Explorations in Latin American economic history

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Chapter 5

Catching Up, Falling Behind, and the Role of Institutions:

Explaining Productivity Growth in Latin America and Asia from a Sectoral Perspective

"...rather than achieve particular resource allocations per se, [...] the policy search must be for a set of institutions that will allocate resources appropriately over a wide range of circumstances and time".

R. Nelson and S. Winter (1977)

5.1 Introduction

The notion that institutions shape the pattern of long-term economic development is virtually an academic consensus. Numerous seminal studies have explored their vital importance for sustained growth (e.g. Hall and Jones, 1999; Glaeser *et al.*, 2004; Rodrik *et al.*, 2004; La Porta *et al.*, 2008). Recently the term 'appropriate institutions' has gained a central role in Schumpeterian growth models inspired by the influential work of Gerschenkron (1962) particularly his concept 'advantages of backwardness'. The premise is that given domestic absorptive capabilities, the further countries are behind the technology frontier, the higher is their growth potential to catch up. Since catching up is not immediate but a gradual context-dependent process, different types of institutions maximize growth at different stages of development (Aghion and Howitt, 2006; Acemoglu *et al.*, 2006).

The general message of these new growth models is that countries have a paradoxical 'need' for policies and institutions in order to catch up with the income levels of advanced economies; institutions and policies that are appropriate for leading economies

may not be 'growth-enhancing' for economies that are far away from the technology frontier, and vice versa. Recent empirical studies have found that countries endowed with institutions that effectively protect property rights and remove the barriers for the diffusion of new knowledge and technologies, experience higher productivity growth (e.g. Coe *et al*, 2009; Comin and Hobijn, 2009).

Furthermore, technology diffusion spills over to sectors of non-frontier countries; backward sectors in developing countries producing only a few innovations benefit from the transfer of knowledge and technologies developed in frontier countries.[213] However, the pace of this transfer is dependent on the existing institutions in the recipient country: backward sectors endowed with the 'appropriate' domestic institutions to allow for the absorption of the knowledge from advanced sectors experience higher productivity growth (Banerjee and Duflo, 2005; Acemoglu *et al.*, 2007).[214]

Thus, if non-frontier countries have been in a process of institutional change setting up the institutions to remove the barriers of technology diffusion, the spillover effect of these institutions on specific economic sectors can shed more light on the overall dynamics of 'catching up' or 'falling behind' to the frontier. Previous empirical studies such as Vandenbussche *et al.*, (2006) and Madsen (2014) have shown that catching up at the aggregate cross-country level depends on the interaction between human capital and the distance to the technology frontier. However, most of these studies have underscored the sectoral dynamics of non-frontier countries.

The main contribution of this chapter is to test empirically the hypothesis whether institutions have served as an absorptive capability to enable the sectors of non-frontier countries to catch up to the frontier. More specifically, this study produces econometric evidence on the spillover effects of a variety of economic institutions on sectoral productivity growth in Asia and Latin America. Employing sectoral labor productivity data for a set of countries of these regions, together with various disaggregated indicators of institutional quality, the analysis follows a re-arranged version of the 'Nelson-Phelps' model to indicate the growth effects of institutions on sectoral productivity.

Because of the unbalanced sectoral structure in non-frontier economies (e.g. several Latin American countries rely heavily on the extraction of natural resources), countries may experience a different convergence process at the sectoral level compared to relatively high-income countries that are already at the frontier or close to it. In other words,

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[213] Under the assumption that the cost to imitation in the non-frontier country is lower than innovation at the frontier. As a result, rather than innovate, a 'typical' entrepreneur in a follower country optimizes his/her profitability by adopting or engaging in the imitation of technologies from the frontier (see a theoretical exposition in Keller, 2004).

[214] A set of domestic policies such as product licensing and intellectual property laws also affect the pace of knowledge and technology transfer. However, in this study I encompass these policies interchangeably within a broad framework as those (institutions and policies) designed to influence economic agents in finding it profitable to make use of new knowledge and technologies (see for e.g. Nelson, 1994).

developing countries that are far from the technology frontier may not be catching up in aggregate terms (e.g. to the levels of real per capita GDP of the United States) but they may be doing so on a sectoral basis (e.g. to the sectoral value added per worker of the United States.) Hence, following the predictions of the Schumpeterian growth theory, different institutions and their interactions can maximize the catch up process at a sectoral level.

This analysis is of particular policy relevance for various 'catch-up' countries. For instance, broad comparisons of post-war East Asia and Latin America have become the typical narrative in recent years; seminal studies have illustrated how 'backward' economies that upgraded the quality of their institutions were able to catch up, whereas countries that experienced slow institutional change fell behind (e.g. Nelson and Pack, 1996; Taylor, 1998; Amsden, 2001). However, for Latin America in particular its post-1980s aggregate TFP (Total Factor Productivity) stagnation has largely dominated the economic growth literature (e.g. Pagés, 2010; Cole *et al.*, 2005) neglecting the sectoral growth dynamics and their interrelationships with institutional change.

Empirically, the literature analyzing the link between institutions and sectoral performance across countries is still incipient.[215] Notwithstanding data comparability issues, the link between institutions and sectoral productivity is not analytically straightforward. A recurring matter is the existence of different definitions, measurements, and classifications of institutions that often obscure their interpretation and empirical relationships. This study narrows the concept of institutions into a group that follows the four-type classification suggested by Rodrik (2005): *market-creating, market-regulating, market-stabilizing, and market-legitimizing* institutions.

The analysis takes as a benchmark the levels of the United States' sectoral productivity over time as the world's frontier. Our empirical approach relies on the framework proposed by Benhabib and Spiegel (2005) which is a re-arranged version of the Nelson-Phelps (1966) technology catch up model. Panel data estimates show that the interactions of different institutions with the distance to the frontier enhance labor productivity growth at the sectoral level. However, these effects are fundamentally different across sectors; some institutions are more important in magnitude in some sectors while others lose significance.

The results of this chapter point out different channels in which institutional quality impact on sectoral productivity growth: greater freedom in the legal structure and property rights, freedom from tight market regulations, greater access to sound money, and a small

[215] For instance, Acemoglu and Johnson (2005), Bhattacharyya (2009) and Manca (2010) have analyzed the effect of different types of institutions on the growth of GDP (Gross Domestic Product) and/or on TFP (Total Factor Productivity) growth. On the other hand, Crafts (2006) and Nicoletti and Scarpetta (2003) explored the impact of labour market regulations on multifactor productivity for a sample of high-income economies (OECD countries).

and a more efficient government, all in a different magnitude, affected positively the growth of sectoral productivity.

Estimates, however, are sensitive to the sample selection. The model predictions apply to the majority of the sectors in the Asian sample. On the other hand, most of Latin America's sectoral productivity is not statistically related to the quality of property rights and market regulations; only in the mining and construction sectors we can find a statistical relationship between productivity and the institutional indicators of size of government and access to sound money. The chapter is organized as follows: the next section analyzes the role of institutions in sectoral catch up. Section 5.3 explains the features of the model of productivity catch up. Section 5.4 describes the data sources. Section 5.5 analyzes the estimates and empirical results. Section 5.6 concludes.

5.2 The role of institutions in catching up

Unbundling 'appropriate' institutions

According to the prominent economic historian Moses Abramovitz (1986) the process of catching up is an opportunity taken only by countries ('followers') endowed with the appropriate characteristics ('social capabilities') to absorb the knowledge and modern technology from advanced countries ('leaders'). Moreover, he argued that "...the knowledge flows are not solely from the leader to followers. A satisfactory account of the catch up process must take into account multiple interactions" (Abramovitz, 1991; p.232).

Following the theory and evidence from Abramovitz and other authors, seminal studies have generally accepted institutions as the ultimate domestic capability determining the potential for catch up. Empirical analyses have demonstrated that indeed, institutions have largely dominated the process of growth in the long-run over other factors like geography or trade (e.g. Rodrik *et al.* 2004). In that premise, Acemoglu and Johnson (2005) discerned two types of institutions following Douglass North's (1981) distinction of institutions: 'contracting' and 'property rights'.

The first type refers to the rules and regulations governing contracting among citizens bounded by their legal systems. The second are rules and regulations that protect citizens against the power of elites and government expropriation, factors that are mainly influenced by the type of political and legal system.[216] For instance, firms are likely to continue to use obsolete technologies if the enforcement of property rights is not credible, leaving firms vulnerable to expropriation. Thus, technology adoption requires reliable

[216] In a later work, Acemoglu and Johnson (2012) framed institutions as 'extractive' and 'inclusive'. In the former, domestic political institutions are under the control of a small elite, which in turn can promote high productivity growth through an investment-based strategy but subsequently fail to maintain it because of the absence of incentives for innovation promoted by 'inclusive' institutions.

relationships that guarantee the legal right of a firm (or an individual) to obtain the revenues generated by their investments.

Rodrik (2005) considers the latter (property rights) as part of a category that can be simplified as *market-creating* institutions since markets either do not exist or perform poorly in their absence. On the other hand, he argues that sustained growth also requires the development of another set of institutions: *market-regulating* institutions to help dealing with externalities, economies of scale and imperfect information. Furthermore, countries would need *market-stabilizing* institution*s* to generate resilience to external and domestic shocks, minimizing macroeconomic and financial volatility. Lastly, *market-legitimising* institutions involve income redistribution and social protection, facilitating a socially acceptable fiscal shared-burden.

The quality of a diverse set of institutions may have a different impact within a country and these effects (of different institutions) could spill over in a different way among sectors. For instance, it has been argued that the catch up process occurs through sectoral systems of innovation and production, where some institutions 'obey' to the sectoral characteristics of the economy providing an environment more suitable for catch-up in certain sectors and not in others. In this case a set of institutions can determine the innovative potential of some sectors, and some of these can become predominant in terms of the overall impact on aggregate growth (Malerba, 2002).

Moreover, the enforcement of intellectual property rights, anti-trust policies, and the enforcement of tight or soft labor market regulations can also have different spillover effects across sectors. Consider the case of a strong enforcement of intellectual property rights in a 'high-tech' manufacturing sector; tight patent laws can act as a growth-enhancing institution fostering innovation by generating more incentives for investment due to the greater potential of the appropriation of profits derived from the blueprint and the following revenues from the introduction of an innovative product and/or service.

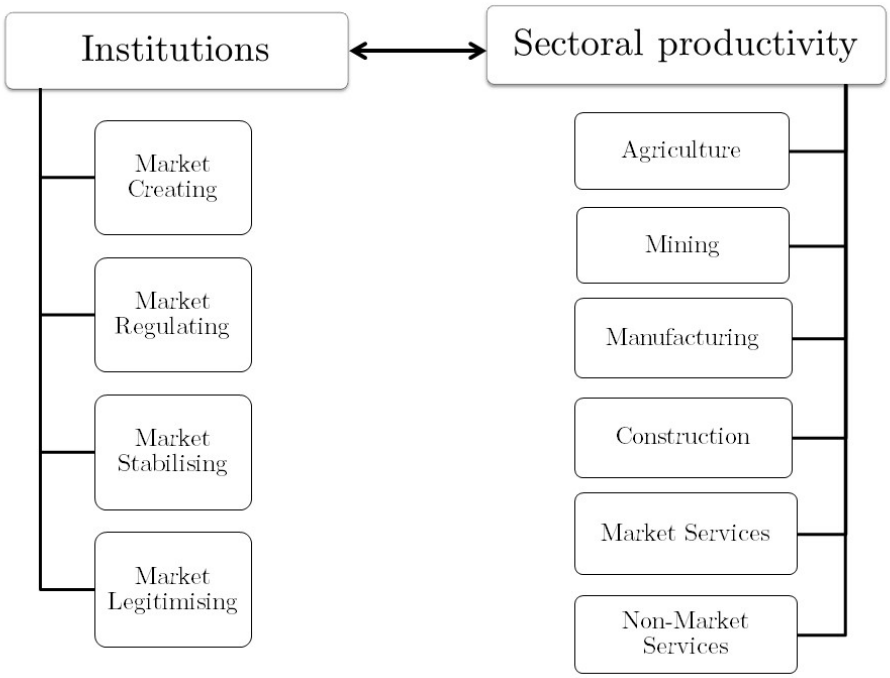
However, catching up to the frontier also depends on the ability of taking the advantage of low-cost blueprints from abroad. Consequently, a tight enforcement of these property rights could act as a barrie*r* as well for catch up in backward sectors by blocking the transfer of knowledge from advanced sectors.

Likewise, specific labor market regulations in different sectors are likely to influence the human resource strategy in an innovating firm by adjusting its workforce according to the wage bargaining system (Scarpetta and Tressel, 2002). Countries that have centralized their wage bargaining systems tend to have high firing and hiring costs, wages are more compressed, and firms (due to the difficulties to attract high-skilled workers) gain from training their own workers. Thus, these factors can induce firms to rely on the internal labor market and choose whether to innovate or import new technologies.

In general, economic institutions are often by policy design 'national' and not 'sector-specific'. This implies that institutions may bind uniformly within a country;

however, their enforcement can have a spillover effect that spreads differently across the sectors of the economy (Malerba and Nelson, 2012). To summarize previous examples, figure 5.1 illustrates a general picture of the set of different institutions and the sectoral disaggregation of the economy analyzed in this study.

Figure 5.1: Institutions for catching up at the sectoral level



Source: Based on Rodrik (2005) and data classification from section 5.4 of this chapter.

Sectoral productivity growth in Latin America and Asia

Rapid productivity growth facilitated by a combination of solid economic institutions and 'market-friendly' policies is often seen as the key element of the so-called 'East Asian miracle'.[217] Most of these East Asian economies have outperformed many developing countries in terms of productivity for almost half a century, yet the most impressive 'overtaking' took place *vis-à-vis* their Latin American counterparts as table 5.1 shows.

Since 1950 countries like Hong Kong and Taiwan, after starting from only a quarter and a tenth of the United States' productivity levels respectively, nearly closed the overall

[217] Although the debate over the sources of TFP growth in East Asia remains controversial, there is a broad agreement that the improvement across the board of the prevailing economic institutions in East Asian countries played a major role in creating the conditions to close the TFP gap relative to the United States. See a discussion in Stiglitz (2001).

gap by 2010 (particularly in terms of real GDP per worker). Although at a much slower pace, major Latin American countries also experienced an early catch up phase to the U.S. levels from 1950 to 1980. Evidently that growth trend was insufficient to catch up. Instead, after 1980 the gap with the United States has remained considerably large and in many cases the gap widened.

Table 5.1: Gross Domestic Product (GDP) per worker and per hour in selected Latin America and East Asian countries relative to the United States, 1950-2010

Year	Argentina	Brazil	Chile	Mexico	Hong Kong	Singapore	South Korea	Taiwan
GDP per worker								
1950	0.55	0.19	0.46	0.35	0.25	0.30	0.12	0.10
1980	0.57	0.31	0.49	0.50	0.57	0.50	0.28	0.33
2010	0.36	0.20	0.50	0.29	0.92	0.72	0.65	0.75
GDP per hour								
1950	0.31	0.11	0.21	0.17	0.10	0.13	0.06	0.04
1980	0.31	0.16	0.23	0.23	0.26	0.22	0.10	0.13
2010	0.16	0.11	0.25	0.13	0.40	0.31	0.31	0.36

Note: Figures are ratios of real GDP (1990 Geary–Khamis international dollars) per person employed and hours worked over the levels of United States.
Source: Total Economy Database, The Conference Board (accessed Jun-2013).

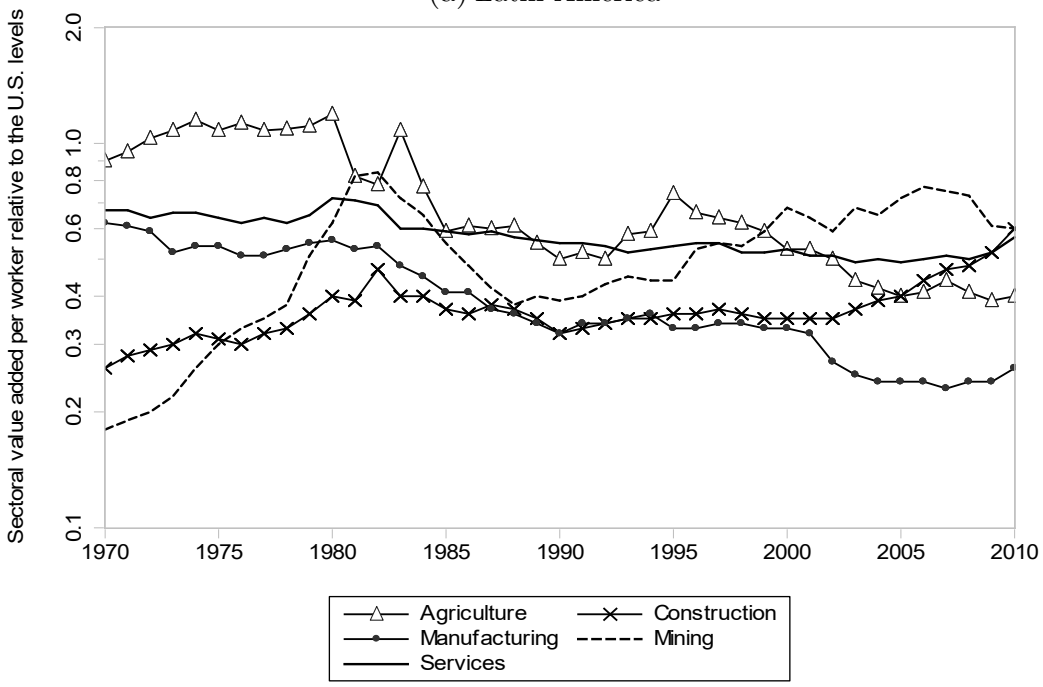
However, a breakdown at the sectoral level provides a more detailed look of the catch up dynamics in these regions. Figure 5.2 depicts a sectoral view of the distance to the U.S. labor productivity frontier. It shows that catching up (and 'taking over') at the sectoral level was already a feature in East Asia early on, when several sectors approached to the frontier (near to unity).

During the decade of the 1970s a number of economic sectors where catching up rapidly to the labor productivity levels of the U.S. (the service sector in East Asia took over briefly and thereafter remained close to the frontier).[218]

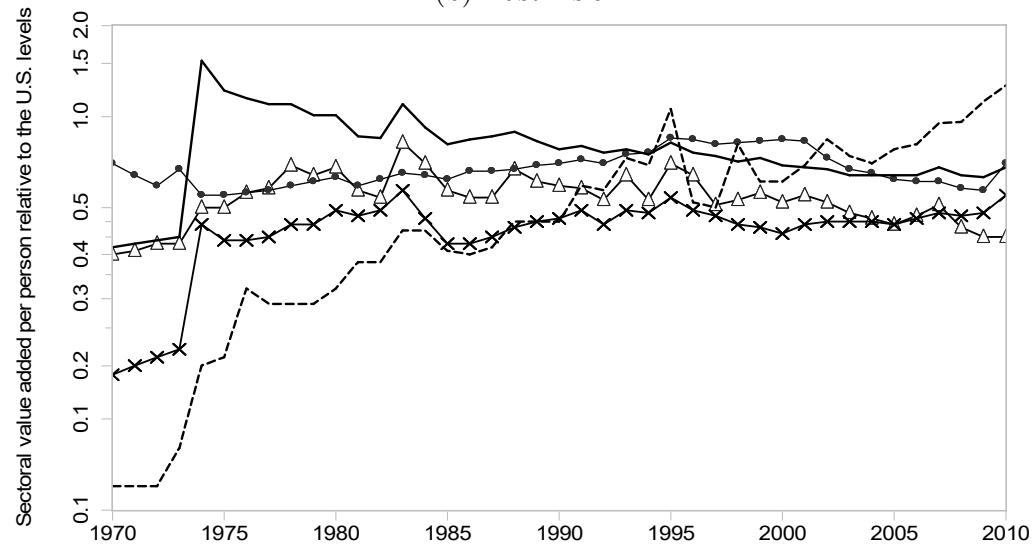
[218] See this particular aspect of East Asia's rise in sectoral labor productivity in these years in van Ark and Timmer (2003).

Figure 5.2: Sectoral value added per worker in (a) Latin America and (b) East Asia relative to the United States, 1970-2010
(Constant 2005 PPP dollars)

(a) Latin America



(b) East Asia



Note: Data refers to averages (unweighted) of sectoral value added per worker over the levels of United States (in constant 2005 PPP dollars; expenditure conversion factors of the 2011 ICP round) in the referred countries from table 5.1. For a better visualization the plot included data on only five major sectors (out of ten) on a logarithmic scale. Following table 5.1, the East Asia country-group refers only to unweighted averages figures of: Hong Kong, South Korea, Singapore, and Taiwan. For Latin America the group of countries is: Argentina, Brazil, Chile, and Mexico.
Source: Based on GGDC 10-sector database. See section 5.4.

Yet, whereas for East Asia the 1980s was a period of a labor productivity slowdown in most of its sectors; Latin America (in a manner similar to GDP measures) fell further behind the sectoral productivity frontier. Overall, many of these gaps have persisted until today and only a few sectors in Latin America have been able to regain their previous levels and catch up to the United States (e.g. mining and construction).[219]

By the mid-1980s and 1990s the majority of Latin American countries opened their economies and carried out a set of 'market-friendly' policies and institutional reforms similar to advanced high-income countries (a set of reforms known as the 'Washington Consensus').

Recently, renewed discussions have emerged related to a potential return to industrial policies aiming to emulate the pre-1980 period. The growth controversy has intensified in several of these countries after the disappointing productivity performance from economic reforms (Ocampo, 2004). Although it is generally acknowledged that after the 1980s, adjustment policies and trade liberalization delivered the required macroeconomic stability for the region, these changes also spurred a type of development that engendered a pattern of high 'heterogeneity' in labor productivity across sectors, causing a reversal in the sectoral composition of the structure of production.

In theory, this sectoral heterogeneity is considered as part of the intrinsic evolution of 'dual-labor' markets, where the reallocation of labor and capital from traditional to more modern activities may generate a bonus on aggregate productivity growth (as addressed in chapter 4). This ultimately affects the pace of productivity growth (average labor productivity) across sectors (Temple, 2005). Following that argument, McMillan *et al.*, (2014) found that the difference in productivity growth between Latin America and (East) Asia can be related to the different patterns of structural change.

In the view of these authors, natural resource-intensive countries in Latin America are 'trapped' in a pattern of growth-reducing structural change, where enclave sectors boosted by the trade patterns of globalization operate at very high productivity, but at the same time are unable to absorb the labor surplus from traditional sectors. The authors claim that the type of institutions and policies that promote less-flexible labor markets are ultimately generating sectoral barriers on aggregate productivity growth.

Table 5.2 depicts the large variation in the growth rates of sectoral labor productivity. As described by previous authors, high productivity growth rates in mining and construction are part of the 'stylized' structure of growth of emerging economies due to their inherent orientation towards natural resources-based and mass-scale production.

[219] See the findings of Castellacci *et al.*, (2014) regarding the observed sectoral heterogeneity employing similar productivity data.

Table 5.2: Productivity growth indicators in Asia and Latin America, 1970-2010 (average compound growth rates)

Region/ Country	Growth of real GDP per worker	Growth of physical capital per worker	Growth of Total Factor Productivity	Sectoral Labor Productivity Growth					
				Agriculture	Mining	Manufacturing	Public utilities	Construction	Services
Asia									
Hong Kong	4.03	4.38	1.36	1.58	12.28	7.43	7.26	0.98	0.61
Indonesia	3.30	5.27	0.92	2.04	-2.74	4.43	6.85	3.24	2.83
India	2.70	3.32	0.90	1.30	3.41	3.40	5.08	0.73	2.64
Japan	2.32	4.30	0.07	3.35	2.68	3.87	2.34	0.19	2.15
Korea	4.75	7.80	0.62	4.89	7.61	6.87	10.48	1.66	1.49
Malaysia	3.94	5.50	0.68	3.27	5.76	3.51	4.97	0.02	3.42
Philippines	0.99	1.45	-0.53	0.91	3.72	1.62	5.41	1.65	1.38
Taiwan	3.87	4.76	0.31	2.86	12.37	3.44	6.29	-2.17	2.11
Singapore	4.39	3.90	0.62	2.84	9.22	4.03	6.98	2.40	2.85
Latin America									
Argentina	0.21	0.27	0.64	2.88	1.53	1.82	5.42	1.18	0.77
Bolivia	0.23	-0.96	-0.46	3.24	4.85	-0.52	2.79	-1.63	-1.73
Brazil	1.09	1.48	-0.04	3.33	12.53	4.01	3.34	1.65	4.70
Chile	1.81	0.94	0.02	5.69	2.90	2.86	1.53	1.22	0.94
Colombia	0.52	0.75	-0.33	1.74	2.04	1.02	3.32	0.17	0.32
Costa Rica	1.58	2.12	-1.10	2.40	5.10	1.48	0.77	1.75	0.01
Mexico	0.63	1.18	-1.02	1.25	3.40	0.21	3.14	-2.44	-0.89
Peru	0.62	-1.88	-0.76	1.45	2.74	1.04	2.31	0.96	-0.48
Venezuela	-1.31	-1.81	-0.89	1.71	-4.23	0.08	4.01	-0.28	-0.68
United States	1.60	2.35	0.82	4.38	1.76	3.28	2.05	1.60	1.46

Note: Physical capital per worker is the total capital stock in 2005 constant prices over number of persons employed. The growth of Total factor productivity is the growth of the welfare-relevant TFP estimate reported in the Penn World Table 8.1. Details of the estimates of the growth of sectoral labor productivity are shown in section 5.4. All data are growth rates of level estimates of constant 2005 PPP dollars. *Source*: Penn World Table 8.1 (Feenstra, Inklaar, and Timmer, 2015) and 10-sector GGDC database.

The table (5.2) also indicates the large differences between other aggregate measures of productivity. For instance, unlike Asian countries, the growth rates of total factor productivity are nearly always negative for Latin American countries. As other studies have shown, average TFP estimates in Latin America were severely affected by the external shocks of the debt crises of the 1980s, thus, on average their regional productivity performance appears meager compared to Asia.

The paradox of productivity growth in Latin America

Although some Latin American countries have explicitly switched their growth policies to a more 'heterodox' type focused on reducing income inequality and stimulating the growth of domestic demand, little has been accomplished in enhancing growth and redistribution (see e.g. in Birdsall, 2008).[220] In general, most Latin American countries have shifted their attention to removing the market barriers that were still in place (e.g. lack of flexible labor markets, high bureaucratic costs, etc.) and which were regarded as the main obstacles to raise productivity growth (see, Cole *et al.*, 2005; Pagés, 2010).

However, the underlying development paradox for Latin American countries has to do with the question why in previous decades these economies experienced high productivity growth rates (1950-1970) in a less competitive environment, protectionist policies, and strong government intervention, whereas in advanced countries growth seems to have been promoted by higher competition, trade openness, and less government intervention.

In the growth models of Aghion and Howitt (2006) and Acemoglu, *et al.* (2006), this phenomenon is referred to as a middle-income 'non-convergence trap' in which the persistence of the same institutions and policies that generated high productivity growth in an earlier stage fail to deliver growth once the economy approaches the technology frontier. Maintaining a growth strategy (investment-based) with the same institutions for too long and failing to switch into an 'appropriate' set of institutions (innovation-based strategy) may generate a middle-income trap, or in this case a Latin American productivity trap.

Institutional persistence hampering productivity is not an unusual characteristic of developing countries. Many cliometric studies have studied how institutional persistence has been a fundamental factor determining the patterns of development. Latin American economic history has been used to illustrate the effects of 'path-dependence' in productivity growth.[221]

For instance, there is a strand in the literature that portrays colonial institutions as having perpetuated the centralized bureaucratic traditions carried over from the

[220] This is particularly the case for South American countries like Venezuela, Ecuador, and Bolivia.

[221] See an overview of the cliometric literature in N. Nunn (2014).

Spanish and Portuguese heritage. It is claimed that this type of institutional environment was prone to have schemes to evade taxes and circumvent courts and which were therefore detrimental to credible commitments, investment certainty, and economic growth (see for e.g. Coatsworth, 2005).

Although the idea of path-dependence of colonial institutions has been widely popularized in the economic literature, there is a growing criticism on the methods employed to test it. Many authors have suggested that the (econometric) instruments employed (e.g. settler mortality rates causing low institutional quality) to avoid endogeneity problems are not the most adequate ones since the cross-sectional evidence cannot capture intra-country dynamics (other than binary variables controls) and thus, do not provide a clear relationship between growth and the quality of institutions.

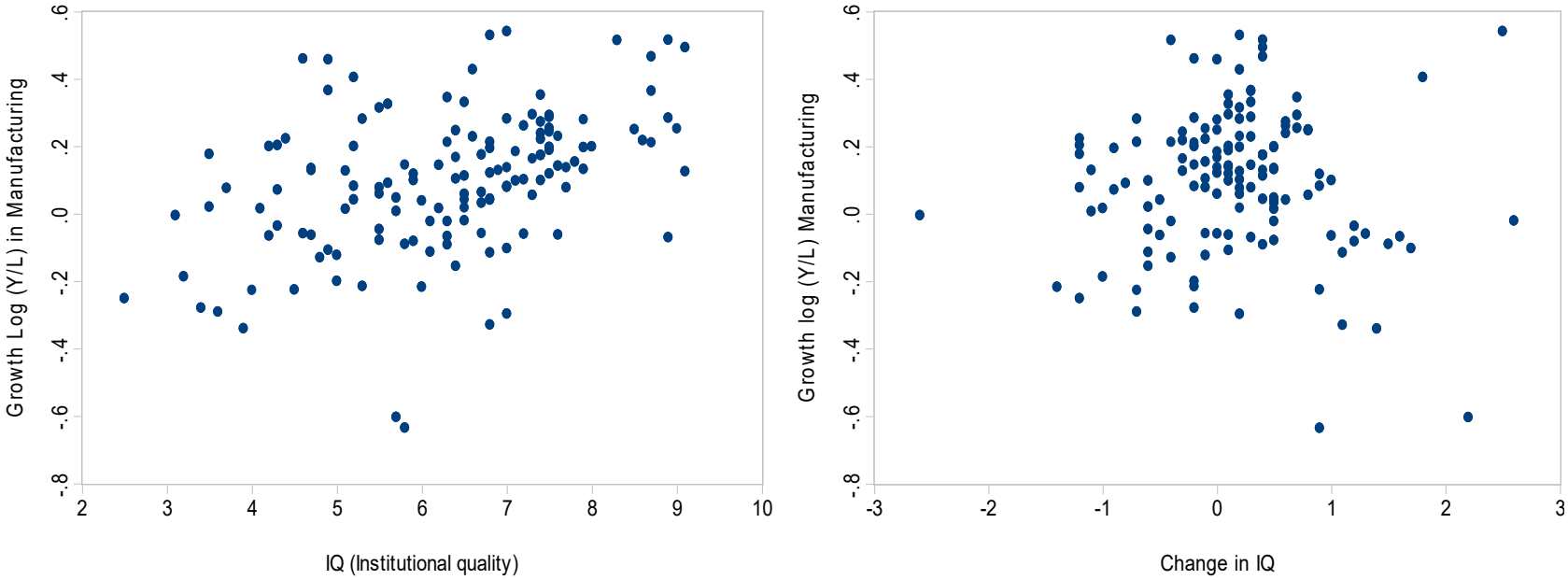
In this study tests a diversity of institutions which consist of standardized indicators of institutional quality scores of economic freedom (see section 5.4) in order to measure the effects of institutions on growth from a sectoral perspective (sectoral labor productivity growth).

Graphical evidence

The scatter plots in figure 5.3 depict an example of a trend in the relationship of productivity growth and institutions in a particular sector. Since the manufacturing sector has been historically one of the largest and leading 'engines' of growth in many countries far away from the frontier, it is relevant to mention some of its general features for subsequent econometric analysis. The left-side scatterplot shows a positive relationship between manufacturing labor productivity growth (five-year intervals) and institutional quality. This suggests that countries endowed with overall higher institutional quality experience higher productivity growth.

However, the scatterplot on the right side which depicts the change of institutional quality (five-interval change in the economic freedom index) and labor productivity growth shows no apparent trend. This may be related to the fact that institutional change (measured as the change in economic freedom) has been highly heterogeneous across the sample. Some countries experienced noticeable positive improvements over time but others have been through a reversal of institutional quality. Therefore, from these graphs is not possible to establish neither a direct relationship nor causality. An endogeneity bias may be present because countries with higher productivity growth could also develop better institutional quality. Thus, the initial positive relationship (in the left-side scatter plot) should be tested with the inclusion of lags (it is less likely that current productivity growth could affect the institutions of five years ago), time and country dummies, and other omitted variables that may potentially have affected productivity growth.

Figure 5.3. Manufacturing labor productivity growth, institutional quality, and change in institutional quality in Latin America and Asia, 1970-2010



Note: Institutional quality (IQ) is the summary index of economic freedom ranging from 0-10 where 0 corresponds to 'less economic freedom' and 10 to 'more economic freedom'. Labor productivity growth in the manufacturing sector and change in IQ are measured in five-year intervals from 1970 to 2010.
Source: See data source details in section 5.4.

The measurement of institutions for catch up in Latin America

The empirical analysis faces a similar challenge of previous studies attempting to measure a variety of institutions via Rodrik's four-way partition (e.g. Bhattacharyya 2009). However, aside from the issue of narrowing a country's institutional quality into this classification, the accurate measurement of the effects of institutional development over time in Latin America can also be in itself a quantitative issue. This is due to the fact that most policy changes (reforms) have time-lags on their targets; the effects of the changes in institutional quality on productivity are also not expected to be observed instantly but after a time interval. As mentioned, for most countries in the sample the initial year is 1970. Because of the nature of the econometric method employed (as explained in the ensuing section 5.3), lagged five-year variables (t-1, t-2) were introduced matching the timing of the beginning (years 1975 and 1980) and subsequent deepening of the institutional reforms (and demise of ISI policies) in the majority of Latin American countries.

According to several specialists, most of the institutional changes were already underway in the decade of the 1970s. The opening of the Latin American market to international trade and capital flows, the promotion and development of the private financial sector, and the reduction of the role of the government in the economy were considered an integral part of a 'new' growth strategy in the mid-1970s (e.g. Foxley 1983). The most explicit cases of this are the economic programs of the military governments in Chile (since 1973) and Argentina (since 1976). Apart from short-term macroeconomic goals, by the end of that decade, other major countries like Mexico gradually attempted to implement deep institutional reforms. These were characterized by exposing key sectors of the economy to market competition by removing barriers to international trade (Mexico attempted to join the GATT in 1979 ahead of other Latin American countries); legislating towards a *flexibilization* of the labor market; deregulating the use of urban and rural property, liberalization of the banking system, and reducing the size of the public sector by the privatizing state-owned industries.[222]

Thus, although economic reforms originated in the mid-1970s, their deepening was set forth during the mid-1980s (at the time of macroeconomic stabilization) and 1990s. These major changes are broadly encompassed in the standardized indices of Gwartney, et al. (2012) employed in this analysis (property rights; market regulation; sound money; size of government). Yet, although the continuous efforts in that direction were evident across Latin America, the intensity in which they were imposed differed across countries. Figure 5.3.A (in appendix 5) shows this feature. In spite of the large dispersion (by country and type of institution) and except for the case of Venezuela, most of the indices of institutional quality show a broad but gradual improvement since 1970.

[222] GATT stands for 'General Agreement on Tariffs and Trade'. For detailed case-by-case historical account of the institutional reforms in Latin America, see Corbo (1988).

From the analytical background it is possible to indicate tentatively *a priori* which institutions are more important to catch up at the aggregate level (as explored in previous policy research). One of the premises of the 'advantages of backwardness' approach is that if foreign backward countries are not endowed with the relevant institutions (capabilities) to absorb new knowledge, technology will not spill over across countries. One of the notions of why non-frontier countries fail to develop good institutions and catch up to the frontier is that incumbent governments may actually oppose to some sources of institutional change blocking the upgrading of institutions if these erode the economic and political advantages of the ruling elite.

Building on that notion, however, Acemoglu *et al.,* (2006) and Aghion and Howitt (2006) pointed to the context-dependent effects of different institutions on long-term growth. They argue that in early stages of development high productivity growth can be promoted through institutions that are not necessarily the same for frontier countries (institutions promoting innovation-based growth). Instead, institutions that promote the emulation of technologies developed elsewhere (imitation-based growth) can be productivity growth enhancing.

In broad terms, the latter can be a typology of institutional development in Latin America from the 1950s until the 1970s. Institutions under import substitution yielded high productivity growth rates in major countries (as seen in chapter 4). As part of the industrial strategy, institutions were crafted under a very uncompetitive environment looking to promote the accumulation of domestic technological capabilities. The freedom to trade internationally was restricted, business regulations were relatively high, and the size of the public sector was large. As showed previously in table 5.1 and figure 5.2, under these type of institutions several countries in Latin America managed to move to the productivity frontier; however, that development model collapsed in the 1970s. A new era of institutional development started thereafter (c.1970-onwards) based on market-oriented institutions, or in Schumpeterian terms, towards crafting the type of institutions that promotes innovation-based growth.

Several empirical studies have confirmed those dynamics employing aggregate data (e.g. Madsen 2014). At the sectoral level, however, the empirical examination is more challenging because channels through which technology diffusion takes place can be different since some sectors are intrinsically different from the aggregate economy (i.e. highly unbalanced structure of production), together with the institutions that promote this diffusion. According to several studies, international trade is a central factor that makes available new goods embodying foreign technologies and promoting absorptive capabilities. However, certain type of institutions like reducing barriers of entry (business regulations; e.g. low 'MR' index), low tax burden (i.e. low 'SG' index), and/or access to sound money can also spur the absorptive capabilities that promote high sectoral productivity growth and catch up.

In the present empirical examination, controlling for other determinants of productivity (education, physical capital, trade), the enhancing/reducing effects from upgrading institutions are confined in the interaction terms (institutions*sectoral productivities) included in the estimations. For Latin America, natural resource

intensive sectors are of specific relevance due to their well-known regional reliance on commodity trade (e.g. Venezuela, Bolivia, Chile, and Brazil). As mentioned, access to resource rents in these sectors may provide an incentive for governments to stay in power blocking institutional upgrading that threaten their power. Thus, several studies have found a negative statistical correlation between the size of the government and productivity growth in these sectors (Ross 2001), an effect that disappears under 'better' institutional environments (e.g. Haber and Menaldo 2011).

Given these a priori theoretical expectations (institutions, sectoral productivity, distance to sectoral frontier, and their interactions), a potential concern is the endogeneity of the estimators. A reversed causal relationship can emerge in the aforementioned cases when extraordinary productivity rates (i.e. natural resource based) affects institutional development and not vice versa as expected. Thus, to control for this, the econometric method employs lagged regressors (t-1, t-2) as internal instruments looking to attenuate the serial correlation bias. For example, the five-year interval spike in productivity in natural resource-intensive sector is less likely to influence the dynamic of institutional development of one or two periods (i.e. 5 or 10 years).

5.3 Empirical model

This section outlines the empirical setting of the theoretical model and its econometric specification. The idea of a baseline model of catching up dates back to Richard R. Nelson and Edmund Phelps (1966) who postulated an interaction between the level of education of a country and the rate at which it closes the technology gap. They hypothesized that differences in human capital explain the observed differences in the speed of convergence to the technology frontier. The explanation for this is that human capital yields higher technology levels not only domestically, but also by adapting ideas of countries from the technology frontier. This formulation has become the workhorse catch up model in the empirical literature (see, Benhabib and Spiegel, 2005).

Similarly to other model specifications, here it is argued that apart from human capital, the sectoral catch up process is enhanced by the diffusion of technology promoted by the economic institutions as described in the previous sections. I have re-arranged the functional catch up potential in the equation of a follower country to the variables of institutions.[223] Unlike other exercises testing institutions on growth, I consider a disaggregated set of institutions (four-type) hypothesizing that the spillover effect of their interactions with the distance to the frontier diffuses on different sectors of the economy. For each sector, the diffusion process is as follows:

[223] This equation re-arrangement was similarly formulated in previous econometric studies, however, these were focused on the aggregate total economy (e.g. Dollar and Kraay, 2003; Manca, 2010) and not at a sectoral level.

$$\Delta a_{ij} = b + \left(g + \frac{c}{\rho} \right) \bar{s}_i - \frac{c}{\rho} \bar{s}_i \left(\frac{A_{lj}}{A_{ij}} \right) + \varepsilon_{ij} \quad (1)$$

With an error ε_{ij} independently and identically distributed. Denoting i as the follower country, l represents the country leader (United States), and j is the specific sector.[224] Δa_{ij} is the average growth rate of productivity of sector j in country i. Aij and A_{lj} denote the sectoral productivity levels of the follower and leader country respectively. $\bar{s}_i$ represents the institutional quality in country i. The coefficients to be estimated are $g + \frac{c}{\rho}$ and $\frac{c}{\rho}$.

Equation 1 shows that the further a follower country is behind the leader, the higher is its productivity potential provided by the technological absorptive capacity driven by the institutional quality component.

However, not all countries are always on a catch up path. Benhabib and Spiegel (2005) suggest a 'catch up condition', in which there is a threshold level of the main independent variable. In our sectoral model, the set of institutions is the main independent variable, meaning that the country must be endowed with a certain quality of a particular type of institution in order to be on a catch up path to the sectoral level of the productivity leader. A level of institutional quality below that threshold would imply that the sector in that country would fall further behind the productivity frontier:

$$s_{i,t}^{*} = \exp\left(\frac{g\bar{s}_{l,t}}{g + c} \right) \quad (2)$$

where $s_{i,t}^{*}$ is the threshold level of institutional quality that the follower country must possess for the specific sector in order to be on the catch up path to the productivity leader. $\bar{s}_i$ is the institutional quality endowment of the leader.

Empirical specification

In hindsight, the country sample (Latin America and Asia) is highly heterogeneous and thus, it is very likely that their intercepts are quite different. In the sub-components of our institutional proxy, I explore their role for catch up at the aggregate level:

[224] As typically presented in the literature, the technology frontier refers to the (sectoral productivity) levels of United States. Selecting other countries' productivity levels as the overall frontier would be rather inadequate since they do not remain consistently over time as productivity leaders. For e.g. although in some short intervals the productivity levels in the mining and services sectors of the United States were surpassed by the levels of Hong Kong and Singapore, on average the United States remained the productivity leader in the majority of the sectors.

$$\Delta lp_{ijt} = \alpha_{ijt} + \beta_{it}\left(\frac{lp_{ijt}}{lp_{ljt}}\right) + \psi_{it}(X) + \delta_{it}\left(X * \frac{lp_{ijt}}{lp_{ljt}}\right) + C_{it} + \varepsilon_{ijt} \quad (3)$$

Where Δlp_{ijt} is the rate of growth of labor productivity in country i, sector j, in time t.

α_{ijt} denotes country and period fixed effects. The β_{it} coefficient captures the effect of the distance to the frontier (lp_{ijt}/lp_{ljt}) defined as the ratio of the follower country's labor productivity level (lp_{ijt}) relative to the country leader (lp_{ljt}) for a particular sector for each time interval. X is a vector of different institutions (sub-categories of institutional quality), ψ_{it} accounts for the effect of the set of institutions.

The interaction term is denoted by coefficient δ_{it} which implies the catch up potential due to the absorptive capacity promoted by the institutional quality and its different components. C_{it} is a vector of control variables, and ε_{ijt} represents the stochastic error term.

In general, this specification follows essentially the original predictions at the aggregate level of the Nelson and Phelps model. The difference relies in that at the sectoral level, the country's absorptive capabilities on sectors are measured indirectly (as externalities) since these variables (institutions) were constructed at a country level. Yet, this (sectoral) approach may provide a more comprehensive picture of the phenomenon of catch up growth and the role of institutions in non-frontier countries.

5.4 Data

Description: Sectoral labor productivity

The country coverage is based on eighteen countries: nine Latin American countries (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela), and nine Asian countries (Hong Kong, Japan, India, Indonesia, Malaysia, Philippines, Singapore, South Korea, and Taiwan). Conventionally, in empirical growth modeling, it is necessary to filter out random and cyclical fluctuations, thus regression models in this study are estimated in five-year interval panel data from 1970 to 2010.[225] For this reason the annual productivity data was expressed into five-year intervals calculated as average compound growth rates.

The data used for constructing the measures of labor productivity relied on the basis of the availability of information of gross value added and employment from the 10-sector database published by the Groningen Growth and Development Centre (www.ggdc.net).

The measures of sectoral labor productivity (Y/L) are real gross value added (Y) over the number of persons employed for each economic sector (L) in every year

[225] Sectoral data for Hong Kong and Malaysia is available for the period 1975-2010.

(1970-2010). Gross value added by sector was originally reported in local currencies, thus, the figures were adjusted into constant prices, first from current prices into local constant prices of 2005, and then converted into 2005 PPP US dollars using expenditures prices provided by the International Comparison Program (ICP) from the World Bank.[226]

Overall, the data covers ten different sectors of the economy; however, for parsimony, sectors related to the services sector were re-classified into a two-type classification: market services and non-market services. In total, our sectoral coverage was re-classified into six main sectors: (1) Agriculture; (2) Mining; (3) Manufacturing; (4) Construction; (5) Market services (which includes wholesale and retail trade, hotels and restaurants; transport, storage and communication; finance, insurance and business services; and (6) Non-market services (includes social and personal services, public utilities, and government services).

Description: Institutions

Although several empirical studies have used a wide variety of measures of institutional quality, most of them generally include at least a measure related to corruption or to the enforcement of the rule of law. As discussed previously, however, Rodrik (2005) has categorized a more 'inclusive' four-type grouping to facilitate the addition of other institutional factors that affect the efficient allocation of resources.

Aiming to approximate the aforementioned institutional classification I employed the measures of economic institutions based on data from Gwartney, Lawson, *et al.* (2012). Extensively used in previous growth studies, this data is considered as a representative scale to measure a country's endowments of 'market-based' institutions.[227] It measures in particular different areas of 'freedom' to engage in market transactions within a country over a relatively long period of time (1970-2010).

The dataset is jointly published by the Fraser Institute compiling indices to measure five components of economic freedom; (1) Legal structure and security of property rights, (2) Regulation of credit, labor, and business, (3) Access to sound money, (4) Freedom to trade internationally, and (5) Size of government.

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[226] A more accurate PPP conversion at the sectoral level should employ sector-output prices instead of aggregate expenditure prices. This is because expenditure prices do not include transport margins and intermediate goods. Inklaar and Timmer (2014) constructed the first estimates of sector-specific 2005 PPPs for a large set of countries; however, for our country sample that price data is very limited (only a half of our country-sample). Therefore, for cross-country consistency the adjustment of our labor productivity estimates follows the convention in factor conversion using expenditure-side PPPs as in Bernard and Jones (1996).

[227] See for instance the work of de Haan and Sturm (2000) for an application on this data on an aggregate cross-country growth framework. Also, see an historical exploration for OECD countries since 1870 following this methodology in the work of Prados de la Escosura (2014).

The indices are originally standardized on an 11-point ordinal scale, ranging from 0 to 10, where a higher value indicates greater economic freedom. Instead of using the five indices, this study focuses on only four of them. The reason behind this is that a control variable is included to account for openness or trade differences across countries (export share in GDP); therefore, the variable 'freedom to trade internationally' is excluded in the regression analysis since conceptually it has a collinear relationship with the control variable measuring openness.

In this empirical analysis these indices account for different dimensions of institutional quality which allows for their use in a disaggregated way (into four areas). The data matches the specific country and year sample unlike any other data on institutions publicly accessible. In general, these indices are linked in practical terms to the classification of institutions suggested by Rodrik (2005) as depicted in table 5.3.[228]

Table 5.3: Disaggregated economic institutions

Rodrik's four-type classification	Economic Freedom	
	Index	Content
Market creating institutions	Property Rights (PR)	Protection of property rights; Integrity of the legal system; Legal enforcement of contracts; Regulatory restrictions of sale of real property; Judicial independence; Impartial courts.
Market regulating institutions	Market Regulation (MR)	Credit market regulations; Private sector credit; Interest rate controls/Negative real interest rates; Labor market regulations; Minimum wage; Hiring and firing regulations; Centralized collective bargaining; Mandated cost of hiring; Mandated cost of worker dismissal; Conscription; Business regulations; Price controls; Bureaucracy costs; Starting a business; Cost of tax compliance
Market stabilizing institutions	Sound Money (SM)	Freedom to own foreign currency bank accounts; Standard deviation of inflation; Inflation in most recent year. Average annual growth of the money supply in the last five years
Market legitimising institutions	Size of Government (SG)	Government consumption spending as a % of Total Consumption; Transfers and subsidies as a % of GDP; Government enterprises and investment as a % of GDP; Top marginal tax rate; Top marginal income tax rate; Top marginal payroll tax rate

Source: Based on the classification of Rodrik (2005), and on the Economic Freedom of the World dataset of Gwartney, J., R. Lawson, *et al.* (2012).

[228] I have re-labeled each index into a short name (e.g. 'Regulation of credit, labor, and business' only into 'Market Regulation', likewise for 'Access to sound money' into the label of 'Sound Money').

To gain a better intuition related to the functional interpretation of these indices and how these are a proxy for different institutions, I simplify their ordinal connotation (from 0 to 10):

A higher value in the 'Property rights' index (PR) implies a greater protection, and vice versa. However, in the 'Market regulation' index (MR) a higher value implies more freedom from regulatory-government related restrictions, therefore, higher values of this index means less regulation and vice versa.

Likewise, higher values in the 'Sound Money' (SM) imply lower financial restrictions (e.g. a value of 10 means 'foreign currency bank accounts are permissible without restrictions and 'low money growth' and 'inflation rates'). Finally, a higher value in the 'Size of government' index (SG) corresponds to a relatively small government, that is low government consumption as a % of total consumption, few government enterprises, and low marginal tax rates.

The scores of the indices are significantly different for the total sample. In all categories the means of Asian countries are higher than in Latin America but in a different degree depending on the type of institution over time.[229]

Control variables

As mentioned before, productivity growth is likely to be influenced by factors other than institutions. Thus, there were included control variables following the overall findings of previous literature on the typical factors influencing economic growth in cross-country growth regressions (see Easterly and Levine, 1997). To include these, the analysis made use of aggregate country data from the Penn World Table 8.1 (Feenstra *et al.,* 2014).

The estimates control for the country differences in human capital (HC) across the country sample. The reason for including this has a theoretical logic. According to endogenous growth theory human capital is one of the core drivers of innovation and productivity growth (Aghion and Howitt, 1992). More educated people are likely to increase the chances of new discoveries, facilitate the adoption and use of new technologies, and thus, will be more productive relative to others endowed with less human capital. Therefore, the years of schooling combined with the returns from education as reported in the latest version of the Penn World Table were used as a 'proxy' of human capital.

In relation to that variable (HC), Vandenbussche *et al.*, (2006) have argued that human capital has a dual effect on the economy depending on the stages of technological development. Unskilled human capital facilitates imitation or the diffusion of existing technologies, and skilled human capital promotes the development of new technologies and innovation. They claim empirically that tertiary education

[229] See a test of differences in table 1.A. of the appendix

becomes more important and secondary and primary less important to catch up as countries move closer to the technology frontier.[230]

Another control included is the level of physical investment as a percentage of GDP (labeled as 'Invest'). This variable has been considered by the growth literature as one of the most robust determinants of growth across countries. This is because investment may influence growth through productivity externalities or directly through the production function (capital deepening).

The level of openness has also been considered an important driver of growth in empirical modeling. From seminal studies like Sachs and Warner (1995) to more recent analyses, the link between openness and economic growth has been a common denominator in testing growth differences across countries. It is commonly argued that the higher the openness of the economy, the higher is the absorption of technologies from abroad.

Additionally, firm-level studies have found a positive impact of trade on productivity growth through the reallocation of resources to the sector that is more open to export competition (for e.g. Melitz, 2003). To control for this productivity-enhancing effects arising from the openness of a country, I included the share of exports in GDP ('Export').[231]

Table 5.4 presents the summary statistics of all the variables employed in the study. As expected, averages of labor productivity growth and institutions differ significantly. For instance, the maximum value of mining labor productivity (growth and the distance values) surpassed at one point the level of the United States (a logarithm value above unity) and its standard deviation is the highest of the productivity variables.

The overall pairwise correlations are depicted in table 5.1.B (See the appendix). These show relatively low correlations between the independent variables, which gives an indication that the problem of multi-collinearity is not a serious issue to carry out the econometric analysis.[232]

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[230] To verify this prediction, it was checked as a robustness test in the final estimates the effect of adding as a control variable data on primary and tertiary schooling using the dataset from Barro and Lee (2010).

[231] Other studies have included the sum of imports and exports as share of GDP as an openness indicator. However, exports share (and not the imports share) is the variable that would capture more accurately the commodity booms driven by the rise of international prices of exported commodities. In addition, it is well-known that after the 1960s the pro-export orientation of Asian countries was a distinct policy feature in the region, which is a bias which I look to control in the estimates.

[232] This low pairwise correlation among institutions is a major advantage over other institutional data employed in related studies like Campos and Nugent (1999).

Table 5.4: Summary statistics

Variable	Average	SD	Minimum	Maximum
Δln(Y/L) in agriculture	0.10	0.18	-0.49	0.53
Δln(Y/L) in mining	0.12	0.44	-1.26	1.78
Δln(Y/L) in manufacturing	0.10	0.21	-0.64	0.54
Δln(Y/L) in construction	0.04	0.24	-0.84	0.79
Δln(Y/L) in market services	0.03	0.20	-0.71	0.54
Δln(Y/L) in non-market services	0.12	0.23	-0.84	0.75
ln(DTF) agriculture	-1.14	0.83	-2.76	0.82
ln(DTF) mining	-1.25	1.29	-3.59	1.93
ln(DTF) manufacturing	-0.84	0.75	-3.67	0.97
ln(DTF) construction	-1.22	0.66	-3.18	0.94
ln(DTF) market services	-0.79	0.64	-2.38	0.71
ln(DTF) non-market services	-0.99	0.86	-3.58	1.18
Overall institutional quality (IQ)	6.38	1.39	2.50	9.10
Property rights (PR)	5.47	1.63	1.60	8.50
Market regulation (MR)	6.14	1.32	3.30	9.40
Sound money (SM)	7.06	2.43	0.00	9.90
Size of government (SG)	6.65	1.24	4.00	9.70
Human capital (HC)	2.32	0.47	1.23	3.35
Investment share (Invest)	0.23	0.10	0.09	0.59
Export share (Export)	0.30	0.39	0.02	2.37

Note: Sample period: 1970–2010 for the level variables and 1975–2010 for the growth variables. Δln((Y/L) in each sector is measured as the natural logarithm of the five-year annualized change. ln(DTF) stands for 'distance to frontier' which is measured as the logarithm of the ratio between the levels in the specific country/sector and the level of the United States. Human capital (HC) is educational attainment measured in years of schooling (Barro and Lee, 2012) and returns to education (Psacharopoulos, 1994). Investment (Invest) and export (export) share is the investment share and exports to real GDP respectively.

5.5 Estimates and results

This section presents the estimates from equation (3) specified with its different institutional variables as described in sections 5.2 and 5.3. The unbalanced longitudinal dataset comprehends a maximum of (n x T) 162 country/sector observations (total panel observations vary according to the specification of the model). Following a

similar econometric strategy as in Madsen (2014), I compare the estimates under two different methods aiming to correct for correlated time-invariant factors and endogeneity bias. Baseline results are reported under fixed-effects (country and period effects) ordinary least squares (FE-OLS) and instrumental variables regressions (FE-IV).

The dependent variable refers to the growth of labor productivity in each sector of the economy, which in all regressions is specified as the change of the natural logarithm of sectoral value added per worker ($\Delta \ln Y/L$). Independent variables are the institutions in question (lagged), the (lagged) distance to frontier (DTF), and the interaction term between them (Institutions*DTF). As mentioned in the previous section, in empirical modeling it is necessary to control for other factors influencing productivity growth, thus, explanatory variables other than institutions (and distance to frontier) such as physical investment (Invest), level of openness (Export), and human capital (HC) are included systematically. For the case of the instrumental variables regressions, all instruments are internal; as long as they are proven to be orthogonal to the error term (exogenous), I employ their own lags (in two periods) as usually conducted in panel growth models (Durlauf *et al.*, 2005; p. 103).[233]

Baseline estimates and theory predictions

In terms of estimated coefficients of the empirical model, a negative coefficient on the distance to frontier is expected.[234] On the other hand, we may expect a positive sign on the coefficient of the interaction between institutions (e.g. Property Rights index) and distance to frontier as stated in the empirical specification. The effects of the legal structure and property rights (PR) on sectoral productivity growth are shown in table 5.5.

The sign of the estimates of the distance to frontier across sectors is negative as expected in the model. Although there may be other inherent factors that cause sectoral productivity differences (product and industry composition within the sector), these statistical differences are variations in line with the findings of previous studies

[233] Instruments are lagged values of the independent variables in two periods. Different sets of instruments with lags from 2 to 3 were tested. They showed that estimates are not very sensitive with respect to the choice of lags (2 and 3), thus, to preserve degrees of freedom, instruments were lagged with only two periods. Typical external instruments such as the log of savings and the log of education expenditures were additionally considered, however, these all proved to be insignificant individually and jointly in most of the estimations. Using the Generalized Method of Moments (GMM) instead of the standard IV could have been a better technique to deal with unobserved heterogeneity and serial correlation for a panel; however, because of the nature of the data employed in this study that method reduces significantly its efficiency (e.g. low range in our panel dimension).

[234] Other similar studies such as Griffith *et al.*, (2004) obtained a positive sign in this coefficient because the specification of their variable of distance to frontier is the inverse to ours, that is, they set the follower country on the numerator side. Instead, as mentioned, the analysis followed Benhabib and Spiegel (2005) and several others' standard specification (follower country on the denominator) as originally in Nelson and Phelps (1966).

on technology diffusion; technology diffuses at a different speed and unevenly across countries and sectors (Comin *et al.*, 2006).

The coefficients obtained under both methods (OLS and IV) are not much different from each other.[235] Although for the case of OLS they are highly significant for most of the specifications, endogeneity bias is suspected to be present under this method, thus, conducting a correction with an IV specification would entail more reliable estimates (unbiased) than those under the former.[236]

Except for the lack of statistical significance (in the IV specification) at 5% of institutions and the interaction term in the services sectors (market and non-market), in general, the baseline regressions of table 5.5 show the vital importance that the legal structure and property rights have for labor productivity growth across sectors.

The higher the interactions of property rights and distance to the frontier within a country, the higher the labor productivity growth in the respective sector. In other words, controlling for other factors affecting growth, the spillover effect of institutions materializes in sectors far away from the frontier and those countries endowed with better (higher score) legal structures and property rights.

[235] Both estimates were reported aiming to compare whether there are significant differences between them, but in general, the differences of OLS and IV, is that OLS estimates rely on all of the natural variation that exists across the sample, whereas IV estimates are derived only from the variation attributable to the instruments.

[236] The equations are exactly identified (exact number of endogenous variables and numbers of instruments). Thus, testing on whether the estimated equations are over-identified (employing a 'Sargan test') does not apply here. Although the identification of the current restriction is grounded on standard theory, Angrist and Pischke (2009) show that the presence of a bias due to weak instruments tends to be very small when the instruments and the endogenous variables are correlated around 0.1 (as a rule of thumb).

Table 5.5: Property rights (PR), distance to frontier (DTF), and interactions: 1970-2010

Variable/sector	Agriculture	Mining	Manufacturing	Construction	Market Services	Non-Market Services
			FE-OLS			
DTF_{t-1}	-0.38***(0.05)	-0.76***(0.06)	-0.53***(0.05)	-0.60***(0.06)	-0.46***(0.06)	-0.52**(0.07)
PR_{t-1}	0.04***(0.01)	0.05* (0.03)	0.04***(0.01)	0.07***(0.01)	0.03** (0.02)	0.01* (0.02)
(PR*DTF)	0.05***(0.01)	0.11***(0.01)	0.08***(0.01)	0.08***(0.01)	0.08***(0.01)	0.06*(0.01)
F-stat	5.34	11.73	11.03	7.86	6.11	3.67
Adj R^2	0.48	0.77	0.76	0.69	0.63	0.5
N	138	138	138	138	138	138
			FE-IV			
DTF_{t-1}	-0.51** (0.2)	-0.87**(0.20)	-0.53* (0.09)	-0.67***(0.18)	-0.31* (0.15)	-0.48* (0.2)
PR_{t-1}	0.05 (0.05)	0.04 (0.07)	0.04 (0.04)	0.04 (0.06)	-0.04 (0.8)	-0.06 (0.7)
(PR*DTF)	0.07***(0.02)	0.13***(0.01)	0.07***(0.01)	0.09***(0.01)	0.05* (0.02)	0.07*(0.02)
F-stat	3.34(0.00)	3.26(0.00)	7.99(0.00)	2.43(0.00)	2.26(0.00)	2.15(0.00)
χ^2	0.19(0.90)	0.17(0.45)	0.16(0.98)	0.02(0.69)	0.09(0.97)	0.25(0.59)
Adj R^2	0,41	0.87	0.77	0.71	0.33	0.45
N	120	120	120	120	120	120

Notes: Dependent variable is $\Delta\ln(Y/L)$ which is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. DTF_{t-1} is the natural logarithm of the distance to frontier lagged in one-time period. PR_{t-1} stands for Property Rights lagged in one-time period (t-1). PR is the index of the legal structure and security of property rights that ranges from 0–10 where 0 corresponds to "no judicial independence", "no trusted legal framework exists", "no protection of intellectual property", "military interference in rule of law", and "no-integrity of the legal system" and 10 corresponds to "high judicial independence", "trusted legal framework exists", "protection of intellectual property", "no military interference in rule of law", and "integrity of the legal system". Robust standard errors in parentheses. *, **, *** statistically significant at 10%, 5%, and 1% levels, respectively. *FE-OLS* and *FE-IV* refers to ordinary least squares with fixed effects (FE) and an instrumental variable regression respectively. Coefficients of the constant estimate, period and country dummies, and control variables (invest, export, and human capital) were calculated, however are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no serial correlation. Internal instruments for the IV model are the variables from the first stage regression lagged in two time periods (t-2).

Table 5.6: Market regulation (MR), distance to frontier (DTF), and interactions: 1970-2010

Variable/sector	Agriculture	Mining	Manufacturing	Construction	Market Services	Non-Market Services
			FE-OLS			
DTF_{t-1}	-0.58***(0.07)	-0.80***(0.04)	-0.77***(0.06)	-0.85(0.05)***	-0.68***(0.05)	-0.68 (0.07)
MR_{t-1}	0.06**(0.001)	0.10***(0.02)	0.05***(0.00)	0.07(0.01)**	0.05**(0.01)	0.03**(0.02)
(MR*DTF)	0.06***(0.007)	0.12***(0.00)	0.11***(0.00)	0.11(0.01)***	0.11***(0.00)	0.09**(0.01)
F-stat	6.29	20.19	13.65	13.99	10.35	5.04
Adj R^2	0.55	0.81	0.74	0.75	0.68	0.48
N	129	129	129	129	129	129
			FE-IV			
DTF_{t-1}	-0.73**(0.37)	-1.13**(0.53)	-0.81***(0.12)	-0.63(0.15)***	-0.46** (0.12)	-0.61 (0.012)
MR_{t-1}	0.06 (0.08)	0.03 (0.10)	0.02 (0.04)	0.002(0.04)	0.04 (0.04)	-0.03 (0.05)
(MR*DTF)	0.07*(0.03)	0.12***(0.01	0.10***(0.02)	0.08(0.01)***	0.06* (0.02)	0.03**(0.02)
F-stat	2.98	3.99	7.58	2.12	1.95	2.08
χ^2	0.13(0.94)	0.10(0.68)	0.11(0.98)	0.02(0.56)	0.03(0.89)	0.14(0.97)
Adj R^2	0.42	0.71	0.57	0.67	0.45	0.44
N	111	111	111	111	111	111

Notes: Dependent variable is $\Delta\ln(Y/L)$ is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. DTF_{t-1} is the natural logarithm of the distance to frontier lagged in one-time period. MR_{t-1} indicates 5-year lagged regulation of credit, labor and business index that ranges from 0-10 where 0 and 10 correspond to highest and lowest regulation, respectively. Robust standard errors in parentheses. *, **, *** statistically significant at 10%, 5%, and 1% levels, respectively. *FE-OLS* and *FE-IV* refers to ordinary least squares with fixed effects (FE) and an instrumental variable regression respectively. Coefficients of the constant estimate, period and country dummies, and control variables (invest, export, and human capital) were calculated, however are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no serial correlation Internal instruments for the IV model are the variables from the first stage regression lagged in two time periods (t-2).

Table 5.7: Sound Money (SM), distance to frontier (DTF), and interactions: 1970-2010

Variable/sector	Agriculture	Mining	Manufacturing	Construction	Market Services	Non-Market Services
			FE-OLS			
DTF_{t-1}	-0.29***(0.06)	-0.74***(0.05)	-0.48***(0.06)	-0.62(0.07)***	-0.48***(0.07)	-0.51**(0.06)
SM_{t-1}	0.02**(0.008)	0.04***(0.01)	0.03***(0.00)	0.02(0.02)**	0.02**(0.00)	0.006 (0.00)
(SM*DTF)	0.02***(0.004)	0.07***(0.00)	0.03***(0.00)	0.03(0.01)***	0.04***(0.00)	0.04***(0.00)
F-stat	3.21	12.99	7.44	4.65	4.66	3.89
Adj R^2	0.32	0.71	0.57	0.43	0.43	0.38
N	142	142	142	142	142	142
			FE-IV			
DTF_{t-1}	-0.35**(0.21)	-0.85***(0.25)	-0.71***(0.11)	-0.45(0.23)	-0.41(0.15)*	-0.47**(0.17)
SM_{t-1}	0.02 (0.02)	0.08 (0.02)	0.05***(0.01)	0.006(0.02)*	0.04(0.02)**	-0.02** (0.01)
(SM*DTF)	0.02**(0.01)	0.05***(0.00)	0.05***(0.01)	0.02(0.01)*	0.03(0.01)**	0.03**(0.03)
F-stat	2.23(0.00)	3.14(0.00)	7.48(0.00)	1.60(0.01)	2.12(0.00)	2.22(0.00)
χ^2	0.11(0.54)	0.29(0.19)	0.18(0.78)	0.09(0.84)	0.06(0.53)	0.31(0.66)
Adj R^2	0.34	0.74	0.54	0.39	0.34	0.35
N	124	124	124	124	124	124

Notes: Dependent variable is $\Delta\ln(Y/L)$ is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. DTF_{t-1} is the natural logarithm of the distance to frontier lagged in one-time period. SM_{t-1} stands for access to sound money index (SM) lagged in one-time period(t-1) that ranges from 0-10 where 0 corresponds to 'high annual money growth', 'high variation in the annual rate of inflation', 'high inflation rate', and 'restricted foreign currency bank accounts' and 10 corresponds to 'low annual money growth', 'low or no variation in the annual rate of inflation', 'low inflation rate', and 'foreign currency bank accounts are permissible without restrictions'. Robust standard errors in parentheses. *, **, *** statistically significant at 10%, 5%, and 1% levels, respectively. *FE-OLS* and *FE-IV* refers to ordinary least squares with fixed effects (FE) and an instrumental variable regression respectively. Coefficients of the constant estimate, period and country dummies, and control variables (invest, export, and human capital) were calculated, however are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no serial correlation Internal instruments for the IV model are the variables from the first stage regression lagged in two time periods (t-2).

Table 5.8: Size of government (SG), distance to frontier (DTF), and interactions: 1970-2010

Variable/sector	Agriculture	Mining	Manufacturing	Construction	Market Services	Non-Market Services
			FE-OLS			
DTF_{t-1}	-0.48***(0.06)	-0.83***(0.05)	-0.64***(0.018)	-0.75***(0.05)	-0.61***(0.05)	-0.59* (0.06)
SG_{t-1}	0.04** (0.01)	0.07***(0.02)	0.02* (0.102)	0.04***(0.01)	0.03** (0.01)	0.03 (0.06)
(SG*DTF)	0.06***(0.00)	0.10***(0.008)	0.08***(0.013)	0.09***(0.00)	0.09***(0.00)	0.08**(0.01)
F-stat	6.30	23.09	12.44	11.85	10.37	6.13
Adj R^2	0.53	0.82	0.70	0.69	0.66	0.52
N	142	142	142	142	142	142
			FE-IV			
DTF_{t-1}	-0.59**(0.24)	-0.92***(0.22)	-0.67***(0.14)	-0.71***(0.19)	-0.40***(0.17)	-0.89* (0.46)
SG_{t-1}	0.01 (0.10)	0.10 (0.12)	0.01 (0.07)	0.16 (0.14)	-0.05 (0.12)	0.20 (0.21)
(SG*DTF)	0.06***(0.01)	0.11***(0.010)	0.08***(0.017)	0.08**(0.01)	0.06** (0.01)	0.10 (0.03)
F-stat	15.67(0.00)	3.84(0.00)	8.70(0.00)	2.49(0.00)	2.92(0.00)	2.77(0.00)
χ^2	0.16(0.94)	0.09(0.97)	0.19(0.96)	0.13(0.98)	0.34(0.76)	0.30(0.98)
Adj R^2	0.4	0.82	0.72	0.50	0.46	0.03
N	124	124	124	124	124	124

Notes: Dependent variable is $\Delta\ln(Y/L)$ is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. Government size index (GS) ranges from 0-10 where 0 corresponds to 'large general government consumption', 'large transfer sector', 'many government enterprises', and 'high marginal tax rates and low-income thresholds', and 10 to 'small general government consumption', 'small transfer sector', 'few government enterprises', and 'low marginal tax rates and high income thresholds'. Robust standard errors in parentheses. *, **, *** statistically significant at 10%, 5%, and 1% levels, respectively. *FE-OLS* and *FE-IV* refers to ordinary least squares with fixed effects (FE) and an instrumental variable regression respectively. Coefficients of the constant estimate, period and country dummies, and control variables (invest, export, and human capital) were calculated, however are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no serial correlation. Internal instruments for the IV model are the variables from the first stage regression lagged in two time periods (t_{-2}).

Similar results hold with the effect of market regulation (MR) on sectoral labor productivity growth in the full sample as table 5.6 shows. Again, although the institutional variable alone is statistically non-significant in the IV estimation, its interaction (MR*DTF) is significant, pointing at the growth-enhancing effects on labor productivity when sectors are far-removed from the frontier and endowed with less market regulation (except for services sectors where there is a weak effect on the interaction term; no more than 5% of statistical significance).[237]

Results remain qualitatively and quantitatively comparable in table 5.7 on the effect of access to sound money (SM) on sectoral productivity growth (except for the construction sector; statistical significance only at 10%). Having a sound monetary policy (e.g. stable prices) does provide a positive productivity effect across sectors in the full sample. Furthermore, as shown in table 5.8, except for the low statistical significance in non-market services, there is a positive effect across sectors between the size of the government (SG) which according to this index implies an inverse relationship; a smaller government (e.g. may imply a more efficient bureaucracy) is related to a higher sectoral productivity (except for non-services sectors).

Estimates in a restricted sample

The results from the baseline regressions are consistent with the literature of the so-called New Institutional Economics; a well-designed structure of property rights, less distortions from market regulations, fewer unexpected monetary shocks, and a well-functioning bureaucracy, enhance overall productivity growth.[238]

However, although estimations from tables 5.5 to 5.8 show that there are positive and significant differences on the role of institutions across sectors, they may hide important regional dynamics not visible when using the full country-range (taking into account fixed effects).

In order to uncover these differences and to verify quantitatively whether the hypothesis and the general propositions of the model hold, it is necessary to restrict the country sample by region (Asia and Latin America separately). Although this estimation may reveal the high sensitivity of the estimators relative to the ones in the full country sample, it can also provide relevant additional information on the role of different institutions on productivity growth at the regional level.[239]

The sensitivity issue of restricting the sample is likely to arise because as was shown before, Asian countries' sectoral productivity levels were rapidly catching up to the frontier in an earlier period (1980s) unlike the productivity levels of Latin American

[237] Average marginal effects are depicted in figure 5.3.B of the appendix.

[238] See for an e.g. in T. Eggertsson, 'A quick guide to new institutional economics'

[239] Restricting the estimates into a lower country-range entails widening the confidence intervals for the regional regression analysis. Also, uncovering the specific mean difference in each estimator becomes more challenging when the sample distribution is not normal. Results on this regard however, indicate that through the 'Jarque-Bera' normality test (on the residuals) it was not possible to reject the null hypothesis that these are **n**ormally distributed (See in table 5.1.B from the appendix).

countries which fell behind during the same period. Yet, the variety of institutions could have been equally influential on sectoral productivity growth of both regions.

Since the parameters of interest are mainly the coefficients of the interaction terms (institutions*DTF) for the restricted sample, table 5.9 reports a re-estimation of these within an instrumental variable specification.[240] The results in the table 5.9 show that the previous baseline estimates are not entirely robust when the sample is restricted.

Although the results remained in line with the hypothesis that the variety of institutions affects sectors differently (in magnitude), several of the re-estimated coefficients lose explanatory power, predominantly in the Latin American sample. Intuitively, we could expect to find various inverse relationships with respect to the interactions terms (negative signs in coefficient across sectors) since some institutions as was hypothesized, could have hindered the diffusion of knowledge and thus, deter productivity growth. However, although these negative coefficients were present in the manufacturing and construction sectors (interacted with access to sound money) they are not statistically significant.

Overall, labor productivity growth in the majority of sectors (five out of six) in Asia appears positively and significantly 'enhanced' by the endowments of 'better' economic institutions in question (their interactions to the distance to the productivity frontier). In terms of statistical significance (at 5% and 1%) and the magnitude of the baseline results the coefficients remained within those intervals (0.04 to 0.11 across sectors).

However, the statistical significance for the estimates in the non-market service sectors is largely negligible in both country samples. Notwithstanding the weak statistical significance in various sectors of Latin America, table 5.9 pinpoints the channels in which institutions have promoted the acceleration (or deceleration) of sectoral productivity growth within the restricted sample:

The interaction regarding property rights (PR*DTF) has a statistically significant growth-enhancing effect on agriculture, mining, and manufacturing in Asia.

[240] Similarly to previous estimations (from table 5.5 to 5.8), instruments employed in the restricted sample were (verified for exogeneity with Hausman tests) the dependent variables lagged in two periods.

Table 5.9: Interaction terms across sectors and controls: Restricted sample for Asia and Latin America, 1970-2010
(Instrumental variable regression)

Variable	Agriculture		Mining		Manufacturing		Construction		Market Services		Non-Market Services	
	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America
PR*DFT	0.07**	0.001	0.12***	0.20	0.10**	0.03	0.10	0.07	0.29	0.06	0.02	0.17
MR*DTF	0.09**	0.05	0.11***	0.10	0.11***	0.07	0.09***	-0.02	0.07**	0.04	0.04	0.10
SM*DTF	0.04**	0.01	0.09**	0.08***	0.08**	-0.03	-0.98	0.02	0.02	0.01	0.07	0.03
SG*DTF	0.08***	0.07	0.13***	0.10***	0.12***	0.04**	0.08***	0.08**	0.09***	0.05	-0.01	0.03
HC	0.006	0.15	-0.06	0.92	0.32**	-0.35**	-0.06	-0.12	0.17*	0.001	-0.06	-0.13
Invest	0.74**	0.95	-0.34	0.26	0.42***	0.25**	0.17	1.28	1.20**	0.42	1.55**	0.05
Export	-0.19***	0.52	-0.05	0.42*	0.12	0.61**	-0.06	0.67*	-0.03	0.04	0.20	1.09
F-stat	2.98	3.99	7.58	2.12	1.95	2.08	2.09	2.10	2.11	2.12	2.13	2.14
χ^2	0.16(0.9)	0.09(0.5)	0.35(0.9)	0.03(0.7)	0.10(0.4)	0.11(0.4)	0.12(0.9)	0.13(0.9)	0.67(0.9)	0.51(0.9)	0.00(0.2)	0.12(0.3)
Adj R^2	0.42	0.71	0.57	0.67	0.45	0.44	0.45	0.46	0.49	0.66	0.06	0.50
N	61	62	59	60	59	60	61	60	59	62	59	51

Note: The dependent variable is $\Delta\ln(Y/L)$ is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. PR*DTF, MR*DTF, SM*DTF, and SG*DTF are the separate interaction terms of Property rights, Market regulation, Sound money, and Size of government with the Distance to frontier (DTF). The symbols *, **, *** are statistical significant at 10%, 5%, and 1% levels, respectively. To avoid a repetitive display of estimates, individual coefficients of DTF, and the institutions are not shown. Similarly, the constant terms and period and country dummies were included but are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no serial correlation. Internal instruments in the IV regression are the variables from the first stage regression lagged in two periods (t-2).

On the other hand, except for non-market service sectors, the market regulation interaction (MR*DTF) in Asia reports a highly positive significant effect across sectors. Yet again, the positive effect of the interaction of sound money (SM*DTF) is valid for Asia across sectors with the exception of the service sectors.

For Latin America, interestingly, the estimates of institutions that maintained statistical validity are only the interactions with size of the government (SG*DTF) and sound money (SM*DTF); and solely in 3 sectors: mining, manufacturing and construction, with 'quinquennial' contributions on labor productivity growth of 0.10, 0.04, and 0.08% respectively.

Robustness checks and other growth determinants

A final element to support the empirical evidence presented is to check the magnitude of the control variables and their significance in driving the overall results in the restricted sample. An avenue that could have been taken was to include the interaction between human capital and institutions.

However, aside for the econometric issues arising from the loss of degrees of freedom, vast empirical research already documented the effects of human capital (and its different measurements) on catch up (e.g. Madsen, 2014). Since the aim of our specification was to isolate the effects in order to disentangle the ones from institutions we report them only to verify whether these controls are coherent with what previous works have found. Although estimates from tables 5.5 to 5.8 controlled for this, table 5.9 shows a more relevant picture on a restricted sample by region.

Factor accumulation (human and physical capital) appears as a significant growth factor in various sectors. For instance, the coefficient of investment (Invest) is significant for Asia in agriculture, manufacturing, and services (market and non-market). However, with exception of the manufacturing sector, surprisingly the effect of human capital (HC), although positive, is not significant for most of the sectors (and negative for the case of the construction sector). Results remain robust when we include an alternative variable of human capital and non-linear effects.[241] On the other hand, for the Asian sample trade (Export) appears as an important determinant of growth in most of the sectors as previous literature has found.

Asia and Latin America's productivity paradigms in perspective

Other works like Taylor (1998), and Campos and Nugent (1999) have also pointed out the importance of institutional differences on long-term growth. Taylor (1998) argues that productivity growth in Latin America was largely affected by various policy distortions (e.g. tariffs, and misaligned exchange rates). He claims that unlike Asia,

[241] Table 2B in the appendix confirms the magnitude of these estimates, showing that when employing tertiary schooling as a measure of human capital, the results do not change significantly.

these distortions generated relatively lower rates of capital accumulation (growth of physical investment) affecting ultimately overall per capita income growth.

However, although Taylor's evidence speculates on the presence of 'inefficient' institutions as a possible source of productivity differences, it does not address quantitatively the paradox of why if both regions followed similar policies they were only distortive for Latin America.

On the other hand, Campos and Nugent (1999) revealed statistical differences of various governance characteristics among the regions. Yet again, their analysis does not indicate the specific channels in which institutions affected productivity growth. Several others studies have helped understanding the growth dynamics in these regions, however, the drivers behind the differences in the regional patterns of productivity growth have remained unanswered.

The work of McMillan *et al.*, (2014) attempted to solve this question by decomposing the sectoral changes of aggregate productivity. It was found that Asian economies have been more successful than their Latin American counterparts in reallocating employment from traditional to modern activities. The authors tentatively indicate that policies that prevented currencies to become overvalued and that avoided placing large costs on firms to hire or fire workers facilitated a successful 'growth-enhancing' structural change in Asia (and not in Latin America).

The findings in this chapter are noticeably in line with the previous authors (and with McMillan *et al.* 2014) in the sense that their variables related to monetary policy (exchange rate) and less business regulations bear conceptually close resemblance to the type of institutions tested in the present study. In the results shown in the previous section, institutional components such as 'access to sound money' (SM) and 'market regulations' (MR) turned out to be important factors in enhancing labor productivity, particularly across the sectors for the sample in Asia.

However, in addition to other previous works, our results expanded the empirical scope in which institutions impacted on productivity growth. To restate our key findings, it is necessary to point out the transmission channels in which a greater institutional quality has impacted on the rate of productivity growth across sectors; controlling for human capital, physical capital, and trade openness, the estimates show that the quality of economic institutions, that is, countries with greater freedom in their legal system and property rights, freedom from tight market regulations, greater access to sound money, and a minimum and more efficient government has increased productivity growth for the period 1970-2010.

Although in most cases the coefficients show that these institutions *per se* did not augment directly the dependent variable (the growth of sectoral labor productivity) they did this through their interactions with the variable of the distance to the frontier within each sector. In hindsight, this particular channel (significance of interaction terms) shows that the 'catching up' notion of the role of institutions on long-term growth are measurable at the sectoral level: sectors far-removed from the levels of the

leader (frontier) caught up aided with a set of institutions. The exception to this was the sectoral productivity of non-market service sectors.[242]

However, the baseline results are not satisfactory when the sample is restricted. Once the sample is split up by region, into Asia and Latin America, the results' statistical power weakens.[243] As a consequence we get a sample that is too small to retain significant correlations for Latin America. The underlying explanation for this (as seen in the data description) is that on average, Latin American countries have been endowed with lower scores on the quality of their economic institutions relative to Asian countries. This directly affects the magnitude of the interaction coefficients, which is an indication that only in those sectors that are catching up, the sectoral gap is closing much slower than the ones in Asia. In other words, it can be said that unlike Asia, Latin American sectors did not exploit the catch up potential of having backward sectors (relative to the United States), instead, the productivity benefits of the improvement in institutional quality was transferred only towards natural resource-based sectors.

In relation to these findings, there is a key indication that for the mining and construction sectors, the 'size of government' (institutional endowment of less government involvement) has a positive growth effect on Latin America's sectoral productivity. Although this could be interpreted as a positive prospect for the region, catching up in sectors highly dependent on natural resources such as mining supplemented with less government 'involvement' could dangerously develop into an undesirable type of productivity growth in the long run. Cross-country research on the so-called 'natural resource curse' has found that the abundance of natural resources in countries with low institutional quality are detrimental for sustained growth.[244]

As for Asia, evidence indicates that with the exception of the service sector, there is an overwhelming positive effect of institutional quality on sectoral labor productivity growth; that is to say, on average the variety of the economic institutions analyzed have enabled different sectors to make better use of the knowledge and technologies from abroad, thereby raising labor productivity, and creating possibilities to catch up.

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[242] Since the activities within non-market services include government services and public utilities it is not surprising to find a non-significant relationship between institutions and productivity since these activities are not particularly exposed to market competition like other sectors.

[243] The loss of statistical power for splitting the country-sample is not a rare feature in growth regressions. Several seminal 'convergence' studies were confronted with this problem related to the size and general characteristics of the sample. For e.g. one of the pioneer works such as Baumol (1986) using aggregate cross-country data coined the term 'convergence clubs', that is, convergence can be found statistically significant only by splitting the sample into country-groups with similar characteristics.

[244] See for example the findings of Arezki and van der Ploeg (2011).

5.6 Conclusions and suggestions for future research

Simply lagging behind the leader is not sufficient to catch up. As Nelson (2008) has pointed out, the ability to absorb knowledge from abroad has been historically one of the most important elements determining the ability to catch up for lagging countries. This chapter addresses that idea providing new evidence on whether institutions play a role in the absorption of knowledge to accelerate productivity growth.

Using the Nelson and Phelps model, this study produces econometric evidence on the mechanisms through which a variety of institutions has functioned as a capability to foster labor productivity growth at the sectoral level. The empirical analysis uses a longitudinal sectoral dataset of eighteen countries together with disaggregated data of institutional quality in Latin America and Asia for the period 1970-2010.

Results suggest that controlling for other growth factors, institutions which interacted with the distance to the frontier affected positively and significantly the growth of labor productivity at the sectoral level. This indicates that backward sectors in countries endowed with higher institutional quality grow faster than in sectors of countries with lower institutional quality. Following the empirical specification, I analyzed the different effects that the same institutions have on sectors far-removed from the frontier. The results pointed to different channels through which institutional quality impact on sectoral productivity growth: greater freedom in the legal structure and property rights, freedom from tight market regulations, greater access to sound money, and a small and more efficient government, all in a different magnitude affected positively the growth of sectoral productivity.

In hindsight the results are in line with the body of literature of the so-called New Institutional Economics regarding the prominence of 'market-friendly' institutions in enhancing productivity growth in the long-run. However, in spite of controlling for country and time invariant factors, estimates are sensitive to the sample selection. The model predictions apply to the majority of the sectors in the Asian sample. On the other hand, sectoral productivity growth in Latin America is not statistically associated with the quality of property rights and market regulations; only in the mining and construction sectors, productivity is statistically associated with the improvement in the quality of institutions of size of government and access to sound money.

Overall findings of this study have relevant implications for the current debates in development policy. A number of policy reports have emphasized the need for Latin American countries to emulate the Asian growth strategy; removing the barriers for productivity by deepening institutional reforms. However, as this chapter has examined, the improvement in the quality of institutions affects countries and sectors differently. Whereas it has been markedly significant for Asia, for Latin America the

effect has been meager and, if significant, this has been in natural resource-based sectors, a positive dynamic that ultimately could also turn into a curse.

It is important to point out the limitations of this study so as to open new windows of opportunity for future research: regardless their wide use in several seminal articles, the data from Gwartney e*t al.*, (2012) is taken as if there was zero noise in the computation of the ranking score and the actual performance indicator. Relying on the solid accuracy of these indices over time can be a risky endeavor considering the great variety of unobserved institutional development. Also, as stated before, most of the 'contracting' institutions are national (e.g. rule of law) and not sectoral. However, considering the emerging literature on evolutionary economics highlighting the importance of national systems of innovation in creating learning processes specific to each sector, the construction of cross-country sectoral measures of institutions is imperative.

Furthermore, a common caveat in the methodology of panel growth regressions is the issue of omitted variables. There can be numerous unmeasured variables and initial conditions that have remained outside the scope of the study. Further research should explore other variables related to the country's specific resource endowments. This is the case with data on informal employment. It is of particular relevance for the case of Latin America since there is vast statistical evidence that this became a large share in total employment after the 1980s. Once this is accounted for in the measurement of labor productivity, it may reveal different results within the present framework.

Additionally, the possibility that economic sectors of frontier countries may react to the catch up dynamics of sectors in non-frontier countries remains as an unexplored theoretical and empirical issue. Leading productivity sectors may react to the competitive pressures; in order to remain ahead of the followers, leaders can upgrade sectoral policies and institutions in accordance with the competition. If that occurs, the issue of endogeneity in the conventional catch up framework is likely to arise.

Finally, looking at the concept of technology, a central limitation is that the measures of labor productivity growth are not the best to quantify the improvements of productivity related to technological progress. A more comprehensive and reliable measure embodying the advancements in technology should include the changes in capital and intangible inputs in particular if we look at post-1980s structural change. The construction of new time series of 'sectoral-specific' TFPs for the post-1950 period in Latin America should therefore also be put on the research agenda.

5.7. Appendix to chapter 5

5.1.A: Test of differences in means of institutions by region 1970-2010

Institution	Latin America	Asia
Overall index	5.667*	6.913*
Property rights & legal structure	4.546*	6.091*
Market regulation	6.033*	6.570*
Access to sound money	5.681*	8.015*
Size of government	6.508*	6.820*

Note: The test uses the analysis of variance of means (ANOVA). The symbol * indicates that the mean differences are significant at the 95% level.

Table 5.1.B. Normality test on estimated residuals from table 5.9

Sector	Region	Jarque-Bera	Probability
Agriculture	Asia	10.35	0.06
	Latin America	0.44	0.80
Mining	Asia	2.82	0.24
	Latin America	0.26	0.87
Manufacturing	Asia	0.79	0.67
	Latin America	1.84	0.39
Construction	Asia	0.40	0.97
	Latin America	0.96	0.61
Market Services	Asia	1.02	0.59
	Latin America	0.23	0.88
Non-Market Services	Asia	6.95	0.04
	Latin America	6.40	0.04

Note: The null hypothesis is that the estimated residuals are normally distributed (χ^2), symmetric and a kurtosis of 3.

Table 5.2.A: Pairwise correlation matrix

Variable	Δln(Y/L) agriculture	Δln(Y/L) mining	Δln(Y/L) manufacturing	Δln(Y/L) construction	Δln(Y/L) market services	Δln(Y/L) non-market services	Property rights (PR)	Market regulation (MR)	Sound money (SM)	Size of government (SG)
Δln(Y/L) agriculture	1.00									
Δln(Y/L) mining	0.20	1.00								
Δln(Y/L) manufacturing	0.29	0.09	1.00							
Δln(Y/L) construction	0.14	-0.06	0.28	1.00						
Δln(Y/L) market services	0.21	0.00	0.46	0.32	1.00					
Δln(Y/L) non-market serv.	0.16	0.26	0.25	0.03	0.08	1.00				
Property rights (PR)	-0.08	0.01	0.24	0.09	0.03	-0.01	1.00			
Market regulation (MR)	0.18	0.15	0.41	0.04	0.20	0.05	0.21	1.00		
Sound money (SM)	0.15	0.02	0.39	0.09	0.31	0.001	0.38	0.45	1.00	
Size of government (SG)	0.03	0.06	0.35	0.06	0.17	0.07	0.51	0.56	0.66	1.00

Table 5.2.B: Re-estimation using different human capital control (tertiary schooling) and non-linear effect (DTF^2), 1970-2010
(Instrumental variable specification)

Variable	Agriculture		Mining		Manufacturing		Construction		Market Services		Non-Market Services	
	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America	Asia	Latin America
PR*DFT	0.07**	0.001	0.12***	0.20	0.10**	0.03	0.10	0.07	0.29	0.06	0.02	0.17
MR*DTF	0.09**	0.05	0.11***	0.10	0.11***	0.07	0.09***	-0.02	0.07**	0.04	0.04	0.15
SM*DTF	0.04**	0.01	0.09**	0.05**	0.04**	-0.02	-0.98	0.02	0.02	0.01	0.07	0.01
SG*DTF	0.08***	0.07	0.12***	0.09***	0.12***	0.04**	0.08***	0.06*	0.08***	0.05	-0.01	0.02
DTF ^{2}(Sq)	0,38	0.31	0.25	0.19	0.24	0.45	0.25	0.14	0.35	0.24	0.36	0.22
HC (Tert)	0.001	0.02	0.19	0.75	0.11*	0.20**	-0.02	-0.13	0.17*	0.001	-0.06	-0.13
Invest	0.74**	0.95	-0.38	0.26	0.43*	0.24	0.17	1.28	0.46*	0.42	0.55*	0.05
Export	-0.19***	0.52	0.01	0.42*	0.12	0.61	-0.06	0.67*	-0.03	0.04	0.20	1.09
F-stat	2.90	4.95	9.71	3.12	2.97	3.08	2.09	2.10	2.11	2.12	2.13	2.14
χ^2	0.07(0.96)	0.29(0.89)	0.10(0.78)	0.18(0.56)	0.44(0.59)	0.02(0.16)	0.55(0.98)	0.41(0.88)	0.02(0.96)	0.03(0.98)	0.11(0.24)	0.08(0.52)
Adj R^2	0.42	0.71	0.57	0.67	0.45	0.44	0.45	0.46	0.47	0.48	0.49	0.50
N	61	62	61	60	61	60	61	59	61	62	61	62

Note: HC (Tert) refers to schooling at the tertiary educational level. DTF (Sq) refers to the square of the variable of distance to the frontier.
The dependent variable is $\Delta\ln(Y/L)$ is the change of the natural log of labor productivity in the respective economic sector in every 5-year interval. PR*DTF, MR*DTF, SM*DTF, and SG*DTF are the separate interaction terms of Property rights, Market regulation, Sound money, and Size of government with the Distance to frontier (DTF). The signs *, **, *** are statistical significant at 10%, 5%, and 1% levels, respectively. To avoid a repetitive display of estimates, individual coefficients of DTF, and the institutions are not shown. Similarly, the constant terms and period and country dummies were included but are not reported in the table for brevity. χ^2 is the Breusch-Godfrey test for first-order serial correlation under the null hypothesis of no s erial correlation. Internal instruments in the IV regression are the variables from the first stage regression lagged in two periods (t-2).

Figure 5.3.A: Indices of institutional quality in Latin America, 1970-2010
(Standarized average scores [0-10])

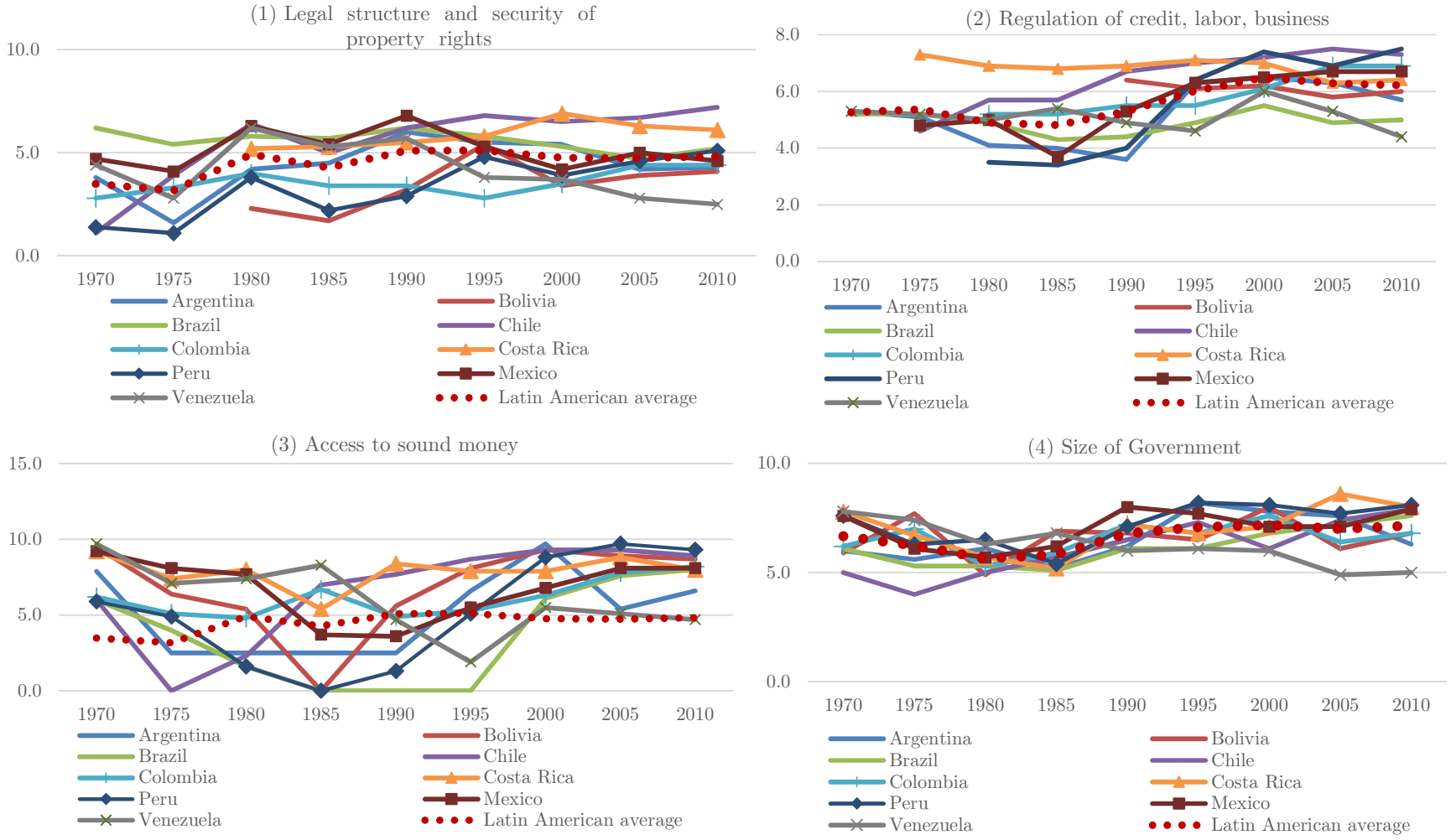
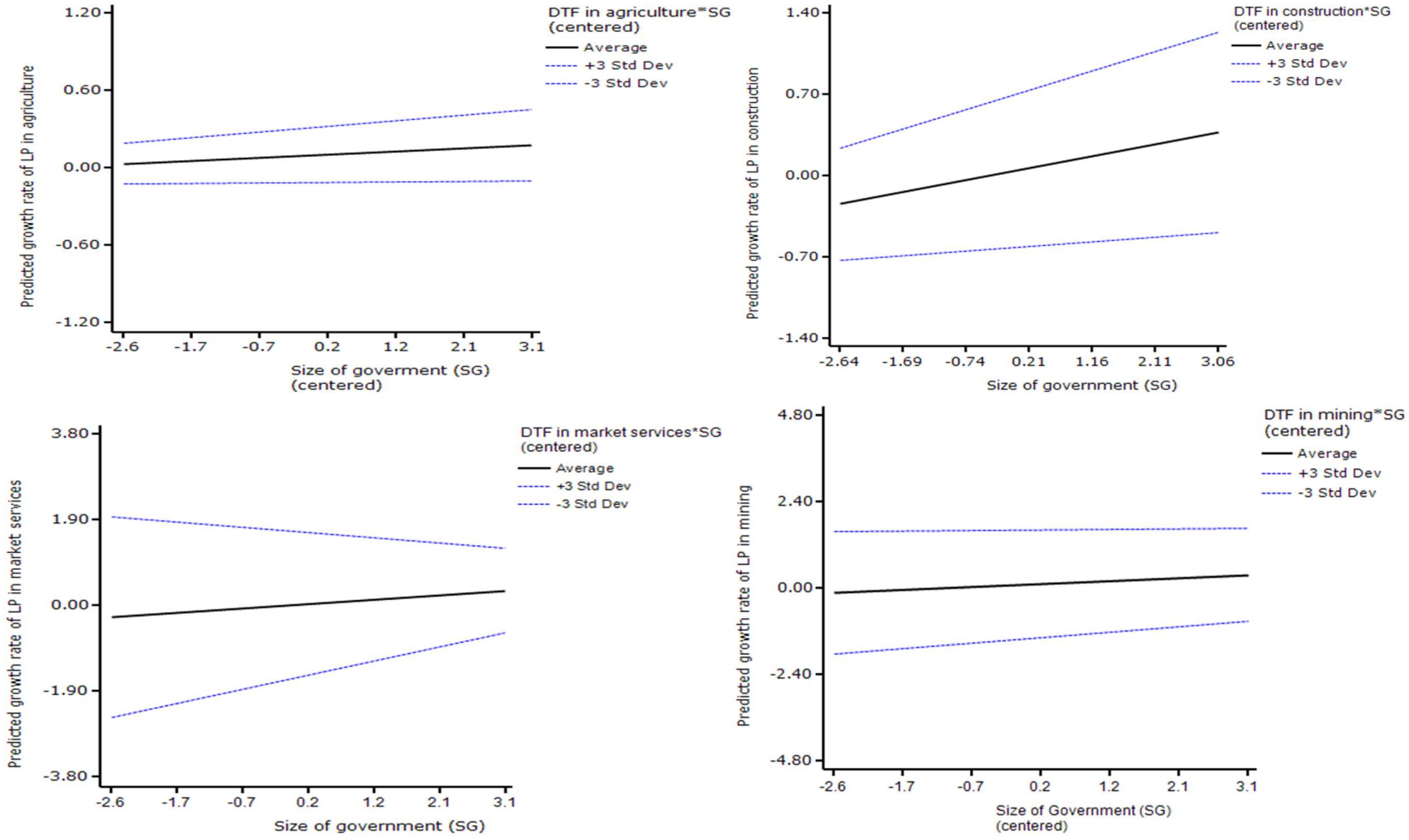
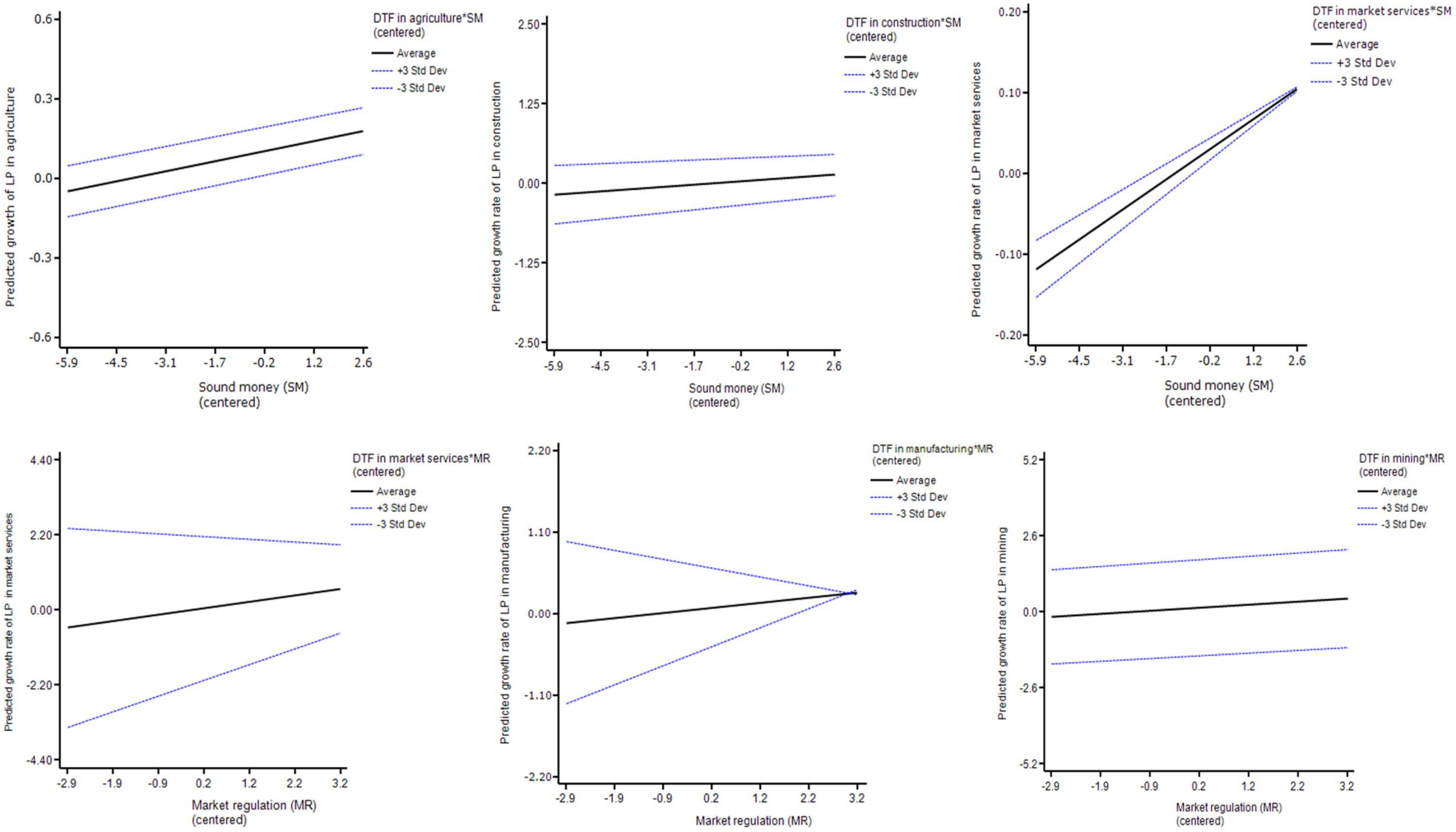


Figure 5.3.B Average marginal effects of interactions with distance to the frontier on labor productivity growth at different levels and types of institutions (based on interaction terms from tables 5.5 to 5.8)



Continuation of figure 5.3.B.



References

Abramovitz, M. (1986). Catching up, forging ahead, and falling behind. *Journal of Economic History*, 46, pp. 385-406.

---------- (1991). Thinking about growth: and other essays on economic growth and welfare. *Cambridge Books*.

Acemoglu, D., Aghion, P., and Zilibotti, F. (2006). 'Distance to frontier, selection and economic growth', *Journal of European Economic Association* 4(1), 37–74.

Acemoglu, D., Antràs, P., and Helpman, E. (2007). Contracts and technology adoption. *American Economic Review*, 916-943.

Acemoglu, D., and Johnson, S. (2005). Unbundling institutions. *Journal of Political Economy.* 113. Vol. 5 pp. 949–995.

Acemoglu, D., S. Johnson, and Robinson, J. (2005). Institutions as the fundamental cause of long-run growth, in Aghion, P., Durlauf, S. (Eds.), *Handbook of Economic Growth*. Elsevier.

Acemoglu, D., and Robinson, J. (2012). *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. Crown Business.

Aghion, P., and Howitt, P. (2006). Appropriate growth policy: A unifying framework. *Journal of the European Economic Association* 4, 269–314.

Amsden, A.H. (2001). *The rise of the rest: challenges to the west from late-industrializing economies*. Oxford University Press.

Angrist, J. D., and Pischke, J. S. (2009). A note on bias in just identified IV with weak instruments. London School of Economics - Working paper.

Arezki, R., and van der Ploeg, F. (2011). Do natural resources depress income per capita? *Review of Development Economics*, *15*(3), 504-521.

Banerjee, A. and E. Duflo. (2005). Growth theory through the lens of development economics. In: Aghion, P., Durlauf, S. (Eds.), *Handbook of Economic Growth*. Elsevier.

Benhabib, J., and Spiegel, M. (2005). Human capital and technology diffusion. In: Aghion, P., Durlauf, S. (Eds.), *Handbook of Economic Growth*. Elsevier.

Bernard, A., and Jones, C. (1996). Comparing apples to oranges: Productivity convergence and measurement across industries and countries. *American Economic Review*, 86(5), 1216–38.

Bhattacharyya, S. (2009). Unbundled institutions, human capital and growth. *Journal of Comparative Economics*, 37, pp.106–120

Birdsall, N. (2008). Income distribution: effects on growth and development. *International handbook of development economics*, *77*, 193.

Campos, N. F., and Nugent, J. B. (1999). Development performance and the institutions of governance: evidence from East Asia and Latin America. *World Development*, *27*(3), 439-452.

Carlsson, F., & Lundström, S. (2002). Economic freedom and growth: Decomposing the effects. *Public choice*, *112*(3-4), 335-344.

Castellacci, F., Los, B., and de Vries, G. (2014). Sectoral productivity trends: convergence islands in oceans of non-convergence. *Journal of Evolutionary Economics*, *24*(5), 983-1007.

Coatsworth, J. H. (2005). Structures, endowments, and institutions in the economic history of Latin America. *Latin American Research Review*, *40*(3), 126-144.

Coe, D. T., Helpman, E., & Hoffmaister, A. W. (2009). International R&D spillovers and institutions. *European Economic Review*, *53*(7), 723-741.

Cole, H. L., Ohanian, L. E., Riascos, A., & Schmitz, J. A. (2005). Latin America in the rearview mirror. *Journal of Monetary Economics*, *52*(1), 69-107.

Comin, D., and Hobijn, B. (2009). Lobbies and technology diffusion. *The Review of Economics and Statistics*, *91*(2), 229-244.

Comin, D., Hobijn, B., and Rovito, E. (2006). Five facts you need to know about technology diffusion (No. w11928). National Bureau of Economic Research.

Compton, R. A., Giedeman, D. C., & Hoover, G. A. (2011). Panel evidence on economic freedom and growth in the United States. *European Journal of Political Economy*, *27*(3), 423-435.

Crafts, N. (2006). Regulation and productivity performance. *Oxford Review of Economic Policy*, *22*(2), 186-202.

Dollar, D., & Kraay, A. (2003). Institutions, trade, and growth. *Journal of Monetary Economics*, *50*(1), 133-162.

Durlauf, S. N., Johnson, P. A., & Temple, J. R. (2005). Growth econometrics. *Handbook of economic growth*, *1*, 555-677.

Easterly, W., and Levine R. (2001). It's not factor accumulation: Stylized facts and growth models. *The World Bank Economic Review 15*(2): 177-219.

Eggertsson, T. (2013). Quick guide to new institutional economics. *Journal of Comparative Economics*, *41*(1), 1-5.

Feenstra, R. C., Inklaar, R., & Timmer, M. P. (2015). The Next Generation of the Penn World Table. *American Economic Review*, *105*(10), 3150-3182.

Gerschenkron, A. (1962). *Economic Backwardness in Historical Perspective*. Harvard University Press, Cambridge.

Glaeser, E.L., La-Porta, R. and Lopes-De-Silanes, F. (2004). Do institutions cause growth? *Journal of Economic Growth*, 9, pp. 271-303

Griffith, R., Redding, S., & Van Reenen, J. (2004). Mapping the two faces of R&D: productivity growth in a panel of OECD industries. *Review of Economics and Statistics*, *86*(4), 883-895.

Gwartney, J., Lawson, R., & Hall, J. (2012). Economic Freedom of the World 2012 Annual Report (Vancouver, British Columbia: Fraser Institute).

Haber, Stephen, and Victor Menaldo. "Do natural resources fuel authoritarianism? A reappraisal of the resource curse." *American political science Review* 105, no. 01 (2011): 1-26.

Hall, R. E., & Jones, C. I. (1999). Why Do Some Countries Produce So Much More Output Per Worker Than Others? *Quarterly Journal of Economics*, *114*(1), 83-116.

Inklaar, R., and Timmer, M. (2014). The relative price of services. *Review of Income and Wealth*, *60*(4), 727-746.

Keller, W. (2004). International Technology Diffusion. *Journal of Economic Literature*, *42*, 752-782.

La Porta, R., Lopez de Silanes, F., Shleifer, A. and Vishny, R. (2008). The economic consequences of legal origins, *Journal of Economic Literature*.

Madsen, J. B. (2014). Human capital and the world technology frontier. *Review of Economics and Statistics*, *96*(4), 676-692.

Malerba, F. (2002). Sectoral systems of innovation and production. *Research policy*, 31, pp. 247-264.

Malerba, F., and Nelson, R. (2011). Learning and catching up in different sectoral systems: evidence from six industries. *Industrial and Corporate Change*, *20*(6), 1645-1675.

Manca, F. (2010) Technology catch-up and the role of institutions. *Journal of Macroeconomics* 32, 1041-1053.

McMillan, M., Rodrik, D., & Verduzco-Gallo, Í. (2014). Globalization, structural change, and productivity growth, with an update on Africa. *World Development,63*, 11-32.

Nelson, R. (1994). The co-evolution of technology, industrial structure, and supporting institutions. *Industrial and corporate change*, *3*(1), 47-63.

Nelson, R. (2008). What enables rapid economic progress: What are the needed institutions? *Research Policy*, *37*(1), 1-11.

Nelson, R. and Pack H. (1999). The Asian miracle and modern growth theory. *Economic Journal*, Vol. 109.

Nelson, R. and Phelps, E. (1966). "Investment in humans, technological diffusion, and economic growth". *American Economic Review,* 56, 69–75.

Nelson, R. and Winter, S. (1977). In search of useful theory of innovation.*Research Policy*, *6*(1), 36-76.

Nicoletti, G. and Scarpetta, S. (2003). Regulation, productivity, and growth. *Economic Policy.* 18:36, pp. 11-53

North, D. C. (1981). *Structure and Change in Economic History.* New York: Norton.

Nunn, N. (2014). Historical Development. *Handbook of Economic Growth*, *2*, 347-402.

Ocampo, J. A. (2004). Latin America's growth frustrations during structural reforms, *Journal of Economic Perspectives* Vol. 3.

Pages, C. (2010). *The Age of Productivity*, Inter-American Development Bank, Washington, D.C.

Prados de la Escosura, L. (2014). Economic Freedom in the Long Run: Evidence from OECD Countries, 1850-2007. Center for Economic Policy Research Working Paper.

Rodrik, D. (2005). Growth strategies. in P. Aghion and S. Durlauf, eds., *Handbook of Economic Growth*, vol. 1A, North-Holland.

Rodrik, D. Subramanian, A. and Trebi, F. (2004). Institutions rule: The primacy of institutions over geography and integration in economic development. *Journal of Economic Growth*, 9, pp. 131-165.

Scarpetta, S. and Tressel, T. (2002). Productivity and convergence in a panel of OECD industries: Do regulations and institutions matter?" *OECD Economics Department Working Paper.* No.342

Stiglitz, J. E. (2001). From miracle to crisis to recovery: lessons from four decades of East Asian experience. In: Stiglitz, J. and S. Yusuf, eds. *Rethinking the East Asian Miracle*, 509-526. World Bank.

Taylor, A. M. (1998). On the costs of inward-looking development: Price distortions, growth, and divergence in Latin America. *Journal of Economic History*, vol. 58.

Temple, J. (2005). Dual economy models: A primer for growth economists. *The Manchester School*, vol. 73, num. 4.

Timmer, M. and de Vries, G. (2009). Structural change and growth accelerations in Asia and Latin America: a new sectoral data set. *Cliometrica*, *3*(2), 165-190.

Ark, V. B., & Timmer, M. (2003). Asia's Productivity Performance and Potential: The Contribution of Sectors and Structural Change, GGDC, University of Groningen.

Vandenbussche, J., Aghion, P., & Meghir, C. (2006). Growth, distance to frontier and composition of human capital. *Journal of Eonomic Growth,11*(2), 97-127.