriers to trade) are left out of the picture. The effect of other provisions often included in trade agreements (e.g. for investment) are also left out. Finally, long-term effects of trade liberalization, running through investment reaction, changes in production structures, and shifts in the specialization pattern of countries, are also ignored. Therefore, our estimates should be considered as giving a lower-bound for the total effect of traede agreements on trade. Despite this very narrow focus, the 83 agreements we observe being

[21] More precisely, our criterion is to retain all PTAs for which we observe a direct trade creation effect greater than 10%. Note that we apply this criterion to every uni-directional trade relation, so that we allow for an agreement to be active only on one side. For example, the agreement between the EU and Morocco is considered active in the period only in the direction of EU exports to Morocco, as tariffs have been dismantled on the Moroccan side but EU tariffs on imports from Morocco had been removed before, and thus have not changed sensibly in the 2000s.

implemented in the period have had a treatment impact of 25% on trade in average, with a quarter of agreements creating more than 35% additional trade.

Second, our results on the *treatment effects of PTAs* show clearly that these effects vary widely across agreements. This is due essentially to two factors: heterogeneity in the depth and width of tariff reductions, and heterogeneity in indirect effects, i.e. in the effects of trade barrier reductions on multilateral prices of the importer and the exporter. A reduction in bilateral trade costs between two partners affects the importing country's CES price index, as well as the exporter's mill price. The incidence on these prices reduces the overall trade creation that results. As has been shown in section 2, a given reduction in tariffs yields lower trade creation between countries wich trade more together (with higher trade shares).

Overall, treatment effects vary from 4.3% to 77.8%. In other words, PTAs should be expected to yield widely varying trade effects, even without taking into account the impact of paralell trade policy changes occuring in the same period. Note that this variation in treatment effects also has consequences for the measurement of PTA impacts using traditional ex-post regression techniques. Regression estimates are intended to measure precisely treatment effects, that is, the effect of a PTA all else equal. Controls and various instrumentation and panel techniques are usually used to ensure that this hypothesis holds. Our estimates show that, even if all other variables are exactly controlled for, there remains large variability in treatment effects, which casts doubts on the reliability of estimates based on a single coefficient. Moreover, the next columns also show that diversion effects are an additional source of variability, which translate into additional variables in the estimation.

Columns (2) and (3) then measure the diversion impact of those parallel changes, focusing on tariff reductions implemented by the importing country considered. Such reductions can occur either because the country is engaging in several preferential agreements at the same time: the effect of this is computed in column (2). Moreover, some countries also reduce their trade barriers with countries outside their agreements, in particular when they implement multilateral tariff reductions.

The effect of those reductions appears in col. (3).

Finally, column (4) computes the change in bilateral trade resulting from all tariff changes as recorded in our data. Note that in addition to those taken into account in columns (2) and (3), this column also includes all tariff changes by countries other than the opening country, which may also indirectly influence the bilateral trade flow considered.

This table shows that, for a majority of PTAs, trade creation is strongly reduced by diversion effects, so that the overall change in bilateral trade is small. Among the 83 agreements retained, 26 increase trade by less than 10%.

Table IV.1: Trade impacts of PTAs (%): summary table

	(1) Treatment effect	(2) Diversion: PTAs	(3) Diversion: non-PTAs	(4) Global effect
Average tde. change (%)	25.0	-10.7	-8.1	16.5
Std. error	15.4	11.1	8.9	13.1

Statistics of PTA trade effects on 83 active PTAs in the period 2001-2007. See complete results in appendix. Diversion effects are decomposed into: effect of parallel tariff reductions with other preferential partners (col. 2), and of multilateral reductions (col. 3). Global effect: trade change implied by all world tariff changes in the period.

4.2 Did world trade become more or less discriminatory?

We have seen evidence of the "proliferation" of PTAs, and of its weakening impact on the potential trade creation of each of these agreements taken in isolation. Moreover, non-preferential tariff reductions by world countries further reduce this trade creation. At this point, a natural question is whether world trade tends to evolve rather "preferentially" or "multilaterally". The high and growing number of PTAs does not in itself imply that the former holds true.

We start by examining this question at the level of each countries' individual trade policies. For each country, we consider its unilateral trade policy - i.e., all changes in its tariff structure - and ask what would have been the impact *all else equal*.

Results in table IV.2 show contrasted profiles across countries. Out of the 42 countries we consider, 23 have had a trade policy that favored the preferential mode of liberalization, in the sense that it made their trade grow faster with their preferential partners. The other 19 countries have had a trade policy that oriented their trade relatively more toward multilateralism.

The table also displays the real income and welfare impacts of each country's trade policy. One observes, reassuringly, that most countries have implemented a policy that yielded real income and welfare gains. In particular, this is the case also for countries that mostly lead a preferential policy still obtained a positive gain from it, confirming that detrimental effects due to diversion are generally small compared to the gains of preferential opening. Thus, these results offer a more contrasted picture of the evolution of trade policy, than a casual look at the explosion of PTAs might suggest. Most countries implement preferential and multilateral trade barrier reductions concurrently, with the relative importance of the two processes varying across countries. Results on welfare effects of these policies suggest that these countries are choosing their trade policy in their best interest: there is no significant difference in the welfare and real income impacts of trade

policies between the "preferentialist" and "multilateralist" countries.[22] The relative attractiveness of opening trade multilaterally or preferentially varies across countries with the structure of their trade, the importance of trade diversion to be expected from signing a PTA, and the levels of tariffs in the country and in its partners; this should result in different trade policy choices. Testing the optimality of these choices will be the objective of next section.

[22] Grouping countries by the sign of the relative trade growth of preferential over non-preferential trade, we find that the income effect of trade policy is .13% lower in the first group (s.e. 0.63), and welfare effect 3.03% lower (s.e. 2.84).

Table IV.2: Trade and welfare impacts of countries' trade policy

	Trade growth (%)		Trade policy impact (%) on	
	Preferential trade	Non-pref. trade	Real GDP	Welfare
Morocco	14.59	-9.64	5.55	6.00
Bolivia	11.10	-4.01	2.41	2.47
Brazil	14.63	-0.28	1.19	1.18
Chile	4.69	-8.01	3.39	3.34
Algeria	3.77	-4.98	1.65	1.56
South Africa	6.40	-2.24	0.86	0.73
Argentina	4.96	-1.89	2.06	1.99
China	11.22	5.18	2.95	3.14
Tunisia	5.67	1.22	3.42	3.40
Malaysia	-0.25	-4.56	3.10	2.70
Ghana	4.81	0.85	1.86	1.81
Indonesia	1.16	-2.18	0.38	0.36
Colombia	2.23	-0.20	0.81	0.83
Morocco	6.36	4.26	1.08	0.85
EFTA	-0.50	-2.34	-0.93	-0.87
Canada	-0.08	-1.30	-0.19	-0.19
Lebanon	0.47	-0.57	0.19	0.05
Ethiopia	0.00	-0.51	0.66	0.29
Japan	0.59	0.10	-0.02	-0.12
Korea	1.63	1.15	0.21	0.09
Kenya	-0.51	-0.90	4.53	4.12
EU	0.53	0.33	0.03	0.05
Venezuela	1.34	1.21	0.25	0.30
Ivory Coast	-0.15	-0.02	-0.30	-0.28
Syria	-0.09	0.11	-0.03	-0.01
Cameroon	0.08	0.42	0.07	0.06
Jordan	1.34	1.83	3.04	2.45
Congo	-0.28	0.51	0.26	0.18
USA	0.11	1.03	0.03	0.04
Taiwan	0.75	1.93	1.63	1.21
Nigeria	-0.04	1.29	8.71	7.84
Russia	-3.65	-0.69	0.97	0.98
Israel	-0.15	3.00	0.56	0.59
India	10.44	13.69	6.18	6.50
Senegal	-3.33	0.22	-0.13	-0.10
Ecuador	-1.50	2.37	0.35	0.40
Uruguay	-3.19	2.37	2.15	2.18
Turkey	-1.24	4.61	0.21	0.31
Paraguay	-4.99	2.42	1.64	1.65
Morocco	2.81	12.09	1.68	2.03
Egypt	4.68	17.93	4.78	59.69

This table considers the impact of each country's trade policy on its trade structure, income and welfare, all else equal. Trade changes with preferential and non-preferential partners are computed. Real GDP is the ratio of nominal income to the domestic aggregate CES price index.

Before this, we wish to ask whether world trade is becoming as a whole more or less "preferential", i.e. whether trade between PTA partners is growing faster or slower than that with non-PTA partners. To examine this question, we perform counterfactual estimation of the impact of the two processes separately: in other words, we study two scenarios, one including all tariff reductions between PTA partners, the second including all other tariff reductions, thus being the complementary of the first.

Table IV.3: Trade impacts of PTAs: treatment effects

	%change in world trade		
	PTAs	non-PTAs	Global
Non-preferential trade	-0.96	2.49	0.31
Preferential trade	2.04	-0.41	1.06

Table IV.3 shows the results. If only preferential trade barrier reductions had been implemented in 2001-2007, world trade would have increased by 2.04% between PTA, while contracting by almost 1 percentage point among non-partners. Conversely, allowing only non-preferential tariff reductions would have resulted in an decrease in the relative weight of preferential trade. What is interesting is that, overall, tariff changes in that period have made world trade more preferential than not: preferential trade has grown by 1 percentage point, more than three times more than non-preferential trade. This may be surprising given the balance between the orientation of trade policies across countries, but results from the fact that a higher number of large countries have implemented preference-oriented trade policies in the period: the countries with preference-oriented policies represented 67% of total world trade in 2001.

5 Do countries sign the most beneficial PTAs?

We now use our model to examine this simple question: among all possible trade agreements, how do countries choose the ones they sign? Are these agreements the best they could engage into, from the point of view of their interest? Finally, do they optimally choose between the options of preferential and multilateral trade liberalization?

To answer these questions, we perform a simulation exercise in which we compute the impacts, for each country in our sample, of all possible bilateral trade agreement with each other country. We model these agreements as follows: the two countries agree to reduce their tariffs to half the lowest of their two tariffs in each sector. In other words, in each sector, the one country with the lowest tariff cuts it by half, and the other country goes down to the same level. This is intended to capture the reciprocity that applies to most agreements. Although one can argue that many agreements differ in from this rule, we consider it as a tool that allows us to estimate the impact on the export and domestic markets that a country can expect.

We then regress the actual signing of agreements in the post-2001 period on these expected gains. Results are shown in table IV.4. These results indicate, reassuringly, that the real income gains that a country can expect from signing a bilateral PTA influence trade policy in the right direction, increasing the probability of signing an agremeent. It also shows that the potential gains from opening multilaterally decrease the probability of signing a PTA: in other words, countries compare the options of multilateral vs. preferential trade openness, and may favor one or the other path depending on the relative gains from each, which vary with a a country's position in world trade.

However, decomposing the real income gains from PTAs into their impacts on production prices (i.e., market access gains for producers) on one hand, and on the domestic aggregate price index (i.e. CES price index faced by consumers) on the other reveals that these two objectives are not weighted equally in the determination of trade policy. Namely, production prices have an impact on the probability of signing which are more than two times that of consumer prices. This difference is

significant and robust across specifications. It is even higher when controlling for the propensity of a country to sign PTAs, using country fixed effects.

Table IV.5 tests the relevance of our measures of PTA effects for explaining trade policy. In a seminal paper, Baier and Bergstrand (2004) develop a model of trade which they use to derive a list of determinants of the potential gains from a PTA; they then show that this list allows to correcly predict a number of the agreements which were actually signed. Their model includes several dimensions of the gains from PTAs, including specialization gains. By contrast, our approach is restricted to more specific gains from PTAs, namely terms-of-trade gains; but we measure these gains structurally. To test if our model adds some elements to ther understanding of countries' trade policy, we run in table IV.5 regressions including the two lists of variables.

Natural is a dummy for two countries being on the same continent. It captures the gains from singing PTAs with so-called 'natural partners', yielding higher gains because of the more intense trade relations. *Remote* is a proxy measure of the distance of two partners from the rest of the world countries, distance which increases the PTA gains as diversion effects are reduced. Finally, *drgdp* is a measure of the gap in income levels between two countries and captures the similarity between two economies.

Results show that although these variables have some power to explain PTAs, they do not exhaust the determinants of countries' trade policy; in particular, our measures of PTA price impacts remain significant.

Table IV.4: Determinants of PTA signing

	(1)	(2)	(3)	(4)	(5)
			$Pr[PTA = 1]$		
Real income impact of bilateral PTA	0.63^a		0.63^a		0.81^a
	(0.10)		(0.10)		(0.14)
PTA impact on fob prices		1.42^a	0.79^c	1.44^a	1.32^b
		(0.48)	(0.47)	(0.49)	(0.52)
PTA impact on domestic price index		-0.63^a		-0.63^a	
		(0.10)		(0.10)	
Real income impact of multilateral opening	-0.25^a	-0.24^a	-0.24^a		
	(0.06)	(0.06)	(0.06)		
ML opening: prod. prices				-0.33	
				(0.26)	
ML opening: domestic prices				0.24^a	
				(0.06)	
Country fixed-effects					yes
Observations	1722	1722	1722	1722	1148
Pseudo R^2	0.053	0.056	0.056	0.056	0.136

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Logit regression on the probability of a PTA being signed between two countries in or after 2001. Impact of each PTA on production f.o.b. prices and on the domestic price index (CES price index) are used in % variation. They are computed at sector level, then aggregated consistently with the model structure. See text for the definition of PTAs in the simulation exercise.

Table IV.5: Determinants of PTAs: robustness checks

	(1)	(2)	(3)
		$Pr[PTA = 1]$	
PTA impact: production prices	1.21^b	1.21^b	1.17^b
	(0.48)	(0.48)	(0.48)
PTA impact: domestic price index	-0.64^a	-0.64^a	-0.57^a
	(0.10)	(0.10)	(0.11)
Real income impact of multilateral opening	-0.24^a	-0.25^a	-0.24^a
	(0.06)	(0.06)	(0.06)
Natural	0.49^b	0.50^b	0.56^a
	(0.21)	(0.21)	(0.22)
Remote		-0.15	-0.15
		(0.54)	(0.54)
Drgdp			0.09
			(0.06)
Observations	1722	1722	1722
Pseudo R^2	0.062	0.062	0.065

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Regressions in this table add to the former specification used in table IV.4 the determinants of PTAs as identified in Baier and Bergstrand (2004). Natural is 1 if the two countries are on the same continent. Remote is the average distance of the two partners to other countries outside the pair. Drgdp is the absolute value of the difference of the log of real GDPs of the two partners.

Table IV.6: Determinants of PTAs: diversion effects

	(1)	(2)	(3)
	$Pr[PTA = 1]$		
Real income impact of bilateral PTA	0.49^a	0.51^a	
	(0.13)	(0.14)	
Diversion: real income impact	-6.22^b		
	(2.83)		
Diversion: production prices		-4.35^a	
		(1.38)	
Diversion: domestic prices		-0.94	
		(3.73)	
Production prices: net impact			1.28^a
			(0.39)
Domestic prices: net impact			-0.60^a
			(0.11)
Real income impact of multilateral opening	-0.28^a	-0.27^a	-0.28^a
	(0.06)	(0.06)	(0.06)
Observations	1600	1600	1600
Pseudo R^2	0.064	0.071	0.065

Standard errors in parentheses.

^{c} p<0.1, ^{b} p<0.05, ^{a} p<0.01

Regressions in this table add estimates of the potential losses by diversion faced by one country if the partner country implements another PTA with a third country. These impacts are decomposed into effects on production prices, domestic CES price index and overall real income impact. "Net impacts" are the difference between the impact of signing a PTA, and the impact if the partner country signs with a third country.

6 Conclusion

What determines trade policy has been a recurrent question in the literature. In this paper we have proposed an original approach to it, based on observing trade policies in the data and looking at the implied trade and income effects. First, we looked at all tariff changes implemented by world countries during 2001-2007, and used a general equilibrium model to compute the implied impacts on trade patterns, and on country real GDP and welfare levels. Although simple, our model essentially captures terms-of-trade effects of preferential and multilateral trade liberalization, thus allowing to quantify trade creation and diversion effects. This exercise reveals that both preferential and multilateral liberalizations are being implemented concurrently by most world countries; overall, about half the countries in our sample have been running a trade policy more multilateral than preferential, thus reducing distorsions in their tariff structure. Next, we found the choice of trade policy to be strongly related to both producer and consumer interests, with the former having an impact about two times larger. In contrast to previous estimates in the literature, this result shows the presence of important distorsions in the setting of trade policy. It suggests that the excessive weight put on market access gains leads countries to exhibit a bias in favor of preferential trade liberalization, despite larger expected gains from multilateral opening.

IV.A Appendix

IV.A.1 Trade impacts of PTAs

Table IV.7: Trade impacts of PTAs: treatment effects (in %)

		(1)	(2)	(3)	(4)
Opening country	Partner country	Bilateral trade impact			
		Treatment effect	Diversion: PTAs	Diversion: non-PTAs	Global effect
Turkey	Morocco	12.5	-20.6	-22.6	50.4
Egypt	Turkey	77.8	-20.4	-15.6	47.2
Morocco	EU	53.1	-0.7	0.5	45.9
Tunisia	EFTA	59.6	-13.1	-5.6	44.7
Colombia	Morocco	44.9	3.4	2.5	43.2
Tunisia	Morocco	27.8	-33.0	-20.2	39.3
Morocco	EFTA	45.4	-6.2	-0.1	36.8
Bolivia	Morocco	46.7	-3.0	-3.4	34.1
Tunisia	Jordan	49.8	-18.8	-1.8	33.9
Bolivia	Uruguay	44.1	-4.1	-1.8	32.9
Turkey	Tunisia	27.9	-0.2	-2.4	32.9
Tunisia	Lebanon	49.3	-19.2	-2.6	31.4
Morocco	Tunisia	36.3	-55.2	-28.8	31.1
Tunisia	Egypt	39.0	-8.9	-4.4	30.3
China	Morocco	35.0	-26.3	-30.0	30.2
Egypt	Lebanon	57.3	-19.9	-13.6	27.7
Argentina	Chile	26.1	-7.6	-12.3	27.6
Uruguay	Chile	41.7	3.2	-2.6	27.4
Egypt	South Africa	38.4	-10.6	-5.1	25.8
Brazil	Chile	38.5	0.2	-8.0	25.6
Morocco	EFTA	38.8	-22.8	-8.8	24.7
Ghana	Ivory Coast	41.4	-2.7	-17.9	24.2
Morocco	Japan	34.8	-1.9	1.7	23.8
Morocco	China	13.1	-15.5	-16.1	22.3
Morocco	Lebanon	52.0	-32.1	-5.0	22.0
Korea	EFTA	21.5	-0.3	-1.5	20.9
Jordan	Tunisia	14.2	-5.7	1.6	20.4
Egypt	Tunisia	56.0	-30.5	-16.6	20.1
China	Hong-Kong	21.5	-20.2	-28.9	20.0
Bolivia	Brazil	26.7	-2.7	-2.2	19.6
Lebanon	Jordan	18.9	-0.9	-0.1	19.3
Paraguay	Chile	27.0	1.0	-1.7	18.1
EFTA	Turkey	9.7	2.7	1.3	18.0
Lebanon	Egypt	11.8	-0.8	0.5	17.6
Morocco	USA	23.1	-26.9	-17.2	17.4
Brazil	Argentina	9.1	-11.4	-15.5	17.1
Chile	Uruguay	24.3	-8.9	1.4	16.7
Bolivia	Argentina	13.1	-10.5	-8.4	15.8
Jordan	Syria	26.1	-5.7	-4.9	15.6
Argentina	Bolivia	27.8	-10.1	-19.5	15.1
Malaysia	Morocco	15.8	-4.8	-1.1	14.9
Egypt	Syria	26.0	-5.4	-5.7	14.7

Table IV.8: Trade impacts of PTAs: treatment effects (in %) (Cont'd)

		(1)	(2)	(3)	(4)
Opening country	Partner country	Bilateral trade impact			
		Treatment effect	Diversion: PTAs	Diversion: non-PTAs	Global effect
Lebanon	Tunisia	10.7	-1.5	-0.0	14.3
China	Malaysia	22.7	-25.6	-30.0	13.5
Jordan	Lebanon	26.2	-9.1	-6.5	13.5
Nigeria	Ivory Coast	45.6	-1.9	-31.9	13.4
Chile	Brazil	27.1	-14.3	0.6	12.9
Jordan	Egypt	16.6	-5.9	-4.3	12.2
Morocco	Syria	9.2	-18.8	-17.3	12.0
Morocco	EU	8.6	-23.3	-20.8	11.9
Morocco	Malaysia	16.1	-3.8	-4.8	11.7
Chile	USA	17.1	-17.4	-5.5	11.5
Jordan	Morocco	10.6	-8.5	-7.1	11.5
Lebanon	Morocco	4.4	-7.7	-5.9	11.2
Tunisia	Syria	17.2	-4.4	-1.3	11.1
Malaysia	Indonesia	14.5	-3.7	-0.3	10.9
Uruguay	Bolivia	18.0	-1.0	-1.2	10.5
Chile	China	11.7	-17.9	-7.1	9.2
Egypt	Jordan	35.4	-18.6	-12.1	8.5
Chile	EFTA	26.0	-16.0	0.4	8.4
Bolivia	Paraguay	11.2	-2.1	-0.1	8.1
Chile	Argentina	7.0	-9.2	-5.4	7.9
Brazil	Uruguay	12.2	0.8	-2.3	7.7
Chile	EU	23.6	-11.0	1.3	7.3
Korea	Chile	18.8	0.7	-5.7	6.8
Morocco	Indonesia	18.3	-5.1	-7.8	6.7
Argentina	Brazil	4.3	-13.1	-15.5	6.0
Chile	Korea	23.7	-13.9	1.5	5.1
South Africa	EU	8.9	0.1	-0.9	4.3
Morocco	Jordan	25.2	-29.0	-11.0	3.7
Egypt	Algeria	14.8	-9.1	-4.8	2.1
Algeria	EU	5.9	0.3	-0.5	1.7
China	Indonesia	11.1	-17.2	-22.6	1.4
Tunisia	EU	9.9	-4.0	-2.6	1.3
Kenya	South Africa	19.4	-0.5	-19.3	1.1
Morocco	Turkey	34.7	-45.7	-14.0	0.8
USA	Jordan	9.7	-6.8	-3.7	0.0
Egypt	EU	15.9	-4.3	-11.9	-0.4
Jordan	EU	9.6	-3.9	-5.8	-1.3
Algeria	Egypt	14.9	-20.6	-3.0	-2.5
Tunisia	Turkey	10.6	-13.0	-2.6	-3.8
China	Chile	8.4	-6.7	-16.2	-8.8
Nigeria	Ghana	16.7	-0.4	-25.7	-9.9

IV.B Estimation of sector elasticities

Table IV.9: Sector elasticities estimates

Sectors ISIC	Coeff.	std. error	Obs.	Sectors ISIC	Coeff.	std. error	Obs.
	(1)	(2)	(3)		(1)	(2)	(3)
101	-3.75	2.88	1602	251	-5.97	0.55	7833
102	-4.1	2.52	1250	252	-7.98	0.58	8390
103	-4.1	2.52	1250	261	-8.06	0.63	6871
111	-1.24	0.22	8025	269	-3.22	0.77	7651
112	-0.33	0.29	5584	271	-4.19	0.78	7634
113	-1.95	0.26	7839	272	-7.15	0.93	7097
121	-0.86	0.48	2056	281	-4.63	0.73	5981
122	-0.21	0.29	4697	289	-4.19	0.58	8885
131	-10.8	2.41	3924	291	-6.31	0.72	9006
132	-10.8	2.41	3924	292	-5.46	1.26	8967
141	-5.96	0.99	4321	293	-5.14	0.59	6367
142	-4.96	1.23	5356	300	-6.8	1.44	7819
151	-1.93	0.24	8811	311	-6.48	0.99	7236
152	-1.34	0.31	4312	312	-5.3	0.83	7147
153	-1.03	0.17	5942	313	-7.7	0.83	5818
154	-0.88	0.21	8059	314	-4.5	0.75	5359
155	-0.34	0.11	5826	315	-4.02	0.59	6313
160	-0.66	0.21	3794	319	-4.43	0.84	6734
171	-2.76	0.58	7772	321	-9.44	1.3	6341
172	-3.66	0.51	8150	322	-0.76	0.62	6548
173	-2.72	0.59	7144	323	-3	0.65	6968
181	-2.8	0.38	8400	331	-5.71	1	8203
182	-1.16	0.87	2448	332	-2.09	0.82	5801
191	-4.98	0.57	6929	333	-2.53	0.83	4508
192	-3.6	0.48	6390	341	-3.96	0.47	6633
200	-1.58	0.5	5542	342	-2.84	0.63	4572
201	-4.13	1.1	5112	343	-6.94	0.67	7262
202	-3.62	0.56	7099	351	-4.1	1.4	3596
210	-7	0.69	7445	352	-12.97	2.01	2571
221	-6.71	0.74	6998	353	-7.99	1.66	4541
222	-4.48	0.59	5799	359	-2.56	0.56	5032
231	-4.75	4.03	1164	361	-5.07	0.49	7348
232	-3.69	0.99	6004	369	-0.79	0.21	8759
233	-5.19	2.59	1713	372	-2.38	1.23	1836
241	-8.77	0.87	9059	500	-1.2	0.6	4370
242	-1.31	0.43	9535	742	-6.63	3.27	1366
243	-4.47	1.05	4772	749	-9.91	1.57	1763
				921	-3.27	0.76	4362

Notes: Estimation of sector-level CES demand elasticities based on equation (IV.2). Heteroscedasticity-robust standard errors are reported in parentheses. Estimations use importer-year and exporter-year fixed-effects. The table reports coefficients obtained on the tariff variable, which corresponds to the factor $1 - \sigma$ in the model. R^2 vary in the range of 0.6-0.86.

General Conclusion

This thesis touches on several aspects of international economics. The process of integration of a country into the world's economy, through increases in trade flows and in the movement of workers, has distributive effects, which antagonize interest groups in the country and modify the political balance between them. As a result, groups of common economic interest attempt to have their voice heard on the conditions in which integration occurs, within the framework of domestic politics. In face of this interaction, the government's problem is multifold. For a welfare maximizing government, the problem is restricted to choosing the policy which allows the economy to reap the largest gains from integration. In reality, evidence suggests that implemented policies often respond to the interests of some constituencies more than their share of the population should command. The four chapters use different methodologies to study the effects and the determinants of economic policy in the integrated economic environment.

The **first chapter** provides a contribution to a large literature on the question of industrial policy. This question can be broadly defined as asking whether a country's government should intervene in any way in the process of integration into the world economy. The focus of the chapter is narrower. It examines the claim that the type of goods which a country produces and exports determines, in part, the growth rates it will achieve, due to the presence of positive externalities associated to the acquisition of the capabilities needed for some particular products. The growth and export performance of China's economy in the past 20 years has been put forward by some authors as representative of this process. The chapter uses data for trade and growth

at subnational level to test this conjecture: if export sophistication has been driving China's growth, then we should find that regions which have been exporting more sophisticated goods have grown faster. The empirical analysis first confirms that the level of sophistication of exports is not only attributable to the assembly sector. in other words, the remarkable level of sophistication of Chinese exports should not be viewed only as a result of Chinese firms' position in the development of vertical trade among countries. Then, it shows that this sophistication contributes to explaining the growth rates achieved by provinces and prefectures, even when controlling for local disparities in factor endowments. Finally, it shows that the higher growth rates associated to export upgrading are restricted to domestic firms operating in the ordinary (i.e., non-assembly) sector. This results is consistent with the claim that the adoption of technologies and capabilities for producing new sophisticated goods among domestic firms has been a correlate of higher growth rates at the local level.

The **second chapter** looks at another aspect of economic policy for trade: the role of the financial system in the development of exports. It belongs to a large literature on the issue, which has established that the financial system contributes in part to shaping the structure of a country's exports. While this literature has generally adopted a cross-country approach, showing that differences in financial systems create comparative advantages between countries, this chapter focuses instead on within-country variations in access to finance. Focusing on the case of China, it shows that credit constraints, which are pervasive in this country, provide an advantage to foreign-owned firms and joint ventures over private domestic firms in sectors with higher levels of financial vulnerability. Namely, foreign-owned firms and joint ventures have easier access to credit than private domestic firms, which shows in their export structures. This is consistent with the hypothesis that firms with partial foreign ownership have access to internal sources of finance through their parent company (although this hypothesis is not being directly tested). The chapter also shows that the pattern of these relative advantages across firm types has considerably

changed over the period considered (1997-2007): State-owned firms have seen their advantage lessened over the period, in conjunction with the diminishing share of State control over the banking sector. In parallel, private firms have increased their share of exports in sectors where finance is most needed.

Chapter 1 and 2 suggest that there is some room for economic policy to intervene in the process of trade integration of the economy. Policies aimed at supporting domestic innovation and the building of capabilities for the production of new goods, may contribute to the upgrading of a country's export structure, which is associated with higher growth rates. Policy intervention may also be necessary in the financial sector, in order to create the conditions allowing firms and entrepreneurs to access credit, which is also crucial in order to develop new, sophisticated products, as well as to develop operations on foreign markets. One needs however to remain careful about drawing normative conclusions from such results. It is well known that the process of integration into the world economy, by creating new opportunities and opening new markets, is often a vector of structural change in the domestic economy. This makes it a difficult task to determine to what extent domestic policy is defining the way integration occurs, and to what extent it is being shaped by integration itself. The case of China is a powerful example of a society which has been transformed at a fast rate during the period of its gradual opening to trade and investment. Determining to what extent this transformation, and in particular the gradual privatization of the economy, has been accelerated by the process of integration remains an open question.

The **third chapter** considers another aspect of economic integration, the international migration of workers. It examines the welfare and distributive consequences of immigration flows in the destination country, and asks how these impacts depend on the regional fragmentation of the host economy. Taking account of such fragmentation is necessary, because economic disparities across regions imply that immigrant workers do not disperse uniformly across the territory, but

rather tend to settle in higher proportion in the regions offering better perspectives. This in turn implies that domestic factors are impacted differently by immigration, depending on their region of residence. The chapter builds a model to study how the gains and losses from immigration are distributed within the population of resident workers. A comparative statics exercise is carried on where the effects of regional disparities and workers' internal mobility on the distribution of gains is studied. Next, it studies how these distributive effects modify the implemented immigration policy, which results from an equilibrium between native interests. It is shown that, in the case of a government maximizing a weighted sum of welfare and of worker's interests, a higher mobility of foreign workers leads to a more restrictive policy, even though it generates higher total welfare gain for the native population.

The **fourth chapter** also focuses on the political economy of economic integration, but from an empirical point of view. It contributes to a large literature on the question of the determinants of trade policy, and of preferential trade agreements (PTAs) in particular. One central issue of this literature has been to determine whether the commercial policy set by governments departs from the one that would be chosen under a welfare-maximizing rule, or equivalently, whether trade policy reveals unequal weights put by decision-makers on the interest of different groups in the society. Empirical studies generally based on the structure of tariffs have yielded mixed results on this question. The chapter offers an original approach to this question, based on estimating the effects, on export and import prices, of all bilateral trade agreements which a country could sign. By comparing these results with the actual agreements being signed, the empirical exercise reveals which potential gains matter the most in determining a country's trade policy decisions. Results show that the overall real income gains to be expected from an agreement do explain the actual signing of PTAs. But they also show that export price gains - accruing to producers in the country - have about twice as much explanatory power than domestic price gains - accruing to consumers. This suggests that the interests of producers loom larger than those of consumers in decisions over trade policy.

Taken together, chapters 3 and 4 emphasize the role of domestic politics in determining the mode of integration of a country into the world economy. Given the distributive effects of integration processes, it is clear that decisions over them depend on how divergent interests are taken into account by decision-makers. The model developed in chapter 3 is based on a theoretical setting which has been extensively used to derive the consequences of the over-representation of particular groups of interests in a government's objective function. Its contribution is to show that, in the case of migration flows, the spatial distribution of impacts also matters, beside the well-known redistributive effects between factors. The spatial dimension potentially creates an additional wedge between welfare maximization of policy design, depending on the political process leading to policy formation. But the nature of this political process, and in particular, the weights which are associated to different groups' interests in a government's objective function remains an empirical question. This is the purpose of the exercise carried on in chapter 4, in the context of preferential trade agreements formation. Although its results could be rationalized in a similar model of political economy, its approach is rather to remain agnostic about the political process underlying trade policy decisions, and to directly estimate which domestic interests are being best served by these decisions. Using this empirical approach to further decompose the contributions of different groups' interests (such as those of expanding and contracting industries), as well as differences across groups of countries, remains an area for future research.

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