Why have so few countries industrialised?

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Why Have So Few Countries Industrialised?

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SUMMARY

In their development process, countries evolve from agrarian into industrial economies: manufacturing employs larger shares of the population and contributes more and more to GDP. Empirical evidence confirmed that structural change towards manufacturing is consistently associated with faster economic growth. Hence, since early development economic theories, manufacturing has been considered an engine of economic growth. Given the role of industrialisation for development, understanding why some countries successfully industrialised, while others did not, is of great importance.

Since the Industrial Revolution, all countries have tried to industrialise. While some succeeded, most of them failed. In the post-war era, successful industrialisers have been mainly Asian countries, namely South Korea, Taiwan, Hong Kong, and Singapore. Latin American and African countries, instead, started to (prematurely) deindustrialise already in the 1980s. The case of Latin America is certainly the most striking. In the 1970s, Brazil, Argentina, and Mexico were believed the next countries to catch up with the advanced world. The observed unexpected divergence in the industrial performance of Latin America and East Asia has attracted the attention of academics and policymakers. This thesis contributes to this literature and investigates the determinants of industrialisation in a historical-comparative setting. It consists of empirical studies that combine quantitative and semi-qualitative research methods, and macroeconomic and microeconomic perspectives.

The first study of this thesis goes back to the model of manufacturing as an engine of growth developed by John Cornwall in 1977. It estimates the equation of manufacturing output growth by applying modern econometric panel data techniques to a dataset that covers roughly 70 developed and developing countries from 1960 to 2005. By doing this, this study puts industrialisation at the centre of the analysis and identifies its determinants and their evolution over time. Results indicate that countries with relatively underdeveloped industrial sectors, large domestic markets, strong export performances and undervalued exchange rates industrialise faster. While in this analysis labour costs are not significant determinants of industrialisation, innovation plays an important role for industrialisation, especially since the mid-1990s. This finding is in line with the evolutionary literature on innovation and development and confirms that innovation is a key driver of catch up.

Industrial policies and macroeconomic conditions are often cited as important determinants of industrialisation, especially in the cases of East Asia and Latin America. The debate on industrial policy polarised around two opposite interpretations. According to neoclassical economists, East Asian governments implemented market-friendly policies that aimed only at ensuring favourable basic conditions for business. By contrast, Latin American selective industrial policies distorted market incentives, maintained inefficient industries, and diffused corruption. According to structuralists and industrial strategists, East Asian governments were at least as interventionist as the Latin American ones. In both regions, selective industrial policies shaped the direction of structural change.

Not only the nature of policies has been discussed, but also the empirical facts - how much intervention there has been- have been fiercely disputed. This thesis contributes to this literature by quantifying industrial policy in some of the most studied country cases, namely Argentina, Brazil, Mexico, South Korea, and Taiwan. The thesis critically reviews the historical-comparative literature on industrial policy in East Asia and Latin America. Based on this, it builds a detailed taxonomy of industrial policy instruments and discusses the indicators used in the literature to quantify them. In a second stage, the thesis systematically constructs and presents solid empirical evidence on the extent and nature of government intervention in the selected country cases. The novelty of this study consists precisely in quantifying industrial policy instruments. This is deemed essential to overcome what has become an unfruitful confrontation on the merits (and demerits) of industrial policies.

The empirical evidence presented in this thesis confirms most of the accepted stylised facts about the divergence of East Asia and Latin America. First, data confirm that Latin American countries more strongly protected their domestic markets, although the East Asian degree of domestic market protection was not negligible. Second, East Asian governments spent more on export promotion than Latin American governments. Our data also confirm the role of East Asian governments in directing financial resources towards strategic industries. Expenses for fiscal and financial incentives were higher in Korea and Taiwan than in any other Latin American country under scrutiny. Finally, Latin American governments supported science more than innovation in firms, while East Asian policies were more balanced between science and innovation and spurred interactions between the two. Not only disbursements for innovation incentives were larger in East Asia, but also

the kind of intervention differed: by combining financial and fiscal incentives, East Asian governments proved to be more entrepreneurial than Latin American governments. Targeted industries also differed, with East Asian governments directing funds to strategic industries like ICTs.

Adverse structural macroeconomic conditions are often considered among the main causes of low investments in developing countries. The last empirical study of this thesis takes a microeconomic perspective and analyses the impact of macroeconomic factors on firms' investment behaviours in the manufacturing industry. Using data from the World Bank Enterprise Surveys, we estimate a multilevel model of firms' investment decisions. Data cover roughly 50 countries from various developing regions, from 2002 to 2010. The main source of novelty of this study consists in the use of firm-level data, rather than national aggregate investments. These allow exploring the micro-macro interactions that shape aggregate investments. Findings suggest that macroeconomic factors are significant determinants of firms' investments. Fiscal policies, external debts, inflation, and exchange rate management contribute to explaining why firms decide to invest and how much they invest. This study also investigates if the structural component of macroeconomic conditions influences firms' investment behaviours. While descriptive statistics show that macroeconomic factors vary more between countries than within countries, firms' investments are associated more with the within country variation component of macroeconomic factors rather than their between countries variation component. This result seems to suggest that firms' investment behaviours follow business cycles' fluctuations, while structural macroeconomic conditions are not significant determinants of firms' investments.

Chapter 1
Introduction

It is well established that economic development is accompanied by pervading processes of transformation involving the economic, productive, and social spheres. At the economic and productive level, resources shift from industries that are less productive to industries that are more productive. At the social level, new firms' organisational models, based on large factories and impersonal management, urbanisation and secularisation challenge existing social structures and ideologies.

The shift of resources from industries that are less productive to industries that are more productive is referred to as *structural change*. Early empirical studies (Clark, 1940; Kuznets, 1966) found that manufacturing output growth is associated with higher economic growth. It was argued that manufacturing has considerable advantages compared to agriculture and services. Manufacturing is more productive and more capital intensive. It offers greater opportunities for dynamic economies of scale: larger volumes of production, made possible by higher capital intensity, reduce unit costs and increase the scope for learning. Manufacturing proved to be the *locus* of technological progress: machines embody state-of-the-art technologies and knowledge and managerial capabilities accumulate with production. Finally, manufacturing spurs economic growth via its linkages to the rest of the economy. These linkages are stronger for manufacturing than for agriculture or services. Early econometric studies confirmed that economic growth is consistently associated with higher rates of manufacturing output growth (Kaldor, 1966; UN, 1970; Cripps and Tarling, 1975).

Based on this empirical evidence, economists put forth the idea that manufacturing is the engine of growth in the economy. Cornwall (1977) developed a model of the engine of growth hypothesis according to which aggregate output growth depends on output growth in the manufacturing industry. Recent analysis demonstrated that manufacturing is still an engine of growth in developing countries (Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011; Felipe et al., 2014). These studies also emphasised the role of skills' accumulation and flexibility, intended as the ability of the economy to shift resources towards more dynamic activities.

Great Britain was the first country to industrialise. Its highly productive agricultural sector allowed shifting labour to manufacturing. The application of new machineries made Great Britain the technological leader of that time. Since the Industrial Revolution, all countries have developed by industrialising: after Britain, European countries and the United States caught up, and later on Russia, Japan,

and the Asian Tigers (Hong Kong, Singapore, South Korea, and Taiwan). Everywhere industrialisation spurred economic growth, created employment, and lifted large portions of the population out of poverty. Today, newly industrialising countries, such as China, India, Thailand, Malaysia, and Vietnam, are among the countries that are undergoing rapid structural transformations.

Virtually all countries in the world have implemented strategies to industrialise. Historically, not all endeavours turned out to be successful. Rather, it could be said that the opposite is true. China, India, and several Latin American countries had developed an industrial sector already at the end of the nineteen century. Historical accounts of Latin American industrialisation show that after a period of deceleration of manufacturing output growth due to upswings in terms of trade, industrialisation took off again around 1870 (Williamson, 2006). Since then, the Latin American industrialisation has gone through different phases. Data on the shares of manufacturing in GDP confirm that in the 1950s Latin America was the most industrialised region of the developing world. However, from the 1980s, Latin America experienced premature deindustrialisation, meaning that the share of manufacturing in GDP decreased before the economy could achieve higher income levels. The same occurred in the African continent (Rodrik, 2015).

Because of premature deindustrialisation, the majority of today low income and middle-income countries did not fully industrialised, i.e. did not become rich industrial economies. While deindustrialisation is considered a natural phenomenon and a sign of economic success in advanced countries, in developing and middle-income countries deindustrialisation is detrimental to socio-economic development. Premature deindustrialisation has long-term negative effects on economic growth because the benefits of industrialisation are not fully reaped (Tregenna, 2011).

In contrast with deindustrialisation in Latin America and Africa, some Asian countries experienced continuous growth of manufacturing since the 1950s. In a span of two decades, the Asian Tigers increased their manufacturing production. Within manufacturing, they moved towards higher value-added activities and production of increasingly sophisticated goods. This occurred although these countries possessed a relatively underdeveloped industrial sector after the World War II. A large body of literature emerged from the observation of these divergent processes of structural change. While there is consensus that institutions and public policies

played a major role in these processes, the literature has reached little agreement on what type of policies were most conducive to industrialisation and catch-up.

According to neoclassical economists, the main determinant of the success of the East Asian countries was their limited state intervention. In this view, East Asian policies exclusively aimed at ensuring favourable business conditions by guaranteeing macroeconomic stability and providing high-level human capital and good infrastructures. Latin American governments, instead, were accused of being too interventionist. Selective and discretionary policies distorted market incentives and kept inefficient firms in the market. This ultimately wasted public money and diffused rent-seeking behaviours and corruption.

In the debate on industrial policies, trade policies have occupied a central position. Neoclassical economists praised the East Asian trade regime and used East Asia as the proof that export-led growth is the best way to catch up. The East Asian trade regime was described as a "virtually free" regime that simultaneously promoted export and liberalised imports. While East Asia became the paradigm of the success of market-based policies and export promotion, Latin America was heavily criticised for not abandoning import substitution in time. In the neoclassical view, these policies introduced biases against exports and directed structural change towards a pattern of specialisation inconsistent with comparative advantage.

So-called revisionists, or industrial strategists, (e.g. Robert Wade, Alice Amsden, and Ha-Joon Chang) and Latin American structuralists were the major opponents of this interpretation. Industrial strategists made a great effort in unveiling the details of policy-making in East Asia. Their analysis emphasised how governments systematically "got prices wrong" to push structural and technological change towards industrial sectors that would have not prospered otherwise. According to their studies, obstacles to free trade were maintained longer than generally acknowledged by neoclassical economists. Moreover, preferential credits and favourable fiscal regimes stimulated investments in strategic industries. Hence, according to this interpretation, East Asian governments intervened in market functioning much more than acknowledged by neoclassical economists and their industrial policies were comparative-advantage-defying, rather than comparative-advantage-following. According to Latin American structuralists, in Latin America import substitution initiated and fuelled firms' learning and affected the direction of struc-

tural change towards engineering-intensive manufacturing industries (Katz, 2000a and 2000b, 2001; Cimoli and Katz, 2003).

As recognised by advocates of both views, some elements of Latin American industrial policies were undoubtedly flawed. Firstly, Latin American policies abounded in carrots but largely lacked sticks: firms were hardly punished for their misconduct and incentives were rarely conditional on clear performance targets. Secondly, policies were rarely adjusted or abandoned when they proved ineffective, but tended to change whenever governments changed. Lack of long-term commitment to given developmental and industrial goals damaged the relationship between governments and business by adding uncertainty and destroying trust. Finally, Latin American firms lacked sufficient incentives for capabilities' accumulation, which ultimately affected the rate and direction of technological change.

Neoclassical economists and Latin American structuralists (unintentionally) agree that adverse macroeconomic conditions hindered industrialisation in Latin America. In the 1980s, Latin America entered a huge debt crisis that signed the end of active industrial policy in the region. Insolvent countries were pressured to accept a new policy agenda, the Washington Consensus. This type of policies is also commonly referred to as *structural policies*, or *structural adjustment programs*, because they aimed at forging the *structural* conditions for investment and economic growth. Following the Washington Consensus, markets were freed from "distortive" government interventions. Policies were set to achieve and maintain macroeconomic stability and fiscal discipline. Trade and financial liberalisations, privatisations, deregulations, price and tax reforms further reduced the role of the state.

There is little agreement about the impact of structural policies on industrialisation and economic growth. Some empirical studies found that structural policies were associated with faster economic growth and higher rates of private investments (e.g. Serven and Solimano, 1991; Easterly and Rebelo, 1993; Bleaney, 1996; Easterly et al., 1997). According to structuralists, macroeconomic instability in Latin America is the result of a variety of mechanisms that depend on production structures. Abundance of natural resources makes developing countries specialise in primary commodities. This makes them vulnerable to volatile commodity prices and causes cyclical overvaluations of the exchange rate. In particular, high commodity prices increase the profitability of resource-based industries, which attracts national and international capital and generates capital account booms. High

commodity prices and capital account booms tend to appreciate the exchange rate. Appreciated exchange rates penalise manufacturing firms by reducing the cost of imported substitutes and eroding firms' competitiveness in international markets. Exchange rates' movements and volatile commodity prices also affect inflation. These mechanisms have long-lasting and reinforcing effects on investments and push the direction of technological change away from productive diversification (Ocampo, 2011; Bresser-Pereira, 2008, 2012).

In the structuralist view, the lack of recognition of macroeconomic instability as a structural phenomenon (i.e. related to countries' production structures) explains why structural policies failed to generate truly stable and favourable macroeconomic conditions in Latin America. According to this interpretation, inflation targeting and fiscal discipline depressed economic growth by affecting investment behaviours and modifying the direction of structural change away from engineering-intensive manufacturing industries. It has been argued that Latin American adverse macroeconomic conditions -and the unsuccessful attempts at macroeconomic stabilisation of structural policies- permanently mutated firms' investment behaviours and induced firms to prefer low-risk high-return investments. Structural policies ultimately reversed the direction of technological change: natural resource-based industries prospered, while R&D and engineering-intensive manufacturing industries were the most hit. Evidence of this comes from a long series of case studies pioneered by the work of Jorge Katz.

This reading of Latin American macroeconomic conditions leads structuralists to advocate for a dual development strategy. Its central objective is to promote the diversification of production structures -naturally hampered by the mechanisms described above- by boosting innovation in industrial sectors with the strongest linkages to domestic production and counterbalancing external vulnerabilities -caused by international prices and capital account shocks- via counter-cyclical fiscal, monetary, and exchange rate policies (Ocampo, 2011). Hence, while neoclassical economists propose structural policies as a means to ensure favourable macroeconomic conditions, structuralists advocate in favour of selective industrial policies to counteract the adverse structural macroeconomic conditions that characterise Latin America and potentially other developing regions.

The debate on structural policies has seen a revival with the recent European crisis and the imposition of structural adjustment programs in peripheral European

countries. These are deemed necessary to improve business conditions and bring Southern Europe closer to Northern Europe. Although these policies are creating recession, unemployment, and social unrest, it is still believed that they will have long-term positive effects on the chronically low levels of investments of Southern European countries in the last decades.

The debate on industrialisation started long ago and attracted considerable attention, but key factors and mechanisms behind it are still disputed. Different policy approaches have been experimented since the 1950s. There is an abundant literature that evaluated their impact, but reached contradictory conclusions. Disagreement arose especially in two policy areas: industrial and macroeconomic policies. The debate on industrial policies polarised around the concepts of functional and selective industrial policies and analysed their effects on industrialisation and economic growth. This debate, however, has resulted in an unproductive confrontation that cannot enlighten policymakers, especially in newly industrialising and developing countries. The literature on the role of macroeconomic policies for economic growth argues that developing countries' economies are affected by structurally adverse macroeconomic conditions that depress investments. However, how to counteract these adverse structural macroeconomic conditions remains disputed. This thesis hinges on these literatures and adds to their polemics.

Nowadays, it is argued that manufacturing is not the only modern industry capable of driving economic growth. Agriculture, natural resource-based industries, and services apply more and more knowledge and technologies (e.g. von Tunzelmann and Acha, 2005; Perez, 2010; Spithoven, 2000). Consequently, the term *structural change* has been also used in a broader way to indicate shifts from lower to higher value-added productive activities. Within the service sector, it is possible to distinguish between traditional and modern services, where modern services refer to ICT-enabled tradable services, such as computer, financial, and business services. In the last decades, the share of services in GDP has increased tremendously both in advanced and emerging economies (Szirmai, 2012). Some authors, therefore, put forth the idea that modern services can be the new engine of economic growth, or at least play the role of an additional engine (e.g. Dasgupta and Singh, 2006, 2005; Timmer and de Vries, 2008; Chakravarty and Mitra, 2009; Felipe et al., 2009). Despite acknowledging that other industries could have acted as engines of economic growth at least in the last two decades or so, this thesis focuses on the manufacturing industry.

The thesis investigates the determinants of industrialisation. Why some countries industrialised and others did not is the fundamental question that motivates each chapter of the thesis. After the Second World War, most of the attempts at industrialisation failed -except for the notorious cases of the so-called Asian Tigers. Understanding the causes of these failures is not only historically important, but also necessary to formulate sound policy recommendations for newly industrialising countries. A large number of countries are still trying to industrialise. Their *advantage of backwardness* is not only in terms of knowledge and technologies, but also in terms of industrial strategies and policy practices.

We tackle this research question in three sequential steps, each of them with an empirical study. Given the nature of the topics treated, quantitative and semi-qualitative research methods are applied. First, we explore the determinants of industrialisation in a large number of developed and developing countries. Then, we delve deeper into the analysis by looking at the role of industrial and macroeconomic policies.

In the second step, we provide a detailed account of industrial policies in the most debated cases of successful and relatively less successful industrialisation processes, namely East Asia and Latin America. These cases are illustrative of the role of industrial policies, especially given the initial economic conditions of the two regions. In this part of the thesis, we are interested in assessing the extent and nature of industrial policy in East Asia and Latin America. The ultimate objective of the analysis is to identify the elements that distinguished East Asian and Latin American industrial policies and understand if these elements can explain their patterns of structural and technological change. Industrial policies alone are not enough to industrialise. Favourable macroeconomic conditions are also important.

In the third step of our analysis, we investigate how macroeconomic factors affect manufacturing growth. As mentioned above, both neoclassical economists and structuralists talked about *structural* macroeconomic conditions. However, what *structural* means and how to counteract adverse structural macroeconomic conditions is very much debated. This study aims at verifying if the structural component of macroeconomic factors -as opposed to the cyclical movements expected in any capitalist economy- explains firms' investments.

The main source of novelty of this thesis consists in analysing the role of public policies for industrialisation in a (semi-)quantitative fashion. This is accomplished

by a major effort in constructing suitable semi-quantitative indicators of industrial policies, and distinguishing the channels through which public policies affect industrialisation.

Structure of the thesis

This thesis is structured as follows. In the first study (Chapter 2), we explore the determinants of industrialisation by estimating the equation of manufacturing output growth of the Cornwall (1977) model. This is a two-equation model where the first equation explains output growth in manufacturing and the second explains aggregate output growth as a function of manufacturing output growth. Because the manufacturing share is endogenous to economic growth, it is generally instrumented with all the other exogenous variables of the model. This estimation constitutes the first step of a two-step instrumental variable estimation. Generally, with two-step estimations, only the second step (the equation of aggregate output growth) is reported and discussed, while the first step is used only to feed into the second equation. This study estimates the equation of manufacturing output growth to identify the variables that truly instrument for manufacturing output growth in two-step instrumental variable estimations. In this way, this study puts manufacturing at the centre of the analysis and investigates its determinants and their evolution over time.

Following the debates outlined so far, we are interested in testing the following two hypotheses. First, policies matter more than broadly defined institutions, as captured by traditional indicators like democracy indexes. The policies analysed in this paper are trade policies, and more specifically trade liberalisation and exchange rate policies. The second hypothesis that we want to test is that skills and knowledge accumulation contribute more to industrialisation than prices. This hypothesis is based on the Schumpeterian idea according to which differences in international competitiveness are determined more by technological capabilities than price competitiveness (Fagerberg, 1988, 1996; Fagerberg et al., 2007).

In order to test these hypotheses, we apply modern panel data techniques to a dataset that covers a large sample of developed and developing countries from 1960 to 2005. A large and long database improves generalizability of results and allows exploring if some forces were more important in some periods than in others. In order to preserve the size of the database, this study relies on secondary

data and excludes potentially interesting variables for which data are not readily available. This partly motivates our second study.

Several important determinants of industrialisation cannot be investigated in an econometric setting. In countries where these determinants are likely to have played a key role, our econometric model poorly predicts manufacturing growth rates. These countries can be considered outliers in the econometric analysis, meaning that, after taking into account important determinants of industrialisation, unexpectedly positive or negative outcomes are observed. These outcomes must be explained by other factors. We hypothesise that public policies, and in particular industrial policies, are among those.

Therefore, the third and fourth chapters of this thesis deal with the role of industrial policies and focus on the experiences of few selected countries in Latin America and East Asia, namely Argentina, Mexico, Brazil, South Korea (Korea hereafter), and Taiwan. As mentioned, after the Second World War, Latin America was better positioned than East Asia to catch up. Indeed, many observers believed that Latin American countries would have been the next to industrialise. Given this advantaged position, the relative failure of Latin America *vis a vis* East Asia has been attributed to the industrial strategies implemented after the Second World War.

The third chapter of this thesis provides a detailed and critical review of the historical- comparative literature on industrial policy in East Asia and Latin America. It defines industrial policy in a broad way and distinguishes two types and four domains of intervention of industrial policy. Industrial policies are defined as functional or selective. The former equally affects all industries of the economy by improving the functioning of markets without discriminating among industries. The latter deliberately target particular industries or firms. Industrial policies are also categorised according to their domain of intervention into framework conditions, trade, investment, and science, technology, and innovation policies. Based on this categorisation, we build a detailed taxonomy of industrial policy's instruments. This chapter lays the ground for a quantitative comparative analysis of industrial policies implemented in the five countries.

In the fourth chapter, the thesis attempts at quantifying industrial policy by defining, constructing, and systematically comparing indicators of industrial policy instruments used by the five countries under analysis. By using these data, the thesis tries to assess whether East Asian and Latin American states directed countries'

processes of structural and technological change; that is, to what extent their industrial policies were functional or selective. Understanding the extent and nature of industrial policies only by quantitative indicators is impossible: any quantitative indicator cannot account for the processes of policy-making, implementation, and enforcement of policies. Moreover, idiosyncratic political arrangements, consequences of the history and evolution of the institutions of the country, reduce the degree of cross-country comparability of indicators. Still, our proxy of industrial policy is a first attempt at bringing solid empirical evidence in the historical debate on industrial policy.

Adverse macroeconomic conditions can alter the effects of industrial policies. The relative unsuccessful industrialisation of Latin America has been partly imputed to adverse macroeconomic conditions. It would be unfair to conclude our analysis without a treatment of this issue. This is why the last study of this thesis (Chapter 5) focuses on macroeconomic policies and in particular, on the role of macroeconomic factors as structural determinants of firms' investments. Firms' investments in manufacturing are the micro-equivalent of industrialisation. In other words, firms' investments choices determine aggregate investments and output of the manufacturing industry.

With this study, we add the microeconomic dimension to our macroeconomic analysis. This approach is novel and interesting because it contributes to a better understanding of the micro-macro interactions that shape investment patterns in manufacturing. In this chapter, we test if macroeconomic conditions are structural; that is, if macroeconomic conditions affect investments because they are structurally adverse or favourable. We use data from the World Bank Enterprise Surveys for the period 2002-2010 and estimate a multilevel Heckman selection model in which firms' investments depend on macroeconomic policies. Following the debate on the effects of the Washington Consensus, we explore the effect of policies for macroeconomic stability, financial and trade liberalisation, and tax reforms.

Chapter 6 draws conclusions and policy implications of the thesis.

Chapter 2

An Analysis of the Determinants of Industrialisation, 1960-2005

2.1 Introduction

The term *industrialisation* refers to the movement of productive resources from low-productivity traditional sectors (agriculture) to high-productivity modern industries (manufacturing). Owing to the higher capital intensity and technological content and the stronger linkages with the rest of the economy of manufacturing, accelerated growth of manufacturing output is associated with faster economic growth (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011).

Recent empirical analysis showed that in the last decades both manufacturing and modern services act as engines of economic growth (e.g. Felipe et al., 2009; Timmer and de Vries, 2008). In light of this empirical evidence, some scholars questioned the idea that industrialisation via manufacturing is still a necessary step towards development and proposed modern services as the new engine of growth (e.g. Dasgupta and Singh, 2005, 2006). While it is undeniable that in the last decades modern services played an important role in the economy, this study adopts a long-term perspective and therefore looks only at the manufacturing industry.

This chapter analyses the long-term dynamics of industrialisation and investigates its determinants in a sample of 74 developed and developing countries from 1960 to 2005. In order to do so, the study goes back to the model of the engine of growth hypothesis developed by John Cornwall in 1977. This model is made of two equations that describe aggregate output growth as a function of manufacturing output growth. Recent econometric estimations applied two-step instrumental variable techniques and instrumented manufacturing output growth with all the other exogenous variables of the model. This literature reports and discusses only the second step of the estimations -the results of the estimation of the equation of aggregate output growth. The first step -the estimation of the equation of manufacturing output growth- is only used to feed into the second equation.

This study looks at the equation of manufacturing output growth before it feeds into the equation of economic growth. This means looking at what variables truly instrument for manufacturing growth when estimating the model of the engine of growth hypothesis with two-step instrumental variable techniques. This not only informs the literature on the hypothesis of manufacturing as an engine of growth, but also the academic and policy debate on industrialisation. By putting manufacturing at the centre of the analysis, this study investigates how some countries

managed to industrialise, while others did not, and how conditions for industrialisation changed over time.

The chapter is structured as follows. The next section provides a literature review on the role and drivers of industrialisation. Section 2.3 presents our econometric model and describes the data used. Section 2.4 presents the results of the econometric estimations. Robustness checks are reported in section 2.5. Section 2.6 briefly concludes.

2.2 Literature review

In early structural development economics, industrialisation referred to the process of structural change that backward countries experience in their development from agrarian to industrial urban economies (Clark, 1940; Kuznets, 1966; Cornwall, 1977). The positive relationship between economic growth and growth of the manufacturing industry was explained by the properties of manufacturing. It was argued that manufacturing is more productive and more capital intensive than the other industries (Hoffmann, 1958; Chenery et al., 1986). Because capital goods embody state-of-the-art technologies and learning accumulates with production, manufacturing is considered the *locus* of technological progress (Cornwall, 1977). Finally, stronger backward and forward linkages to the rest of the economy characterise the manufacturing industry (Rosenstein Rodan, 1943; Nurkse, 1953; Hirschman, 1958; Cornwall, 1977).

Based on this evidence, in his 1977 book, John Cornwall developed a model of the engine of growth hypothesis, according to which economic growth depends on manufacturing output growth. Using data for market economies for the 1950s and 1960s, early empirical analysis confirmed that economic growth is significantly associated with manufacturing output growth (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975). Fagerberg and Verspagen (1999) and Szirmai and Verspagen (2011) verified the engine of growth hypothesis using more recent data and larger datasets. They show that manufacturing is still an engine of growth, if countries target the most dynamic industries and possess enough absorptive capacity. Country case studies (e.g. Tregenna, 2007; Kuturia and Raj, 2009) and reports by international organizations (e.g. UNIDO, 2009, 2013) confirmed the importance of manufacturing for industrialisation.

Early structural development economics evolved into two approaches: the structural approach to development economics, represented by Hollis Chenery and his

co-authors, and the Latin American structuralism. The structural approach to development economics focused on the role of trade and exports. In their empirical analysis, these authors find that trade openness and outward-oriented development strategies led to rapid export growth and structural change. On the export-side, the export push allows countries to specialise in industries where domestic demand is limited. On the import-side, increased availability of foreign exchange allows imports of modern intermediate and capital goods (Chenery, 1960, 1975, 1980; Chenery et al., 1974, 1986; Syrquin, 1988). Based on this analysis, the structural approach to development economics advocated for trade openness and outward-oriented development strategies.

Latin American structuralism focused on the relationship between productive specialisations and balance of payment constraints. Inspired by the writings of Raul Prebisch (1950, 1973), Latin American structuralists argue that developing countries tend to specialise in primary commodities and resource-intensive industries, for which they have comparative advantages. However, this specialisation causes a decline in their terms of trade and constrains their balance of payments (Furtado, 1961; Pinto, 1965, 1970).[1] Dependency on primary commodities makes developing countries vulnerable to volatile international commodity prices and to capital account shocks. This causes cyclical overvaluations of the exchange rate that penalise the manufacturing industry (Bresser-Pereira, 2008; Ocampo, 2011). In these circumstances, active industrial policies are required to redirect the process of structural change away from primary commodities (ECLAC, 1998; Ocampo, 2011).

Modern versions of these two approaches were formulated. Lin (2010) put forth the framework of new structural economics. In this framework, modern industrialisation requires knowledge accumulation, technological upgrading, and innovation. Bresser-Pereira (2012) developed the new developmentalism, based on heterodox and structuralist approaches and inspired by the lessons of the East Asian experience.

In a review of Latin American structuralism, Bielschowsky (2009) noticed that modern Latin American structuralism is giving increasing importance to innovation by incorporating views from the Schumpeterian approach. Schumpeterian (or evolutionary) economists studied the role of innovation for economic growth and demonstrated that international competitiveness is driven more by technological

[1] A similar argument was made by Singer (1950).

than cost competitiveness (e.g. Fagerberg, 1988, 1996; Fagerberg et al., 2007). This finding was corroborated by the experience of East Asian countries that managed to catch up thanks to their efforts in technology adoption and capabilities' accumulation (e.g. Kim, 1992, 1997; Nelson and Pack, 1999; Lall, 2004; Lee and Lim, 2001; Lee, 2009).

In the Latin American context, Katz (2000b, 2001) and Cimoli (Cimoli and Katz, 2003) analysed the processes of structural and technological change in Latin American firms during the different phases of Latin American industrialisation. According to their analysis, abrupt trade and financial liberalisations imposed in the 1980s and 1990s changed the direction of structural and technological change by spurring growth in resource-based industries and hitting R&D and engineering-intensive industries. Most penalised industries were technology-intensive industries: exposure to international competition, devaluations of local currencies, and contraction of aggregate demand halted the processes of learning initiated and spurred by import substitution strategy.

2.3 Approach and data overview

Approach

The model of the engine of growth hypothesis developed by Cornwall (1977) is made of two equations:

$$\dot{Q}_m = g_0 + g_1\dot{Q} + g_2 q + g_3 q_r + g_4 (I/Q)_m \quad (1.1)$$

$$\dot{Q} = e_0 + e_1\dot{Q}_m \quad (1.2)$$

The first equation explains output growth in the manufacturing industry ($\dot{Q}_m$) and the second aggregate output growth ($\dot{Q}$). Aggregate output growth depends on the growth rate of manufacturing output, as reflected by the coefficient, e_1, the measure of the power of manufacturing as an engine of growth. The determinants of the growth rate of manufacturing output are the level and growth rate of aggregate income (q and $\dot{Q}$), income relative to the most developed economies (q_r), and investments ($(I/Q)_m$). The level and growth rate of income capture demand side factors. The ratio of per capita income relative to high-income economies is a measure of the potential for technological catch up. Investments measure the efforts to develop imported and indigenous technologies.

This paper empirically tests a revised version of the first equation of this model, i.e. the equation of manufacturing output growth. This revised version of the model builds on previous estimations of the Cornwall model (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011).

To capture manufacturing output growth, we use the first difference of the share of manufacturing in GDP. As suggested by Corwall himself, the level and growth rate of aggregate income should not be simultaneously included in estimations because the simultaneous inclusion of variables containing income would create collinearity. Therefore, only the income relative to the most developed economy (US) is included in the model. Together with income relative to the US, we include the lagged value of the manufacturing share in GDP to account for catch up or cumulativeness in the industrialisation process. We expect the coefficients of these two variables to be negative. Because the level of investment is endogenous to manufacturing growth, it is accounted for by the variables that drive it in the first place.

Following previous estimations of the model of the engine of growth hypothesis (Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011), we augment the original model by adding labour costs, skills, and capabilities to account for supply-side factors, and size of the domestic and export markets to account for demand-side factors.

Labour costs are a measure of international competitiveness: higher labour costs make exports more expensive and countries less competitive. Nevertheless, according to the Kaldor paradox (Kaldor, 1978), rapidly growing countries are characterised by high growth rates of labour costs. This suggests that labour costs cannot be a determinant of industrialisation in the long run. Moreover, depending on countries' industrial specialisation, low wages can be explained by low productivity, which would mean lower competitiveness. Despite this might vary across industries, the overall effect of labour costs on industrialisation is expected to be negative (Amable and Verspagen, 1995).

Empirical studies showed that price competitiveness is not the most important determinant of international competitiveness in the long run. Instead, skills and technological capabilities are more important (Fagerberg, 1988; Amendola et al., 1993; Fagerberg et al., 2010; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011). In this study, traditional measures of education levels account for skills' ac-

cumulation (Barro and Lee, 2010). Patents and R&D expenditures measure technological capabilities.

In a first stage, we use the number of USPTO patents per capita. Due to its clear advantages in terms of data availability and cross-country comparability, this is the most widely used indicator in the literature. However, USPTO granting procedures require a high degree of novelty of the patented invention. These requirements are likely to be excessive in developing countries' contexts. Therefore, in a second stage, we use depreciated USPTO patent stock, the number of patent per capita at national offices (granted to residents), R&D expenditures, and a measure of technological level developed by Fagerberg (1988). National patent offices' criteria to grant patents are less stringent than the USPTO are, allowing capturing a much broader range of innovations. In contrast with patents that represent the output of innovation processes, R&D expenditures are an indicator of innovation input. For this reason, R&D expenditures and patents can be considered complementary measures of innovation. This is why Fagerberg (1988) combines them in a single indicator, the indicator of technological level.

With respect to demand-size factors, population size accounts for the size of the domestic market. The size of the external market is captured by merchandise exports as percentage of GDP. Exports depend on exchange rates: by making the price of tradable goods higher relative to that of non-tradable, undervalued exchange rates encourage the transfer of resources towards the more profitable tradable sector. Since the tradable sector is mainly made of industrial activities, the effect of the real exchange rate on growth is channelled by industrialisation. To account for exchange rates, we use the undervaluation index proposed by Rodrik (2008). This index, taken in logarithmic form, is positive when the currency is undervalued.

Following previous studies (Fagerberg and Verspagen, 1999; Rodrik, 2008), we also account for institutional and macroeconomic factors. With respect to institutions, in the literature there is broad consensus that institutions matter for growth. This paper tests if institutions affect growth via industrialisation. The indicators of institutions used in the literature mainly capture political systems variables, such as democracy index and rule of law. Fagerberg and Schrolec (2008) demonstrated that good governance contributes to economic growth more than democratic political systems. However, indicators of good governance are not available for long

time series. In order to preserve the length of our panel, we chose to rely on indicators of political systems. Our preferred measure of institutions is the Vanhanen index (Vanhanen, 2000). Compared to other measures (e.g. Polity and Freedom House data), this indicator uses quantitative data, rather than subjective evaluations. With respect to macroeconomic conditions, inflation and terms of trade influence investment choices.

We also include a variable that accounts for the portion of land in temperate climatic zones. Geographical variables are the classic instruments in empirical studies on economic growth. While institutions and trade are endogenous because they are mutually determined and in turn influenced by economic growth, geography is an exogenous determinant of economic growth (e.g. Acemoglu et al., 2001; Dollar and Kraay, 2003; Rodrik et al., 2004; Lee and Kim, 2009).

Details on the sources and definitions of the explanatory variables are provided in Table A.1 (Appendix A).

Data overview

Our dataset is an unbalanced panel of 74 developed and developing countries covering the period from 1960 to 2004. Table A.2 (Appendix A) gives details of the countries and period covered in the analysis. Before delving into the econometric analysis, it is worthwhile showing that indeed many countries in our sample are not industrialised, meaning that they have not yet become rich (industrial) countries. Felipe et al. (2014) found high correlation coefficients between being an industrialised, i.e. rich, country today and having experienced a peak in manufacturing employment share higher than 18-20% and a peak in manufacturing share in GDP higher than 22% between 1970 and 2010.[2] This means that roughly speaking, a country could be defined industrialised if its share of manufacturing in GDP surpassed the threshold of 22%.[3] By applying this rule to our sample, we find that 40 countries out of 74 reached the peak of 22%, or higher, in manufacturing shares in GDP between 1960 and 2005.

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[2] A rich country is defined as a country whose average per capita GDP during 2005–2010 exceeds a cutoff of $12,000 in 2005 prices (not PPP corrected). This roughly corresponds to the World Bank's definition of a high-income economy.

[3] Felipe et al. (2014) show that emplyment shares are better predictors of GDP today, than output shares. Nevertheless, due to data availability and in line with our definition of industrialisation, we look at output shares rather than employment shares.

Table 2.1 presents descriptive statistics of the variables used. This guides the choice of the type of econometric model to adopt.

Table 2.1. Descriptive statistics

Variable	Mean	Standard Deviation			Observations		
		Overall	Between	Within	N	N	T-bar
First difference of the manufacturing share in GDP	0.10	2.30	1.30	2.73	613	85	7.2
Lagged manufacturing share in GDP (manL1)	18.27	8.06	7.48	3.99	645	85	7.6
GDP per capita as % of US GDP (relus)	0.31	0.28	0.28	0.07	734	85	8.6
Wage	7.99	1.26	1.02	0.81	559	80	6.9
Population (pop)	9.32	1.64	1.63	0.28	758	85	8.9
Merchandise exports (export)	0.23	0.17	0.15	0.09	712	84	8.5
Undervaluation index (underval)	0.05	0.46	0.37	0.30	706	85	8.3
Democracy index (democracy)	14.32	13.68	12.33	5.98	699	84	8.3
Education (edu)	5.59	2.78	2.48	1.37	751	85	8.8
Terms of trade (tot)	0.00	0.10	0.08	0.07	729	85	8.6
Inflation	2.20	1.08	0.74	0.82	661	83	8.0
USPTO patents (patents)	0.07	0.18	0.17	0.06	715	82	8.7
Depreciated stock of USPTO patents	0.09	0.28	0.27	0.09	753	84	9.0
National offices' patents	0.10	0.19	0.15	0.09	455	72	6.3
R&D expenditures	0.25	0.27	0.26	0.07	307	63	4.9
Technological level	0.11	0.17	0.17	0.03	300	61	4.9

The table shows that the within component of the standard deviation of the dependent variable (the first difference of the share of manufacturing in GDP) is larger than its between component. The opposite is true for all the explanatory variables, but inflation (because of its high volatility). Because variation in the data is mainly between rather than within countries, we would rather not rely on a fixed effect model. Fixed effects models look at within countries variations and wipe out between effects. Moreover, because our objective is to understand why some

countries industrialised and others did not, we are interested in between countries variations rather than within countries variations.

Finally, because data start in 1980, R&D expenditures data dramatically affect the length of our dataset. While patent indicators and R&D expenditures are generally highly correlated, this correction is much lower for developing countries. The correlation between USPTO patents and R&D expenditures is 0.86 for the whole sample, 0.62 for Africa, and 0.31 for Latin America. Similarly, the correlation between USPTO and national offices' patents is 0.74 for the whole sample, 0.84 for Africa, 0.6 for Asia, and 0.2 for Latin America. This justifies the use of these alternative indicators.

2.4 Results

We begin our econometric analysis by comparing fixed and random effects, between, and Hausman and Taylor (1981) specifications. Following Jacob and Osang (2007) and Szirmai and Verspagen (2011), we separately inspected each explanatory variable by means of Hausman tests (not reported here) in order to identify endogenous explanatory variables. The lagged share of the manufacturing share in GDP, the undervaluation index, and population are endogenous.

Because the lagged dependent variable is included in all these models, fixed effects models are biased (Nickell, 1981). Similarly, the Hausman and Taylor models are also likely to be biased, since they partly rely on within transformations. For this reason, Section 2.5 reports a number of robustness checks, including system GMM estimations that solve the dynamic panel bias.

Results of the estimations are reported in Table 2.2.

Table 2.2. Determinants of industrialisation, 1960-2005

	Fixed effects			Random effects			Between			Hausman-Taylor		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1 #	-0.385	0.049	***	-0.182	0.027	***	-0.052	0.041		-0.349	0.033	***
pop #	3.786	1.456	*	0.358	0.124	**	0.086	0.142		1.493	0.599	*
underval #	1.655	0.821	*	1.484	0.574	**	0.786	0.700		1.925	0.570	***
export	8.440	2.487	**	5.448	1.550	***	5.009	1.773	**	8.170	1.806	***
relus	0.620	2.839		-2.779	1.377	*	-0.029	1.993		-1.317	2.387	
wage	0.417	0.294		0.084	0.234		-0.841	0.398	*	0.343	0.306	
edu	0.249	0.346		0.141	0.094		0.022	0.126		0.354	0.220	
democracy	-0.024	0.030		-0.021	0.020		-0.059	0.029	*	-0.019	0.024	
patents	-1.362	2.445		-0.110	1.109		0.346	1.886		-1.456	2.062	
inflation	0.306	0.189		-0.062	0.158		0.077	0.235		0.287	0.162	+
tot	3.207	2.466		2.103	1.518		-1.216	2.820		3.221	2.004	
kgatemp				1.479	0.486	**	1.455	0.589	*	1.602	1.740	
D65-70	-0.501	0.633		-0.069	0.678		-2.067	4.079		-0.328	0.539	
D70-75	-2.918	0.624	***	-1.733	0.529	**	-0.502	3.971		-2.586	0.604	***
D75-80	-3.950	0.938	***	-1.864	0.710	**	3.001	4.441		-3.269	0.733	***
D80-85	-5.176	1.182	***	-2.450	0.767	**	-8.036	5.267		-4.312	0.905	***
D85-90	-5.468	1.343	***	-2.486	0.714	***	3.886	4.977		-4.557	0.992	***
D90-95	-5.757	1.553	***	-2.549	0.777	**	-0.736	2.992		-4.671	1.127	***
D95-00	-7.532	1.803	***	-4.076	0.768	***	0.350	3.023		-6.303	1.238	***
D00-05	-7.790	1.936	***	-3.882	0.765	***	-2.180	2.656		-6.475	1.365	***
constant	-31.216	13.606	*	0.598	2.063		6.785	4.165		-10.509	5.987	+
rho	0.849			0.075						0.881		
obs.	435			435			435			435		
countries	74			74			74			74		
R^2 within	0.334			0.289			0.002					
R^2 between	0.041			0.418			0.608					
R^2 overall	0.047			0.316			0.031					

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Standard errors for fixed and random effects are robust (adjusted for clusters). The # indicates the variables that are treated as endogenous in Hausman and Taylor estimations.

Results of fixed effects, random effects, and Hausman and Taylor estimations are quite similar: lagged manufacturing shares, population size, export shares, and undervalued exchange rates are significant determinants of industrialisation. In countries with less developed manufacturing industries, manufacturing grows faster, meaning that there is catch-up in industrialisation. Size of the domestic market, export shares, and the undervaluation index are related positively and significantly to industrialisation. This confirms existing empirical evidence on the role of exports and undervalued exchange rates. Wages are positively associated to industrialisation, but never significantly. Income relative to the US is most of the times negative and significant only in the random effects estimation. The coefficient of education is positive but never significant, while the one of USPTO patents is negative.

With respect to macroeconomic factors, the coefficients of inflation rates are positive in all estimations but in random effects, and significant only in the Hausman and Taylor estimation. This suggests that inflation control is not a necessary element of industrial development strategies. Terms of trade are usually positive but never significant.

The coefficient of the institutional indicator (democracy) is always negative and becomes significant only in the between specification. We further test for the role of institutions by using alternative indexes (see Table A.3 in Appendix A). Because results confirm that broadly defined institutions are never significant determinants of industrialisation, we decide to omit democracy indexes from the rest of the analysis. All period dummies but the first are significant and negative. Coefficients suggest that industrialising has become increasingly difficult over time.[4]

The story that emerges from the between estimation is quite different. Because the between model transforms explanatory variables into countries' means, these estimations exploit the pure cross-country dimension of the data. What these results suggest is that between-countries differences in industrialisation are explained by exports, labour costs, democracy, and geography. As expected, countries with higher export shares, lower labour costs, and in temperate climatic zones experience faster manufacturing growth. Less democratic countries industrialise faster.

[4] A significance test on whether these coefficients are statistically different from each other indicates that dummies from the 1980s until the 1990s and the dummies for 1995 and 2000 are not statistically different from each other.

The Hausman test of over-identifying restrictions strongly rejects (p= 0.0000) the null hypothesis of consistency of the random effects model. The same test performed for the Hausman and Taylor specification does not reject the null hypothesis (p= 0.9645), meaning that the Hausman and Taylor specification is both consistent and efficient. Therefore, the Hausman and Taylor model is our preferred model. The model by Hausman and Taylor combines the advantages of fixed and random effects models because it deals with endogeneity and does not eliminate country time-invariant effects.

As a first robustness check, we estimate a Hausman and Taylor model where we follow existing empirical evidence to determine which variables are endogenous. We treat lagged manufacturing shares, exports, wages, education, patents, and the democracy index as endogenous explanatory variables. Results (in Table A.4 in Appendix A) do not vary and the p-value of the test of over-identifying restriction is 0.8061, which again would confirm that the Hausman and Taylor specification is consistent and the most efficient. All results are also robust to the inclusion of continent dummies and to the inclusion of both period and continent dummies (results not reported here).

Table 2.3 reports Hausman and Taylor estimations where we test for four alternative measures of technological change, namely the depreciated USPTO patent stock (column 1); patents at national patent offices (column 2); R&D expenditures as a percentage of GDP (column 3); and the indicator of technological level developed by Fagerberg in 1988 (column 4). Hausman tests indicate that these four variables are exogenous. Because R&D and secondary education are too closely related, education was dropped in column 3 and 4.

Table 2.3. An exploration of alternative measures of technical change

	Patent stock			National patents			R&D			Tech. level		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.349	0.034	***	-0.380	0.040	***	-0.490	0.056	***	-0.484	0.055	***
pop	1.447	0.585	*	1.064	0.655		1.553	0.990		1.757	1.116	
underval	2.006	0.568	***	2.736	0.766	***	2.873	0.774	***	2.395	0.714	***
export	8.380	1.814	***	8.396	2.139	***	9.678	2.176	***	10.281	2.168	***
relus	-1.836	2.293		0.904	2.474		1.358	3.673		2.666	4.038	
wages	0.319	0.306		0.084	0.394		-0.263	0.365		-0.248	0.357	
edu	0.353	0.219		0.510	0.252	*						
innovation	-1.980	3.481		0.085	1.610		3.329	1.856	+	3.017	3.942	
inflation	0.259	0.162		0.382	0.170	*	0.355	0.187	+	0.324	0.186	+
tot	3.302	2.002	+	3.103	3.235		-9.017	4.457	*	-9.604	4.016	*
kgatemp	1.508	1.661		0.517	1.653		0.422	2.397		0.163	2.791	
D65-70	-0.358	0.538		0.425	0.693							
D70-75	-2.600	0.602	***	-2.372	0.737	**						
D75-80	-3.236	0.733	***	-3.190	0.857	***						
D80-85	-4.271	0.904	***	-4.162	1.058	***	1.680	0.669	*	1.683	0.665	*
D85-90	-4.604	0.983	***	-4.331	1.135	***	1.521	0.612	*	1.685	0.601	**
D90-95	-4.762	1.112	***	-4.568	1.264	***	1.566	0.556	**	1.757	0.543	**
D95-00	-6.404	1.223	***	-5.812	1.370	***	0.395	0.444		0.401	0.433	
D00-05	-6.661	1.347	***	-6.692	1.509	***						
constant	-9.926	5.882	+	-6.103	6.681		-9.721	10.653		-12.011	11.976	
rho	0.869			0.877			0.913			0.943		
obs.	432			321			238			241		
countries	72			62			58			58		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

The stock of USPTO patents is negatively associated with industrialisation, while the other three indicators are positively associated with industrialisation. This can be explained by the low number of USPTO patents held by industrialising countries: only the most successful of them industrialise by gradually accumulating technological capabilities. Moreover, only the coefficient of R&D expenditures is significant. The indicator of technological level, built on both R&D expenditures and USPTO patents, is not significant. This confirms how difficult it is to measure

technological efforts in industrialising countries. The introduction of alternative measures of innovation does not affect the other results, but makes education significant in column 2.

We now test if and how the determinants of industrialisation changed over time. According to the data, between 1960 and 1975 the share of manufacturing in GDP increased in the developing world, but decreased in developed countries. After 1975, only Asia continued to industrialise, while Africa and Latin America started to deindustrialise (Szirmai, 2012). In addition, previous estimations evidenced that industrialisation became increasingly difficult over time (the coefficients of the time dummies were negative and decreasing). In order to check how determinants of industrialisation changed over time, we aggregate the 9 time dummies into 3 sub-periods: 1960-1975, 1975-1990, and 1990-2005. These slope dummies are interacted with all the explanatory variables. We estimate three models: the base model (column 4 of Table 2.2), a model with R&D expenditures, and one with Fagerberg (1988) indicator of technological level. As in previous estimations, the introduction of R&D expenditures and technological level reduces the length of panel to the period 1980-2005. Moreover, when these two variables are included, education is dropped because of collinearity. Results are reported in Table 2.4.

Table 2.4. Evolution of the determinants of industrialisation

	Base model			R&D			Tech. level		
	coef	se	sig	coef	se	sig	coef	se	sig
manL1_60_75	-0.367	0.067	***						
manL1_75_90	-0.330	0.049	***	-0.377	0.063	***	-0.373	0.064	***
manL1_90_05	-0.427	0.050	***	-0.602	0.066	***	-0.597	0.066	***
pop_60_75	1.168	0.395	**						
pop_75_90	1.032	0.369	**	0.720	0.711		1.063	1.001	
pop_90_05	0.962	0.343	**	0.960	0.682		1.277	0.987	
underval_60_75	0.581	1.027							
underval_75_90	0.844	0.726		0.667	0.980		0.744	0.964	
underval_90_05	3.084	1.037	**	3.859	1.256	**	3.947	1.290	**
relus_60_75	-3.393	3.110							
relus_75_90	-5.327	2.928	+	-2.430	3.981		-2.265	4.436	
relus_90_05	-5.672	2.541	*	-2.270	3.774		-1.541	4.246	
wage_60_75	1.109	0.831							
wage_75_90	0.484	0.504		-0.148	0.567		-0.122	0.564	
wage_90_05	0.906	0.391	*	0.300	0.425		0.451	0.423	
exp_60_75	8.673	3.415	*						
exp_75_90	5.999	2.451	*	6.345	3.061	*	6.696	3.035	*
exp_90_05	7.533	1.766	***	11.319	2.248	***	11.938	2.268	***
edu_60_75	0.492	0.246	*						
edu_75_90	0.355	0.227							
edu_90_05	0.134	0.199							
tot_60_75	3.340	2.328							
tot_75_90	1.209	3.365		-9.925	4.921	*	-9.861	4.957	*
tot_90_05	4.677	4.224		-2.608	6.417		-1.692	6.438	
infl_60_75	1.289	0.388	***						
infl_75_90	0.173	0.216		0.414	0.225	+	0.373	0.227	+
infl_90_05	-0.094	0.230		0.179	0.236		0.161	0.235	
inn_60_75	-2.137	2.710							
inn_75_90	-0.258	2.868		3.324	2.205		6.589	4.311	
inn_90_05	2.619	2.296		5.049	2.045	*	7.006	4.064	+
kgatemp	2.123	1.118	+	1.410	2.224		1.146	2.560	
rho		0.685			0.901			0.928	
obs.		442			238			236	
countries		75			58			57	

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Notes: Constant and time dummies included in the estimations but not reported.

Four interesting results emerge from these estimations. First, lagged manufacturing and exports are the only two variables that are consistently significant in all sub-periods. The signs of their coefficients confirm previous estimations. Coefficients of export shares also show that exports were particularly important in the period from 1960 to 1975 and from 1990 to 2005. Second, undervaluation index is significant only in the last period (1990-2005). Its significance and higher coefficient show that exchange rate management became more important from the 1990s. Third, income relative to the US, which was rarely significant in previous estimations, becomes significant from the mid-1970s in the base model (column 1). Its negative sign confirms the presence of catch-up forces in industrialisation.

Finally and most importantly, the coefficient of USPTO patents per capita, negative in previous estimations, becomes positive (although not significant) in the last period. This suggests a more prominent role of technological change in modern industrialisation efforts. In column 2 and 3, where R&D expenditures and technological level substitute for USPTO patents, the coefficient of both R&D expenditures and technological levels are always positive and significant in the period from 1990 and 2005. Hence, these estimations confirm that accumulation of technological capabilities became increasingly important in the last two decades.

2.5 Robustness check

All our estimations are likely to be strongly affected by endogeneity. Although this was already addressed by Hausman and Taylor estimations and by preserving the length of the panel, this section further verifies the validity of our results by using General Methods of Moments (GMM) and mixed effects estimations. Because USPTO patents did not turn out to be a significant determinant of industrialisation and other measures of technical change severely reduce the length of the panel, we exclude innovation measures from the next estimations.

In Table 2.5, we report OLS and fixed effects estimations in column 1 and 2 respectively. In columns 3-5, results of three different specifications of system GMM models are reported. Roodman (2006) suggests that for a correct implementation of system GMM a panel must be characterised by small T and large N and the model should include time dummies (which is our case). The standard treatment of endogenous variables is to use lag 2 and deeper for the transformed equation and lag 1 for the levels equation. Moreover, the number of instruments must not exceed the number of groups, as this would weaken the Hansen tests. The p-value of

the Hansen test must be higher than 0.1 and lower than 0.25, and the AR(2) above 0.1. Roodman (2009) proposes three solutions in the case of instrument proliferation and weak tests: limiting the set of instruments to certain lags, collapsing the instrument set, and combining the two former solutions.

Following Roodman (2006, 2009), model (1) in column 3 instruments all endogenous variables (the lagged value of manufacturing, population, and the undervaluation index) with lags 2 and deeper for the transformed equation and lag 0 in differences for the levels equation. Because the number of instruments becomes too high, model (2) in column 4 reduces the number of instruments by collapsing them.5 In model (3) of column 5, we adopt another strategy suggested by Roodman (2009). We reduce the number of instruments by using only some lags instead of the full set of available lags. We take lags 2-5 of the lagged dependent variable for the first difference equation and lag 0 in differences for the levels equation. The other two endogenous variables (population and undervaluation) are instrumented by lag 2 for the transformed equation and lag 0 in differences for the levels equation. This is the maximum number of instruments that we can include without exceeding the number of countries.

At the end of the table, we report the number of observations, countries and instruments, the p-value of the test for autocorrelation of order 2 and the p-value of the Hansen test.

[5] This is done by using the option *collapse* in STATA.

Table 2.5. First robustness check: system GMM

	OLS			Fixed effects			GMM - Model 1			GMM - Model 2			GMM - model3		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.157	0.022	***	-0.381	0.039	***	-0.222	0.070	**	-0.159	0.104		-0.161	0.086	+
pop	0.304	0.093	**	3.680	1.330	**	1.164	0.612	+	2.097	1.432		1.273	0.387	**
underval	1.357	0.427	**	1.786	0.615	**	2.023	1.142	+	1.399	1.461		1.892	0.898	*
export	4.851	1.018	***	8.522	2.013	***	9.050	3.683	*	13.049	5.750	*	8.460	2.489	**
relus	-3.236	1.099	**	-0.365	2.625		-4.950	2.075	*	-8.849	5.594		-5.614	2.010	**
wages	0.017	0.228		0.387	0.336		0.504	0.492		1.021	0.741		0.665	0.340	+
edu	0.105	0.081		0.291	0.292		0.233	0.107	*	0.358	0.234		0.217	0.147	
inflation	-0.154	0.128		0.290	0.177		-0.049	0.186		0.116	0.208		-0.019	0.222	
tot	1.676	1.505		3.326	2.201		2.555	2.132		-0.351	2.610		1.078	2.435	
kgatemp	1.152	0.382	**				1.342	0.705	+	1.484	0.768	+	0.961	0.740	
obs.	435			435			435			435			435		
countries	74			74			74			74			74		
instruments							130			41			73		
AR(2)							0.408			0.355			0.393		
Hansen test							1.000			0.367			0.223		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Notes: All GMM estimations are two-step estimations with Windmeijer correction. Time dummies and constant are included in the model, but not reported.

Before discussing the results of the GMM estimations, we set the credible range for the coefficient of the lagged dependent variable (manL1). OLS and fixed effects estimations define the credible range for the coefficient of the lagged value of the manufacturing share between -0.157 and -0.381.

When we use all possible lags (column 3), the p-value of the Hansen test is 1.000. This is a telltale sign that the Hansen test is weak. The coefficient of lagged manufacturing share is highly significant as in all previous estimations and falls within the credible range. All previous results are largely robust, with the exception of RELUS and education that become significant. By collapsing instruments (model 2), the number of instruments drops from 130 to 41. The p-value of the Hansen test decreases considerably (from 1.000 to 0.367), but is still not in the range suggested by Roodman (2006). The coefficient of lagged manufacturing is in the credible but it is not significant. Only export shares, kgatemp, and the time dummies are significant. In model 3, the p-value of the Hansen test is 0.223 and the AR(2) above 0.1 (0.393), both within the ranges suggested by Roodman (2006). The lagged value of manufacturing is significant and falls within the credible range. As in previous estimations, the undervaluation index and the share of exports are significant and positive. The coefficients of relus and wages are also significant and the other results are largely confirmed.

We now check if mixed linear models would confirm or add on to our results. Mixed linear models permit random parameter variation to depend on observable variables; that is, allow explanatory variables to have a different effect for each country. Here we apply a random slopes model in which not only the intercept (as in a random effect model) but also the coefficients of some variables are allowed to change across countries. We estimate random slopes models allowing one single variable at a time to have a random coefficient.[6] In each estimation, we check the p-value of the LR test and retain only the model for which the LR test rejects the null hypothesis (the null hypothesis is that all the parameters are equal to zero, so that adding random slopes does not add information to the random intercept model). Table 2.6 reports estimations' results of these mixed effects models.

[6] We repeated this procedure for each single explanatory variable and we did not impose restrictions on the correlation of the random effects, i.e. we did not assume that they are uncorrelated.

Table 2.6. Second robustness check: mixed effects models

	Random intercept			Random coefficient: exp			Random coefficient: pop		
	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.178	0.023	***	-0.225	0.024	***	-0.196	0.024	***
population	0.356	0.103	***	0.452	0.105	***	0.451	0.115	***
undervaluation	1.453	0.435	***	1.566	0.429	***	1.498	0.443	***
relus	-3.233	1.169	**	-3.115	1.162	**	-3.058	1.168	**
wage	0.056	0.234		0.162	0.227		0.082	0.230	
export	5.348	1.093	***	6.995	1.700	***	5.967	1.082	***
edu	0.119	0.088		0.165	0.083	*	0.116	0.085	
inflation	-0.099	0.130		0.025	0.125		-0.086	0.131	
terms of trade	2.058	1.562		1.039	1.534		1.904	1.553	
kgatemp	1.273	0.424	**	1.422	0.398	***	1.204	0.415	**
D65-70	-0.084	0.574		-0.066	0.547		-0.066	0.570	
D70-75	-1.702	0.589	**	-1.784	0.560	**	-1.709	0.585	**
D75-80	-1.773	0.632	**	-2.068	0.604	***	-1.838	0.628	**
D80-85	-2.339	0.695	***	-2.826	0.670	***	-2.444	0.692	***
D85-90	-2.437	0.707	***	-2.951	0.680	***	-2.541	0.702	***
D90-95	-2.535	0.763	***	-3.171	0.733	***	-2.620	0.755	***
D95-00	-4.085	0.782	***	-4.680	0.750	***	-4.193	0.772	***
D00-05	-3.890	0.829	***	-4.605	0.799	***	-4.091	0.820	***
constant	0.838	1.911		-0.537	1.911		-0.038	1.944	
sd (constant)	0.563	0.238		1.285	0.438		3.843	1.310	***
sd (residual)	2.301	0.089	***	2.181	0.082	***	2.277	0.088	***
sd (variable)				7.991	1.988	***	0.362	0.126	**
obs.	435			435			435		
countries	74			74			74		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Results show that adding random slopes for all variables, except for export shares and the size of the population, does not add information. Lagged manufacturing shares, size of the domestic market, undervaluation and export shares are persistent determinants of industrialisation. According to these estimations, also income relative to the US (relus) is significantly related to industrialisation. Coefficients on

period dummies confirm that industrialising became more and more difficult over time.

As a final robustness check, we use the growth rate of the manufacturing share in GDP as dependent variable. Hausman tests suggest that the lagged share of manufacturing, population size, and the undervaluation index are endogenous (as in previous estimations). In Table 2.7, we report results of four estimations: fixed effects, random effects, between estimation, and Hausman and Taylor model estimations.

Table 2.7. Dependent variable: growth rate of the manufacturing share in GDP

	Fixed effects			Random effects			Between			Hausman and Taylor		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
manL1#	-0.023	0.003	***	-0.014	0.002	***	-0.004	0.003		-0.021	0.002	***
pop#	0.110	0.095		0.030	0.009	***	0.008	0.011		0.062	0.026	**
underval#	0.138	0.045	***	0.081	0.034	**	-0.005	0.055		0.136	0.041	***
export	0.406	0.144	***	0.310	0.089	***	0.188	0.140		0.418	0.121	***
relus	-0.062	0.206		-0.168	0.108		0.046	0.158		-0.169	0.147	
wage	0.078	0.024	***	0.026	0.018		-0.089	0.031	***	0.062	0.021	***
edu	0.042	0.021	*	0.003	0.007		-0.004	0.010		0.017	0.012	
democracy	-0.001	0.002		-0.001	0.001		-0.001	0.002		-0.001	0.002	
patents	0.024	0.168		0.032	0.099		0.095	0.149		-0.015	0.135	
inflation	0.029	0.013	**	0.008	0.010		0.011	0.019		0.022	0.011	**
tot	0.362	0.158	**	0.312	0.124	**	0.102	0.223		0.367	0.139	***
kgatemp				0.072	0.038	*	0.053	0.047		0.069	0.071	
D65-70	-0.023	0.042		0.018	0.042		0.103	0.323		-0.004	0.039	
D70-75	-0.200	0.049	***	-0.106	0.043	**	0.092	0.314		-0.154	0.042	***
D75-80	-0.312	0.063	***	-0.155	0.047	***	0.331	0.351		-0.235	0.049	***
D80-85	-0.423	0.079	***	-0.198	0.052	***	-0.188	0.417		-0.317	0.059	***
D85-90	-0.452	0.088	***	-0.196	0.054	***	0.112	0.394		-0.330	0.063	***
D90-95	-0.491	0.102	***	-0.205	0.058	***	0.092	0.237		-0.349	0.070	***
D95-00	-0.619	0.114	***	-0.295	0.060	***	0.367	0.239		-0.456	0.075	***
D00-05	-0.654	0.126	***	-0.295	0.064	***	0.032	0.210		-0.479	0.083	***
constant	-1.194	0.895		-0.065	0.154		0.588	0.329	*	-0.540	0.295	*
rho	0.584			0.136						0.611		
obs.	435			435			435			435		
countries	74			74			74			74		
R^2 within	0.331			0.303			0.000					
R^2 between	0.014			0.322			0.560					
R^2 overall	0.086			0.287			0.030					

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

In fixed and random effects and Hausman and Taylor estimations, previous findings are largely confirmed. In contrast with previous estimations, wages are highly

significant and positive in fixed effects and Hausman and Taylor estimations. The coefficient of education is positive and significant in fixed effect regressions. In the between estimation, only the coefficient of wages is significant and negative. This confirms estimations results in Table 2.2. As in previous estimations, time dummies are always significant and negative. Their coefficients confirm that industrialising is becoming more difficult over time. The Hausman test rejects (p= 0.0016) the null hypothesis of consistency of the random effects model and does not reject the null hypothesis (p= 0.9953) for the Hausman and Taylor model.

2.6 Conclusions

Since early theories in economic development, manufacturing has been considered an engine of economic growth and socio-economic development. In 1977, John Cornwall developed a model to explain the role of manufacturing in economic growth. This model is composed of two equations: the first explains manufacturing output growth; the second explains aggregate growth as a function of manufacturing output growth. This model was referred to as the model of the engine of growth hypothesis. Empirical studies estimated the reduced form of this model and confirmed that manufacturing is an engine of economic growth (Kaldor, 1967; UN, 1970; Cripps and Tarling, 1975; Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011).

This chapter goes back to the Cornwall (1977) model and estimates a revised version of the first equation of the model, i.e. the equation of manufacturing output growth. In this way, this study puts industrialisation at the centre of the analysis and shows which variables instrument for manufacturing output growth in reduced form estimations of the engine of growth hypothesis. Understanding what are the drivers of industrialisation, and so why some countries industrialised and others did not, is important for the historic account of industrialisation, but also for policy discussions on catch up and industrialisation.

Following recent empirical estimations of the engine of growth hypothesis (Fagerberg and Verspagen, 1999; Szirmai and Verspagen, 2011), our econometric model includes demand and supply side factors. Sizes of the domestic market and export shares in GDP account for demand-side factors. Labour costs, education levels, and measures of innovation such as patents and R&D expenditures capture supply-side factors. We also include indicators of institutions and macroeconomic factors. We use a panel dataset that covers 74 developed and developing countries

from 1960 to 2005. We deal with the issue of endogeneity by estimating Hausman and Taylor models. Results are robust to alternative model specifications (system GMM and mixed effects models).

Results show that faster industrialisation occurs in countries with relatively underdeveloped manufacturing industries, large domestic markets, strong export performance, and undervalued exchange rates. Undervalued exchange rates significantly contributed to manufacturing expansion, especially from the 1990s. This is in line with the abundant literature on export promotion (especially in East Asia), and with the empirical evidence and development theories on the role of the exchange rate (e.g. Rodrik 2008; Bresser-Pereira, 2008, 2012). Price-related variables are only partly related to industrialisation: while exchange rate management matters for industrialisation, labour costs do not. Labour costs are in most of the regressions positively and not significantly related to industrialisation. By contrast, innovation-related variables matter for industrialisation.

When we look at how the impact of the determinants changed over time, results show that R&D expenditures and the measure of technological level developed by Fagerberg (1988) are significant determinants of industrialisation only from the 1990s. Fagerberg and Verspagen (1999) investigated the role of manufacturing as an engine of growth in the 1970s and 1980s and found a positive but not significant coefficient of R&D expenditures. We interpret our results as further evidence that industrialisation increasingly requires skills and technological capabilities.

Taken together, results on price-related variables and innovation-related variables at least partly confirm the Schumpeterian-evolutionary idea that competitiveness is based more on knowledge than prices, especially in recent decades (Fagerberg, 1988, 1996; Fagerberg et al., 2007) and that catch up became more demanding over time, insofar as it requires more knowledge and skills (Fagerberg and Verspagen, 1999, 2002, 2007).

The literature emphasised the role of institutions in economic growth and industrialisation. Several definitions of institutions exist. Among these, Fagerberg and Schrolec (2008) distinguish between indicators of political systems (e.g. measures of democracy and rights) and indicators of *quality of governance*, such as ease of starting and conducting a business. Results of their empirical analysis show that good governance matters for growth, while political systems matter only for richer countries. In order to preserve our panel, we chose to rely on indicators of political sys-

tems. Our findings show that democracy is not significantly, and sometimes negatively, associated with manufacturing output growth. This suggests that democratisation is not a necessary pre-condition for industrialisation.

In contrast with political system indicators, indicators of macroeconomic policies are significantly associated with industrialisation. Together with the findings on exchange rate policies, the chapter shows that inflation is positively and significantly related to industrialisation.

Appendix A

Table A.1. Definitions and sources of variables used in the study

Variable	Definition	Source
Industrialisation	First difference of share of manufacturing in GDP	Szirmai and Verspagen (2011)
Income relative to US (RELUS)	GDP per capita as a percentage of US GDP, first year of the period	Szirmai and Verspagen (2011)
Size of the market (POP)	Logarithm of the population, first year of the period	Szirmai and Verspagen (2011)
Wages (WAGE)	Logarithm of total wages and salaries (at current prices) in manufacturing divided by number of persons engaged and number of employees, first year of the period	UNIDO INDSTAT2 2011 ISIC Rev.3
Merchandise exports (EXP)	Merchandise exports (current dollars) as percentage of GDP	Lavopa and Szirmai (2012)
Undervaluation index (UNDERVAL)	Real exchange rate adjusted for the Balassa-Samuelson effect, 5-year averages	PWT 7.0
Terms of trade (TOT)	Logarithm of terms of trade (2005 constant prices), 5-year averages	PWT 7.0
Inflation (INFL)	Logarithm of inflation rate, 5-year averages	WDI and IMF WEO[7]
Human capital (EDU)	Average years of schooling for the population above 15 years of age, first year of the period	Szirmai and Verspagen (2011)
Institutions (DEM)	Vanhanen index, first year of the period	Quality of Government Dataset
Geography (KGATEMP)	Percentage of land in a temperate climatic zone, transformed in a binary variable	Szirmai and Verspagen (2011)
Patents per capita	Number of patents per capita at USPTO (PATPC), first year of the period (normalized)	USPTO
	Number of patent per capita at national offices granted to residents (NATPATPC), first year of the period (normalized)	WIPO[8]
R&D expenditures (R&D)	R&D expenditures as a percentage of GDP, first year of the period (normalized)	CANA database (Castellacci and Natera, 2011) [9]

[7] For Chile and the UK, gaps were filled with data from Banco Centrale de Chile and Office of National Statistics respectively.
[8] WIPO data start in 1965 and do not include some countries such as Taiwan.
[9] Data for Korea come from Lim (1995), table 5; OECD. For Taiwan: Smith (2000), table 2.12; National Science Council (2003).

Table A.2. Country and period coverage

Country	Period	Country	Period
Argentina	1980-2005	Jordan	1970-2005
Australia	1960-1995	Kenya	1965-2005
Austria	1960-2005	Korea	1965-2005
Bangladesh	1980-2000	Luxembourg	2000-2005
Belgium	1960-2005	Malawi	1970-2005
Belize	1990-1995	Malaysia	1965-2005
Bolivia	1970-2005	Malta	1970-1995
Botswana	1980-2005	Mauritius	1980-2005
Brazil	1990-2005	Mexico	1980-2005
Cambodia	1995-2005	Morocco	1975-2005
Canada	1960-2005	Netherlands	1960-2005
Chile	1960-2005	Norway	1960-2005
China	1975-1990; 2000-2005	Panama	1960-1970; 1985-2005
Colombia	1960-2005	Paraguay	2000-2005
Costa Rica	1960-1970; 1980-2005	Peru	1980-2005
Cote d'Ivoire	1965-1985; 1990-2000	Philippines	1960-2005
Cyprus	1980-2000	Portugal	1995-2005
Denmark	1960-2005	South Africa	1960-2005
Dominican Republic	1960-1990	Spain	1960-1970
Ecuador	1960-2005	Sri Lanka	1965-1970; 1980-2005
Egypt	1980-2005	Sudan	1970-1975; 2000-2005
El Salvador	1965-2000	Sweden	1960-1995
Eritrea	1995-2005	Syrian Arab Republic	1965-1970; 2000-2005
Ethiopia	2000-2005	Taiwan	1970-2000
Finland	1960-2005	Tanzania	1965-1970; 1995-2005
France	1975-2005	Thailand	1965-2005
Germany	1970-2005	Trinidad and Tobago	1965-1970; 1990-2005
Ghana	1965-2005	Tunisia	1970-1985; 1995-2005
Guatemala	1965-2000	Turkey	1960-2005
Honduras	1960-2000	Uganda	1970-1975; 1980-2005
India	1960-2005	United Kingdom	1960-2005
Indonesia	1970-2005	Uruguay	1965-1970; 1985-2005
Ireland	1960-1980	USA	1960-2005
Israel	1960-2005	Venezuela	1960-2000
Italy	1965-2005	Vietnam	1995-2005
Jamaica	1965-1970; 1995-2005	Zambia	1990-1995
Japan	1960-2005		

Table A.3. Hausman and Taylor model with alternative indicators of institutions

	Polity - Democracy			Polity - Constraint			Henisz index		
	coef	se	sig	coef	se	sig	coef	se	sig
manL1	-0.334	0.034	***	-0.333	0.033	***	-0.340	0.033	***
lnpop	1.467	0.587	*	1.386	0.543	*	1.202	0.547	*
underval	1.893	0.574	***	1.761	0.562	**	1.987	0.567	***
relus	-1.846	2.322		-1.886	2.248		-2.489	2.252	
wage	0.332	0.317		0.277	0.302		0.269	0.305	
export	8.153	1.799	***	7.991	1.771	***	7.904	1.802	***
edu	0.365	0.211	+	0.350	0.200	+	0.359	0.212	+
patents	-2.085	7.445		-2.263	7.331		-0.169	7.489	
inflation	0.238	0.169		0.227	0.160		0.266	0.161	+
tot	3.594	2.110	+	3.172	2.049		3.578	2.080	+
democracy	-0.029	0.064		0.012	0.009		0.343	0.890	
kgatemp	0.895	1.579		0.766	1.412		1.450	1.547	
D65-70	-0.341	0.541		-0.382	0.525		-0.394	0.534	
D70-75	-2.647	0.606	***	-2.575	0.591	***	-2.596	0.601	***
D75-80	-3.466	0.740	***	-3.355	0.715	***	-3.178	0.728	***
D80-85	-4.296	0.911	***	-4.220	0.879	***	-4.169	0.894	***
D85-90	-4.636	0.991	***	-4.430	0.954	***	-4.514	0.972	***
D90-95	-4.761	1.119	***	-4.607	1.076	***	-4.663	1.098	***
D95-00	-6.493	1.224	***	-6.330	1.172	***	-6.303	1.201	***
D00-05	-6.651	1.369	***	-6.460	1.303	***	-6.495	1.334	***
constant	-10.245	6.000	+	-9.158	5.587		-7.351	5.568	
rho	0.845			0.804			0.848		
obs.	420			429			435		
countries	71			71			74		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: In columns 1 and 2, indicators come from the Polity IV dataset (Marshall and Jaggers, 2002) and are the democracy index and the measure of constraint on the executive, one of the components of the democracy index. In the third column, we use the index of political credibility by Henisz (2000, 2002). It measures the feasibility of policy change, i.e. the extent to which a change in the preferences of any one political actor may lead to a change in government policy. It goes from 0 to 1, with higher scores associated with less feasibility of policy change. As in previous estimations, the exogeneity of these variables is checked by means of Hausman tests. The Polity measure of political constraint is the only endogenous variable.

Table A.4. Hausman and Taylor estimations with alternative endogenous variables

	Hausman and Taylor - Model 1			Hausman and Taylor - Model 2		
	coef	se	sig	coef	se	sig
manL1	-0.349	0.033	***	-0.344	0.033	***
pop	1.493	0.599	*	1.044	0.427	*
underval	1.925	0.570	***	1.993	0.558	***
export	8.170	1.806	***	7.950	1.828	***
wage	0.343	0.306		0.321	0.308	
edu	0.354	0.220		0.351	0.244	
democracy	-0.019	0.024		-0.020	0.024	
patents	-1.456	2.062		-1.332	2.136	
relus	-1.317	2.387		-1.412	2.453	
inflation	0.287	0.162	+	0.295	0.162	+
tot	3.221	2.004		3.168	2.000	
kgatemp	1.602	1.740		1.744	1.745	
D65-70	-0.328	0.539		-0.281	0.538	
D70-75	-2.586	0.604	***	-2.509	0.605	***
D75-80	-3.269	0.733	***	-3.110	0.729	***
D80-85	-4.312	0.905	***	-4.100	0.903	***
D85-90	-4.557	0.992	***	-4.320	1.002	***
D90-95	-4.671	1.127	***	-4.393	1.144	***
D95-00	-6.303	1.238	***	-5.964	1.256	***
D00-05	-6.475	1.365	***	-6.097	1.386	***
constant	-10.509	5.987	+	-6.401	4.553	
rho	0.881			0.881		
obs.	435			435		
countries	74			74		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Column 1 refers to the base Hausman and Taylor model (last column of Table 2.2). In Column 2, manL1, exports, wage, education, democracy, and patents are treated as endogenous variables.

Chapter 3

Towards a Quantification of Industrial Policy in East Asia and Latin America

3.1 Introduction

"There exists probably no greater challenge in the area of economic development than that of explaining how eight East Asian economies *(...)* managed to increase their per capita incomes *(...)* considerably faster than any other developing region. Despite a large body of research, there is little consensus on the role that public policies have played in this performance. *(...)* Even the facts -how much intervention has there really been?- have been in dispute" (Rodrik, 1994a, p. 13).

Twenty years of debate passed since Rodrik's observation and the central dispute is neither solved, nor has compelling empirical evidence been systematically gathered. The literature is polarised around two conflicting interpretations of why in spite of lower initial GDP levels and relatively underdeveloped manufacturing industries, East Asian countries industrialised and overcame Latin American countries. According to the neoclassical interpretation, the so-called East Asian miracle was the result of limited state intervention, market-friendly policies, and a focus on export expansion. By contrast, Latin American selective industrial policies maintained inefficient industries and diffused rent-seeking behaviours. According to industrial strategists, industrial policies did play a crucial role also in East Asia by deliberately "getting prices wrong". Hence, industrial policy *per se* cannot explain the divergence between the industrial performances of the two regions.[10]

Today, more and more authors have expressed the need to overcome what has become an unfruitful discussion and have advocated for a more pragmatic view of industrial policy (Wade, 2006; Chang, 2009; Naudé and Szirmai, 2013; Weiss, 2013). This paper contributes to this literature by setting the ground for a quantification of industrial policy in five of the most studied country cases, namely Argentina, Brazil, Mexico, Korea, and Taiwan.

The remainder of the chapter is organised as follows. The next section reviews the debate on industrial policy by discussing the main dichotomies that permeated the historical-comparative literature on East Asia and Latin America. In Section 3.3, we review the main instruments of industrial policy used by Argentina, Brazil, Mexico, Korea, and Taiwan. Based on this review, Section 3.4 builds a detailed

[10] Even more, revisionists, or industrial strategists, also argued that, not only East Asian countries used industrial policies, but also industrialised countries did so, by protecting their domestic markets (Chang, 2002) and by spurring technological development of industries like the ICTs and aerospace via public procurements (Mazzucato, 2013).

taxonomy of industrial policy instruments. Section 3.5 discusses the indicators of industrial policy instruments used in the literature. Section 3.6 briefly concludes.

3.2 An overview of the industrial policy debate

In this thesis, industrial policy is intended as all measures used to alter the allocation of resources in favour of the manufacturing industry. Weiss (2013) distinguishes three dimensions of industrial policy that are sometimes confused in the literature: overall vision or strategic direction, policy instruments, and process of industrial policy-making. This chapter concentrates on the second and touches upon the third dimension.

3.2.1 Functional and selective industrial policies

The most common dichotomy in the industrial policy debate is of functional (horizontal) and selective (vertical) policies. Functional industrial policies equally affect all industries of the economy by improving the functioning of existing factor markets without discriminating among industries. Selective industrial policies deliberately target particular industries or firms and favour them over the others. Selection is based on the strategic value of the industry: in advanced countries, strategic industries or strategic technologies are generally those with a national economic or political interest; in industrialising countries, those that facilitate catching up. Examples of functional industrial policies are investments in infrastructures and education, or R&D tax incentives (when available to all industries and firms). Examples of selective policies are tariffs and import quotas, subsidies and directed credits.

The concepts of functional and selective industrial policies are central to the explanation of the East Asian industrialisation process. Neoclassical economists interpreted the success of East Asia *vis a vis* Latin America as the result of functional industrial policies that maintained macroeconomic stability, guaranteed free trade, and improved the business environment, without distorting market functioning mechanisms. Following this interpretation, East Asia became the paradigm of the success of market-friendly policies and export promotion strategies. In this literature, an active role of the state is generally not acknowledged (Wolf, 1988; Edwards, 1988; Krueger, 1997) and those that acknowledged the use of selective industrial policies judged them growth-reducing (e.g. Kim, 1990; Yoo, 1990; Park and Kwon, 1995; Kwon and Paik, 1995; Pack and Lin, 2001).

Latin American industrial policies, instead, were criticised for being too selective and distortive. By distorting market prices, these policies maintained inefficient industries and introduced biases against exports (e.g. Little et al., 1970; World Bank, 1979; Edwards, 1993; Balassa, 1990). Selective industrial policies require considerable ability and knowledge on the part of the state. Moreover, uncertainty about where and how to intervene and which results to expect reduce the attractiveness of selective industrial policies (Pack and Westphal, 1986). Consequently, the lesson for governments of industrialising countries is to refrain from intervention because government failures generally outweigh market failures (Krueger, 1990).

According to industrial strategists (Amsden, 1989; Wade 1990; Chang, 2002), East Asian governments actively intervened in markets' functioning by protecting selected domestic industries and promoting specific industries (and firms) via directed credits, selective export incentives, and incentives to production and capabilities' accumulation.[11]

In an effort to reconcile these two views, in 1993 the World Bank released a detailed report, "The East Asian miracle: Economic growth and public policy", where it acknowledged, but downsized, the degree of intervention of East Asian governments (Fishlow et al., 1994). Notwithstanding the programmatic intentions, the World Bank's conclusions are still consistent with the neoclassical view. The World Bank recommends to "do less in those areas where markets work", i.e. in the production sector, where they suggest privatisations as a means to spur competition, and "do more in those areas where markets cannot be relied upon", i.e. human capital formation, health, nutrition, social, physical, and legal infrastructures (*ibid.*, p.9).

The dichotomy between functional and selective industrial policies still permeates the literature on industrial policy. Peres and Primi (2009) classified industrial policies according to two dimensions: policy-making capacity, which depends on institutional capacity for design, implementation, and assessment of policies, and the number and scope of instruments used to implement a policy. Functional policies

[11] Despite supporting selectivity, industrial strategists recognise the challenges of implementing selective industrial policies. The success of these interventions critically depends upon the detailed forms that these policies take and the willingness and ability to fully enforce them. Especially in the case of technological sectors, the provision of an 'entrepreneurial vision' that provides guideline for private business's investment requires 'intermediary institutions' to link the state with the business world (Chang, 2002).

necessitate lower degrees of state capacity and fewer policy instruments, while selective policies require greater state capacity and a mix of policy instruments. Peres and Primi identify greater institutional capacity -evident in the strong discipline exercised over the private sector- as one of the key determinants of the success of East Asian public policies.

Rodrik and Subramanian (2005) and Weiss (2013) used different terminologies that resemble, but do not perfectly correspond to the traditional dichotomy of functional and selective industrial policies. Rodrik and Subramanian (2005) distinguish between *pro-market* policies, aiming at removing impediments to markets and stimulating entry of new firms, and *pro-business* policies, that raise profitability of existing firms. Similarly, Weiss (2013) distinguish between *market-based policies*, that intend to correct for market failures and affect existing businesses, and *promotional policies*, that promote or create new (potentially successful) businesses.

Despite its prominence in theoretical debates, the distinction between functional and selective industrial policy loses sharpness in policy practice. Even the most horizontal policies have differential impacts because they affect markets for factors of production and benefit the industries that are more intensive in those factors (Rodrik, 2007; Peres and Primi, 2009; Weiss, 2013). Moreover, a certain level of selectivity, for example in the form of prioritisation, is always present in policy-making (Lall and Teubal, 1998; Weiss, 2013).

3.2.2 The debate on picking winners

Some scholars referred to selective industrial policies as policies for *picking winners* (e.g. Noland and Pack, 2002; Pack and Saggi, 2006; Easterly et al., 2009). The expression picking winners refers to the process by which governments choose which industries and/or firms to support. When governments pick winners, public investments and financing by public development banks are preferentially directed towards the targeted industries or firms. Whether picking winners is a synonym of selective industrial policy is very much debated.

Another strand of this literature describes picking winners as the *negative* subdomain of selective industrial policy, indicating the process of arbitrarily choosing firms or industries, without a rigorous process of definition and application of suitable selection criteria. Following this argumentation, the absence of suitable selection criteria increases the chances of rent seeking behaviours, corruption, and waste of public money (Aghion et al., 2011). According to Ocampo (2011), be-

cause governments learn how to implement industrial targeting, it is unfair to categorize all industrial policies as picking winners. Justin Lin and Celestin Monga (Lin and Monga, 2010; Lin, 2011) argued that when policies that pick winners are too ambitious and do not account for country's comparative advantage, they are doomed to pick losers, instead of winners.

Others (e.g. Amsden, 2001; Cimoli et al., 2009; Stiglitz, 1996; Wade, 1990, 2010, 2012) argue that the concept of picking winner is based on the presumption that there are several competitors in the market and the government selects one of them. However, this is often not the case because, more than picking winners, governments *create winners*. This has been the case in East Asia, where governments played an entrepreneurial role by finding and sizing market opportunities (Stiglitz, 1996). Wade (2010) distinguishes two types of industrial policies: *leading the market policies*, through which governments undertake investments that private entrepreneurs would not undertake (e.g. the establishment of POSCO in Korea) and *following the market policies*, which support some of the investments that private actors would probably undertake anyways (e.g. fiscal incentive schemes). According to Wade, the latter is the furthest away from the concept of picking winners. Hence, in this view, picking winners would refer to the most radical forms of industrial policy.

To summarise, in the literature there are three views about picking winners. According to the first, picking winners is equal to selective industrial policy and both are to avoid because good selectivity is impossible. According to the second, picking winners refers only to misguided selective industrial policies, while selective industrial policy can be growth-enhancing if selection criteria for industrial targeting are suitably chosen. According to the third, picking winners is a way for the state to lead markets towards more risky investments. Hence, picking winners is not to be labelled as negative *per se*.

3.2.3 Selection criteria for industrial targeting

The discussion above shows how important selection criteria are for industrial targeting. The debate on selection criteria has gravitated around three main concepts: economies of scale and linkages; learning and technical change; and conformity to comparative advantage.

According to the balanced growth theory (Rosenstein Rodan, 1943; Nurkse, 1953), modernisation and its production techniques require large investments (a *big push*)

in mutually supporting industries. These investments are needed to build a critical market and benefit from economies of scale and complementarities between industries. In contrast with the balanced growth theory, the unbalanced growth theory (Hirschman, 1958) advocates for limited investments that prioritise industries with the strongest backward and forward linkages with the rest of the economy.[12]

In early development economics, learning opportunities were considered an important criterion for industrial targeting. According to the infant industry protection argument (Hamilton, 1791; List, 1841; Mill, 1848; Bastable, 1921), newly established domestic industries face higher costs than internationally established industries because of imperfections of the local capital market and limited dynamic economies of scale. Temporary protection (by means of tariffs) allows firms to acquire the competences to compete internationally.

Owing to the continuous nature of technical change, the infant industry protection argument can be extended to justify support to any industry. Innovation activities are characterised by high costs and high risks, translating in under-investments in R&D and financial losses especially for new entrants (Soete, 2007). Pack and Westphal (1986) distinguish between intensive and extensive technological change. The former is featured by prevalently incremental technological change, while the latter produces new capabilities. Based on the experience of Korea and other East Asian countries, the authors suggest a dual industrial strategy that selectively targets few areas of extensive technological changes and leaves markets forces to use existing capabilities in areas of intensive technological change. In line with this idea of tailoring policies to industry characteristics, Lee and Lim (2001) analysed how policies change according to the technological regime of the targeted industry, i.e. according to the degree of predictability, frequency, and cumulativeness of technical change.

The most fundamental question in the debate on industrial policy is whether industrial policy should comply or defeat countries' comparative advantages. As discussed in Chapter 2, Latin American structuralists advocate for selective industrial policies that can redirect structural change away from specialisation in comparative advantage compliant industries. This would hurt economic growth by locking de-

[12] Backward and forward linkages are intended as inter-industry linkages in production. The former is the inducement by any non-primary economic activity to seek its own input through domestic production. The latter is the inducement by any activity that does not cater exclusively final demand to offer its output as input for new economic activities.

veloping countries in industries characterised by price disadvantages (Prebisch, 1950). Defiance of the comparative advantage is also at the base of the infant industry protection argument.

Lin and Chang (2009) dispute whether *comparative-advantage-following* or *comparative-advantage-defying* industrial policies are more effective. According to Lin, governments should initially focus on labour and resource-intensive industries and, only once they have accumulated physical and human capital, they should aim at upgrading their industrial structures. According to Chang, by following comparative advantage, policies neglect that factor mobility is limited -that is, the physical capital accumulated in the textile industry cannot be utilized in the automobile industry- and that firms need to acquire industry-specific technological capabilities to operate in an industry.

In this debate, several authors took an intermediate position. Hausmann and Rodrik (2003) interpret structural change as a process of self-discovery in which innovative firms help to discover where a country has a competitive edge. Policies should then aim at supporting these firms, because they bear more risks and costs than their followers do. Lin and Monga (2011) advise to identify latent comparative advantages by comparing industrial structures of similar countries at different stages of development. Among these industries, those where some domestic firms have already entered the market should be favoured. If domestic firms are not present, governments can attract FDI from world industry leaders by leveraging on lower labour costs or by creating export processing zones and industrial parks, or by offering temporary financial and fiscal incentives.

3.2.4 Industrial policy domains: trade, investment, and science, technology and innovation

Industrial policy can be classified according to their domain of intervention into trade, investment, science, technology and innovation policies.

Trade policy

Trade policies are a central component of any development strategy. The debate on trade policy focused on the merits and demerits of inward-oriented and outward-oriented strategies. Inward-oriented strategies, also referred to as import-substitution industrialisation strategies (ISI), are characterised by policies that encourage production for the domestic market and protect indigenous firms against

foreign competition. Outward strategies are of two sorts: export promotion and trade liberalisation. Export promotion is defined as the trade regime that entails positive but equal incentives to production for export and substitution of imports. Trade liberalisation gives negligible incentives to import substituting or exporting activities, so it is considered a neutral strategy. Import substitution and export promotion share the same ultimate objectives: avoiding balance of payment constraints, achieving economies of scale, and providing firms with learning opportunities. By focusing on external markets, export promotion represents a more viable option for small countries and has the extra-benefit of exposing domestic firms to foreign (higher-standard) markets and world technologies.

Since the 1970s, neoclassical economists produced a series of studies showing a positive relationship between outward orientation and economic growth (among the most influential, Little et al., 1970; Bhagwati, 1978; Krueger, 1978; Balassa, 1982). These studies almost exclusively explained the East Asian success by well-designed and well-managed trade strategies, built on the theory of comparative advantage. These created "virtually free" trade regimes that offered equal incentives to all exporters. The East Asian trade strategy was presented as one that simultaneously achieved export promotion and import liberalisation (e.g. Balassa, 1971, 1990; Corbo et al., 1985; Hong and Krueger, 1975; World Bank, 1987; Krueger, 1997; Edwards, 1992).

In this literature, Latin American trade policies were strictly associated with import substitution. Import substitution was blamed for introducing biases against exports, maintaining unproductive industries, and directing countries towards a pattern of specialisation inconsistent with comparative advantage. Latin American countries were also criticised for not abandoning ISI when opportunities for substitution exhausted (e.g. Balassa, 1979, 1983, 1990; Krueger, 1990). Studies in this strand of literature acknowledged that East Asian countries started their industrialisation race with ISI, but argued that domestic market protection was growth-reducing (e.g. Lee, 1996).[13]

This interpretation of East Asian and Latin American trade policies fortified the conviction that outward orientation is the universal key to industrial success. The Washington Consensus emerged in this context and redirected the Latin American

[13] For a review of the literature on the impact of industrial policies, especially trade and investment policies, in Korea and Taiwan, see Noland and Pack (2003).

policy agendas towards trade liberalisation. This interpretation, however, has been fiercely contested.

In the theory of infant industry protection and the Singer-Prebisch hypothesis (Singer, 1950; Prebisch, 1950), import substitution is compatible with export promotion (e.g. Amsden, 2001; Ho, 2012).[14] Indeed, the opposition between ISI and export promotion is spurious insomuch as it was Prebisch himself who encouraged governments to combine import substitution with export promotion (Prebisch, 1950, 1963, 1987).

On an empirical ground, various studies showed that the East Asian degrees of trade protection were higher than accounted for by neoclassical economists (e.g. Wade, 1990; Luedde-Neurath, 1986). Shin and Lee (2012) also proved that these measures were indeed growth-enhancing. When East Asian countries opened their economy to foreign goods, their liberalisation processes did not reach the level of trade liberalisation of Latin American countries, and trade liberalisation was achieved very gradually as compared to Latin America (Rodrik, 1995). Moreover, it was argued that trade liberalisation was not an important step towards the implementation of export promotion (Westphal, 1990). Some scholars even objected that East Asian export promotion instruments were selective (e.g. Westphal, 1990; Wade, 1990). The rigorousness of the empirical evidence on the role of export promotion for economic growth and structural change was also questioned: while it is undisputed that export promotion was accompanied by structural change, it was noted that evidence on the mechanisms through which export push spurred growth was not compelling enough (e.g. Rodrik, 1994a and b; Rodriguez and Rodrik, 2000).[15]

Finally, it was argued that successful firms could also emerge out of protectionism -e.g. Embraer in Brazil or POSCO in Korea (Rodrik, 2007; di Maio, 2009). Firm-

[14] According to the Singer-Prebisch hypothesis, developing countries' terms of trade would decline if their structural change makes them specialise in primary commodities and resource-intensive industries, goods for which developing countries have comparative advantages. This is why developing countries must encourage domestic production of nondurable consumer and intermediate goods.

[15] Rodrik (1994a) argues that cross-country regressions on growth and TFP say nothing about the causal mechanism behind the relationship between exports and technological spillovers, and that in cross-country regressions on trade openness and growth, inappropriate indicators on trade openness are used. In another contribution, Rodrik (1994b) also shows that in Korea and Taiwan export spurts were not associated with increases in the relative profitability of exports and concludes that the export boom was not due to the removal of bias against manufacturing exports (as orthodox economists argued), but rather with investment boom.

level studies documented the engineering efforts and the learning dynamics spurred by ISI in Latin America (Katz, 1976, 1987). Historical studies showed that protection of domestic industries was (and in some cases still is) widely practiced by developing and developed countries alike (Wade, 1990; Chang, 2002, 2009; di Maio, 2009).

To conclude, in the neoclassical literature export promotion is often used as a synonym for free trade. This confusion seems to be associated with the understanding of the East Asian trade regime as one where export promotion was non-discriminatory and simultaneous with trade liberalisation. Hence, the orthodox argument in favour of free trade heavily relies on the empirical question of whether domestic market protection was low and export promotion was not selective. This, however, is what industrial strategists contested. According to their studies, in East Asia, domestic market protection was high until the 1990s and export promotion strategies benefited few strategic industries. This shows that getting empirics right is essential to solve the dispute on the role of trade policies in East Asia and Latin America.

Investment policy

Investment policies are policies aimed at spurring firms' investments. These policies can be formulated in a functional or selective way. Functional investment policies include fiscal incentives and policies to support SMEs (if available to all industries). Selective investment policies range from direct government production via state-owned enterprises (SOEs) to incentives to private production in strategic industries (via subsidies, grants, discretionary and preferential credits, public procurement, tax exemptions and other fiscal incentives). Among these instruments, some have attracted particular attention.

A lively debate emerged on the role of preferential credits and subsidies. Neoclassical economists tended to deny, or downsize, the role of credits, subsidies, and other selective investment policies in East Asia. When the use of selective credits and subsidies is recognised, their impact is estimated to be growth-reducing (e.g. Kim, 1990).[16] For example, according to the World Bank (1993), "the implicit subsidy of directed-credit programs in the HPAEs was generally small, especially in

[16] Refer to Noland and Pack (2003) for a review on the effects of these policies on growth and industrialisation.

comparison to other developing economies" (*ibid.*, p. 20).[17] Latin American countries, instead, were blamed for their excessive and discretionary subsidies (e.g. Balassa, 1979, 1983).

According to industrial strategists, instead, subsidies were crucial in both East Asia and Latin America: "the subsidy serves as a symbol of late industrialisation, not just in Korea and Taiwan but also in Japan, the Latin American countries, and so on. *(…)* The allocation of subsidies has rendered the government not merely a banker *(…)*, but an entrepreneur, using the subsidy to decide what, when, and how much to produce" (Amsden, 2001, p. 143-144). In all countries but Argentina, development banks were the state's agent for financing industrial investments.

The role of SOEs is also very much debated. The literature brought plenty of anecdotal evidence pro and against SOEs. On the one hand, sceptics argued that the societal costs of maintaining SOEs (and repairing their financial deficits) are not compensated by their contribution to investments and economic growth (Galal et al., 1994; Megginson et al., 1994; World Bank, 1995; Shirley, 1999). On the other hand, cases such as the Korean POSCO showed that there is nothing about SOEs *per se* that makes them inefficient (and so nothing about picking winners that makes it unfeasible). In the international arena, the first view dominated and SOEs' reforms and privatisations were implemented in several countries.[18]

Since the 1990s, SMEs were recognised as significant contributors to economic and export growth, employment, regional development, and innovation. Because of their limited financial resources and their obstacles to access capital markets, even successful SMEs face extraordinary difficulties to grow. For these reasons, SMEs became a target of industrial policy: development banks created dedicated credit lines and governments offered various fiscal incentives to spur SMEs' investments. Some of these programs were tailored to innovative SMEs or SMEs in strategic high-tech industries. For example, because in Taiwan most industrial firms are SMEs, they became an early target of Taiwanese industrial policy (Hou and Gee, 1992; Lall, 2004; Mathews and Hu, 2007). In Latin American countries, SMEs policies were the main component of *competitiveness policies*, i.e. the set of functional policies implemented as part of the political reforms of the 1990s (Melo,

[17] The acronym HPAEs refers to High-performing Asian economies.
[18] For a review of the literature on state ownership, see Shirley (1999).

2001). At that time, the emphasis on SMEs was seen as a discontinuity with ISI that had favoured large enterprises (Peres and Stumpo, 2000).

Science, technology, and innovation policy

Science, technology, and innovation (STI) policies permeated the debate on East Asia and Latin America (e.g. Dodgson, 2000; Lee, 2000; Katz, 2000a; Lall, 2004; di Maio, 2009).[19] It is now widely accepted that technological change was a key driver of industrialisation in the East Asian countries. Since the 1960s, STI policies have spurred technological change in Korea and Taiwan (e.g. Lee, 1997; Dodgson, 2000; Lall, 2000). In Latin America, evaluations of STI policies reached ambiguous conclusions. STI policies and institutions were in place already in the 1960s and 1970s and observers of the processes of technical change in Latin America positively evaluated the learning dynamics created by the ISI regime (e.g. Katz, 1976; 1987; Katz and Kosacoff, 1998; Suzigan and Furtado, 2006). Nevertheless, the industrial apparatus originated from ISI did not become an engine of innovation and economic growth, because of their excessive reliance on FDI, weak knowledge transfer mechanisms between the public and private sector, lack of discipline, and excessive trade protection (Di Maio, 2009; Katz, 2000a).

In the literature on national innovation systems (NIS), the Korean and Taiwanese systems are described as systems where at first research institutes were the sole actors in charge of research and innovation. In a later stage, these research institutes spun off high-tech new enterprises that became international market leaders. In this way, these NIS evolved into fairly integrated systems where national firms became vital components of the NIS (Lall, 2000; Kim, 1992; Hou and Gee, 1992). Latin American NIS, instead, gravitated around public universities. Low R&D investments in the private sector and weak linkages between public research agencies and private firms further weakened Latin America innovation systems (Dalhman and Frischtak, 1992; Katz and Bercovich, 1992).

Successful adoption of foreign technologies proved to be an essential ingredient of catch up in East Asia (e.g. Pack, 2001; Hobday, 1995; Kim, 1997; Lall and Teubal, 1998; Lee and Lim, 2001). Foreign knowledge and technologies can be transferred

[19] Science policies are policies aimed at creating a knowledge base (e.g. support to universities and research centres). Technology policies address generic technologies, like ICTs, and facilitate development of technological capabilities. Innovation policies relate to the microeconomics of innovation, i.e. production of new products and services by firms (Lundvall and Borras, 2005).

through several mechanisms: FDI, licensing, consultancy, technical agreements, and turnkey plant and project contracts, as well as trade in capital goods, joint ventures, subcontracting, exports, labour mobility, and technical developmental assistance (Rosenberg and Frischtak, 1985). Among these, the most debated is FDI.

FDI can generate employment and stimulate structural change. If foreign investments are concentrated in industries or activities with low learning opportunities, or if incentives and duties of knowledge transfer are limited, FDI might be detrimental to industrialisation. Foreign firms might simply take advantage of incentives provided by the host country to exploit local low-cost low-skilled labour or natural resources. With respect to the channels of acquisition of foreign technologies, East Asia favoured licensing, joint ventures, and trade in capital goods. Latin American countries relied more on FDI. These strategies ultimately affected the patterns of structural and technological change and firms' learning dynamics in the two regions (Rosenberg and Frischtak, 1985; Amsden, 2001; Chan, 2000).

Since the mid-1980s, scholars and policy-makers have acknowledged the advantages of cooperation and networking for knowledge creation. Especially in East Asia, governments promoted collaborative research projects (Shakibara and Cho, 2002; Mathews, 2002), clusters and science parks (e.g. Melo, 2001; Hu et al., 2005; Bianchi et al., 2006). Sharing risks especially in risky innovation projects was crucial to catch up in several industries (Lee and Lim, 2001).

Finally, learning and accumulation of technological capabilities also depend on regimes of intellectual property rights (IPR). Strong IPR regimes give established firms additional incentives to invest in innovation and facilitate diffusion of the technical knowledge behind a patented invention. By guaranteeing the rights of innovators, strong IPRs can also increase learning opportunities from market leaders via technology licensing agreements and FDI. This leads to higher rates of innovation and an orderly development of its applications. However, strong IPR regimes also represent a societal cost. Stronger protection is not beneficial in *cumulative systems technologies* like automobiles, semiconductors, or computers, where the industrial and innovative process allows for relatively easy entry of new firms, especially from industrialising countries (Mazzoleni and Nelson, 1998). Argentina, Brazil, Mexico, Korea, and Taiwan could benefit from relaxed IPR regimes that allowed firms to accumulate re-engineering and production capabilities. Especially in the

case of Korea and Taiwan, these capabilities proved to be essential to move from imitation to innovation (e.g. Kim, 1997; Wu et al., 2010).[20]

3.3 A synthesis of industrial policies in Argentina, Brazil, Mexico, South Korea, and Taiwan

This section summarises the main industrial policy instruments implemented in the five countries under analysis. Its aim is not to discuss the merits and demerits of any of these, nor to produce new evidence. Rather, it intends to provide a snapshot of the heterogeneous experiences of these five countries with a list of all policy instruments employed over time.

Policies considered prominent in a certain period are indicated in bold. A policy is firstly mentioned when introduced and it is not re-mentioned unless it becomes more important, or is reformed or abandoned. Given the broad definition of industrial policy adopted here and the variety of technical arrangements employed in our five country cases, the number of policy instruments that could be covered is very high. For this reason, we focus on the most discussed policy instruments. Because these instruments are considered the most prominent in the literature, we are confident that, despite not exhaustive, our list satisfactorily represents the industrial policy choices of these five countries.

Table 3.1-3.3 lists policy instruments in the domain of trade, investment, and STI in place from the 1940s to 2005.[21] Table 3.4 details most targeted industries of these policies.

[20] Today, TRIPS agreements and the recent global trend towards stronger IPRs are not good news for firms in industrialising countries.

[21] For a review of modern industrial policy in Latin America, see Crespi et al. (2014).

Table 3.1. A summary of trade policies, 1940-2005

	Argentina	Brazil	Mexico	Korea	Taiwan
40s	Tariffs & NTB	Import restrictions	Tariffs & import controls		Tariffs & NTB (quotas, LCRs)
50-55				Tariffs and NTB	Export fiscal incentives
55-60		**Tariffs & NTB** (LCR); export promotion (exchange rate)	NTB (LCR); export incentives		Export financial incentives
60-65	**Tariffs & NTBs (licenses);** export incentives	Export fiscal incentives		Export incentives	Export promotion (quality controls, awards)
65-70	Tariff reduction	Tariff liberalisation			Export promotion (SEZs)
70-75	Tariff increase	Tariffs & NTB; export incentives			Reduction of NTB; export promotion (business services)
75-80	Trade liberalisation				
80-85	Tariff & import licenses		**Trade liberalisation**; elimination of export subsidies		Elimination of NTB and reduction of tariffs
85-90	Tariffs reduction and elimination of some NTB; **export incentives**	**Trade liberalisation**; export incentives reforms		Reduction of import quotas	**Trade liberalisation**; export incentives reforms
90-95			Export incentives	Trade liberalisation	
95-00					
00-05				Export promotion (SEZs)	

Source: Author's elaboration based on: Argentina: Vaccarezza (2012), Katz and Kosacoff (1989), Katz and Bercovich (1992), Lucangeli (1989), and Melo (2001). Brazil: Dahlman and Frischtak (1992), Suzigan and Villela (1997), and Melo (2001). Mexico: CEPAL (1979), Moreno-Brid and Ros (2009), and Melo (2001). Korea: SaKong and Koh (2010) and Kim (1992, 1997). Taiwan: Wade (1990), Smith (2000), and Hsu and Chiang (2001).

Table 3.2. A summary of investment policies, 1940-2005

	Argentina	Brazil	Mexico	Korea	Taiwan
40s	Directed credit; SOEs; BND		Fiscal incentives		New plants' licensing; SOEs
50-55	FDI attraction	BNDES; FDI restrictions	Financial incentives	KDB; SOEs	Directed credit; FDI attraction
55-60		Fiscal incentives; regional policy	SOEs		Licensing's abandonment
60-65	**SOEs; FDI attraction;** selective incentives	SOEs			SMEs' support
65-70		Financial incentives; SMEs support; relaxed FDI regulations	Regional policy	Sectoral promotion (credits & subsidies)	
70-75	SMEs' support; fiscal incentives; regional policies	Fiscal incentives		Directed credits; FDI regulation	Directed credit; **SOEs;** selective FDI attraction
75-80	Abolition of credit schemes				
80-85		Regulation of SOEs	Elimination of production subsidies; fiscal reform; privatisations	Industrial restructuring; SMEs' support	
85-90	Regional & sectoral policies	Reforms of fiscal & financial incentives	FDI liberalisation; competition policy	Abolishment of sectoral incentives; privatisations; regulation of *chaebols;* selective FDI liberalisation	
90-95	Privatisations; SMEs support; financial incentives (subsidies)	Privatisations; FDI liberalisation; abandonment of incentives		FDI liberalisation	Privatisations; fiscal incentives' reforms
95-00		Sectoral & regional incentives	SMEs support	FDI attraction	
00-05	Sectoral promotion			SMEs' support; regional policy	

Source: see Table 3.1.

Table 3.3. A summary of STI policies, 1940-2005

	Argentina	Brazil	Mexico	Korea	Taiwan
40s					
50-55		Research institutes			
55-60	Research institutes				
60-65				Research institutes	
65-70		R&D financial incentives	Research institutes		
70-75				**R&D incentives** (subsidies, **directed credit**, tax incentives)	Research institutes
75-80				Training programs	Programs for quality control standards; IPRs
80-85				**Fiscal & financial R&D incentives**	**Technology parks**; R&D incentives
85-90		R&D fiscal incentives			Promotion of collaborative R&D projects
90-95			R&D incentives		
95-00	R&D incentives	Support to high-tech SMEs; training programs	Cluster policies; IPRs; training programs		Support to high-tech SMEs
00-05		Technology parks		Technology parks	

Source: see Table 3.1.

Table 3.4. A review of targeted industries, 1940-2005

	Argentina	Brazil	Mexico	Korea	Taiwan
40s	durable consumer goods, basic inputs, metallurgy, chemicals	basic inputs (paper, steel, iron, alkalis)	food processing, steel, textiles	mineral and heavy industry	textiles, fuels, chemicals, mining and metal working, fertilizers, food processing
50-55	all previous + nuclear energy	all previous, + chemicals, machinery, auto, shipbuilding	nondurable consumer goods		all previous, + plastics, synthetic fibres, radios
55-60	all previous, + metallurgy, mechanical industry (auto), basic industries (paper, steel, chemical, petrochemical)				
60-65			durable consumer, intermediate and capital goods (auto and petrochemicals)	light industry, cement, fertilizer, industrial machinery, oil refinery	metals, shipbuilding, electrical appliances & **electronics**, auto, energy
65-70					
70-75		metallurgy, petrochemicals, shipbuilding	mining, metallurgy, fertilizers, oil, petrochemicals	**HCI**: steel, non-ferrous metals, machinery, shipbuilding, petrochemicals	all previous + petrochemicals, electrical machinery, precision machinery, computers, semiconductors
75-80		capital goods, basic inputs, mini and microcomputers, airplanes, nuclear energy	capital goods, agro industry, energy, transport, consumer goods		
80-85		mini and microcomputers		all previous+ energy, auto; computer, electronics, appliances	**ICTs, electronics,** machine tools, robotics, optoelectronics, biotech, new materials
85-90		ICTs, electronics, auto, fine chemistry, precision mechanics, biotech, new materials, oil, natural gas	auto, pharma, chemicals, microcomputers, iron, steel, basic industry	**electronics, appliances, audio-visual products, computers**	
90-95	auto			ICTs	ICTs
95-00	ICTs		textile, footwear, auto, airplanes, electronics, petrochemicals, machinery		
00-05	auto, ICTs	semiconductors, pharma, capital goods	electronics, textiles, leather		

Sources: Argentina: Katz and Kosacoff (1989), Kosacoff (1993), and Vaccarezza (2012). Brazil: Suzigan and Villela (1997), Borelli et al. (2001), and Melo (2001). Mexico: Moreno-Brid and Ros (2009). Korea: SaKong and Koh (2010). Taiwan: Wade (1990), Smith (2000), and Hsu and Chiang (2001).

3.4 A taxonomy of industrial policy

Based on the literature reviewed so far, in this section we construct a comprehensive and theory-grounded taxonomy of industrial policy instruments (Table 3.5). Our list of policy instruments comes from the tables in Section 3.3.

Building a taxonomy of industrial policy implies ordering a list of policy instruments according to a set of attributes of these instruments. An ideal taxonomy is characterised by sharp discontinuities across classes and high homogeneity within classes (McKinley, 1982). The characteristics of our object of analysis (industrial policies) complicate the construction of an ideal taxonomy at least for two reasons. Firstly, policy instruments rarely serve only one objective at a time. This decreases the degree of sharpness across classes. Secondly, policy instruments are often named differently when not functionally different and different levels of generality can be mistaken for different instruments, i.e. two instruments might be taken as two separate mechanisms when they are just two variations of the same instrument. This can result in long lists of policy instruments that should not be enumerated as distinct entities (Linder and Peters, 1989).

Several taxonomies of industrial policy already exist (Chenery, 1958; Kellick, 1981; Roth well and Ziegfeld, 1981; Haggbaldee et al., 1990; Szirmai and Lapperre, 2001; Cimoli et al., 2009; Naudé, 2010; Weiss, 2011; Warwick, 2013). These taxonomies differ in the attributes used for the classification, in how much attributes reflect the debate on industrial policy (e.g. functional *versus* selective policies, import substitution *versus* export promotion, etc.), and in the level of detail with which policy instruments are described.[22]

Our taxonomy intends to contribute to the debate on which kind of policies were employed in East Asia and Latin America. Given this objective, the sole attribute adopted to define instrument classes is the coverage of industrial policy, i.e. if poli-

[22] Among these, Szirmai and Lapperre (2001) and Weiss (2011) included a large number of policy tools. The former distinguished by area of intervention, the latter by coverage. Warwick (2013), instead, combined policy domains and policy. A different approach is adopted by Rothwell and Zegveld (1981), who distinguished between supply-side policy instruments and demand-side policy instruments. Others, such as Cimoli et al. (2009), focused on specific domains of industrial policies (e.g. policies for capabilities' accumulation).

cies are functional or selective. This attribute serves the purpose of our taxonomy and respects the indications outlined in the literature on policy taxonomies.[23]

Given the broad definition of industrial policy adopted here, in our taxonomy industrial policies are loosely grouped according to their domain of intervention into framework conditions, trade, investment, and science, technology, and innovation policies. Borrowing the expression from the literature on European industrial policy (Pelkmans, 2006), we refer to framework conditions as those policies that ensure basic conditions for economic activity (infrastructures, human capital and competition). Because these domains are not mutually exclusive, the last part of the table lists policies that cannot be categorized *ex-ante* as trade, investment, or STI policies, but require a case-by-case evaluation. Hence, we should see the classification according to domains of intervention as a practical one, rather than a theoretical one.

[23] The attributes of policy instruments identified by Linder and Peters (1989) are: complexity of operation, level of public visibility, adaptability across users, level of intrusiveness, relative costliness, reliance on market, chances of failure, and precision of targeting. We argue that the concepts of functional and selective policies involve all these attributes, so this is a valid attribute to construct a classification of industrial policies.

Table 3.5. Taxonomy of industrial policies

Domain	Goal	Policy	Coverage	Policy instruments
Framework conditions	Ensuring basic business conditions	Infrastructure provision	Functional	Preferential credit, tax incentives, procurement, public-private partnerships, direct provision
		Education policy	Functional	Funding, study abroad programs, repatriation packages
		Competition policy	Functional	Privatisations and anti-trust law
Trade	Avoiding BOP constraints; realizing economies of scale and learning effects	Domestic market protection	Selective	High tariffs and non-tariff measures (quantitative restrictions, local content requirements, licenses, etc.)
		Export promotion	Functional	Support services, tax incentives subsidised loans, credit schemes
			Selective	Directed credit, tax incentives, subsidised loans, credit schemes to targeted sectors
Investment	Spurring firms' investments	Industrial support	Functional/ Selective	Tax incentives
			Selective	Direct production, directed credit, subsidies, loan guarantees
STI	Creating opportunities for science and technological innovation	Support to public R&D	Functional/ Selective	Financing of universities and research institutes; training programs
	Fostering capabilities accumulation in firms	Support to private R&D	Functional	IPRs' regulations
			Functional/ Selective	Subsidies, grants, tax incentives, risk-sharing instruments
		Support to cooperative R&D	Functional/ Selective	Government-supported consortia, public-private partnerships
		Technology transfer	Functional/ Selective	Regulations and negotiations of technical agreements, licensing, subcontracting; turnkey plants and project contracts; support to capital goods' imports and JVs

Investment /STI	Spurring investment/innovation	Support to R&D/ industrial support	Selective	Public procurement
	Spurring investment/ technology transfer	FDIs attraction	Functional/ Selective	Liberalisation of investment, tax incentives, infrastructure provision
	Spurring innovation/creating employment/industrial restructuring	Spatial IP (region, cluster, technology park)	Functional/ Selective	Fiscal incentives, grants, infrastructure provision, Special Economic Zones
	Support SMEs/innovative SMEs	SMEs promotion programs	Functional/ Selective	Tax incentives, grants, preferential credit, training, advisory, support services

As the table shows, in each policy domain, policy goals can be achieved via different industrial policy instruments. In other words, there are multiple ways to get the job done: governments can choose from a number of policy instruments to implement a certain policy and achieve a certain policy goal.

Some of these instruments can be classified as functional or selective without knowing much about their technicalities; others could be designed as functional or selective. In these cases, details are necessary to assess their coverage. For instance, in the domain of trade policies, goals include avoiding balance of payment constraints and realizing economies of scale and learning effects. The main policies to achieve these goals are domestic market protection and export promotion. Domestic market protection is generally a selective industrial policy, while export promotion can be functional (if only support services are provided or if all industries and firms face the same fiscal or financial incentives), or selective if only particular firms or industries can benefit from incentives.

Finally, goals are not always specific to a single policy area, so the same instrument can be grouped under multiple domains. Following the example above, realizing learning effects is also an objective of STI policies and so domestic market protection or export promotion could be also classified as STI policies. This, however, does not invalidate our taxonomy because, as mentioned, domains are used solely to restrict the vast range of policies that go under the umbrella of industrial policy.

3.5 Indicators of industrial policy

The next sections review each of the policy domains in the taxonomy and discuss semi-quantitative indicators for each of them. The historical-comparative literature

on East Asia and Latin America used several indicators of industrial policy instruments. Our ideal indicators have three characteristics. First, they represent actual disbursements: while expenditures are not comprehensive of all possible forms of government intervention, they are the least ambiguous indicator of commitments.[24] Secondly, our ideal indicators are sectorally disaggregated, which allows classifying policy instruments as functional or selective. By showing which industries are the most supported, sectoral data also indicate if comparative-advantage-following or comparative-advantage-defying policies were most successful. Finally, while we acknowledge that it is not always possible to find cross-country comparable indicators, we concentrate on indicators that allow comparisons across the five countries under scrutiny.

3.5.1 Indicators of framework conditions

In the domain of framework conditions, we focus on infrastructure development, human capital formation, and competition policy.

In the literature, investments in infrastructures have been captured in two ways: by accounting for development banks' disbursements in infrastructure building (Amsden, 2001) and by accounting for differences in paved roads, electricity capacity, and ICTs (World Bank, 1993). Because the second indicator represents an output rather than an input measure, we present data only for the first indicator. This indicator was originally used to show the role of development banks in infrastructure building, so it should be seen as a sub-optimal indicator. An ideal indicator would capture all investments in infrastructures (i.e. via public procurement, private-public partnerships, and investments by SOEs). Unfortunately, these data are not available.

Following the World Bank (1993), we use public expenditures in education as a share of GNP to account for investments in human capital formation and public expenditure on tertiary education as percentage of total education expenditures to account for investments in technical education (World Bank, 1993). Even if the World Bank (1993) acknowledges that these indicators do not fully account for human capital accumulation in East Asia, there are no better cross-country comparable indicators of governments' commitments to human capital formation.

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[24] This is not only intuitive when reading the comparative-historical literature on East Asian and Latin American industrial policy, but it is also acknowledged in political science literature (e.g. Mosher; 1980; Hood, 1984; Linder and Peters, 1989; Schneider and Jacoby, 2011).

Governments can increase domestic competition by means of antitrust policy, privatisations, and abolishment of controls over foreign investments. Because it is difficult to compare indicators of antitrust regulations in a cross-country analysis, we limit our analysis to privatisations. Following Shirley (1999), we collect data on the value of privatisations. Foreign investments will be discussed in Section 3.5.5.

3.5.2 Indicators of trade policy

The literature on trade policy used several indicators, namely trade profiles, average tariffs (simple and weighted), distortion indexes (nominal or effective rates of protection and effective rate of assistance), and import liberalisation ratios. Our ideal measure of trade protection takes into account the degree of domestic markets' protection and the direction of selectivity, i.e. which industries were protected the most.

Trade profiles (the share of exports in GDP or rate of export growth) are easy to construct, but account only for revealed trade strategies. This means that if a country tries to implement an outward oriented strategy but fails, these indicators do not reflect this attempt. Analysing trade orientations by looking only at average tariffs (simple or weighted by the importance of each item in the country's import profile) ignores that tariffs are not enough to gauge the full extent of protection. Indexes of the degree of trade distortions, i.e. nominal and effective rates of protection (e.g. Westphal and Kim, 1977; Nam, 1990; World Bank, 1993; Pack, 2000), are useful measures, but are extremely difficult to construct because they require data on the specific protection systems, including tax exceptions and ad-hoc subsidies. These indexes are also criticised because they are based on biased definitions of inward and outward orientations (Chang, 2003).[25] Import liberalisation ratios capture the effects of liberalisation programs by showing the evolution of the number of freely imported items. These indicators, however, are hardly ever disaggregated by industry.

The empirical literature on our five country cases shows great variety in terms of indicators of trade policy. For example, Smith (2000) provides substantial empirical evidence on the industrial policies implemented in Korea and Taiwan in the 1980s. However, in the case of Korea trade policies are measured by rates of assistance

[25] Nominal and effective rates of assistance are similar to rates of protection, but include also non-border interventions.

and in the case of Taiwan by rates of protection. Approaches like this clearly hinder cross-country comparisons.

In order to keep the analysis objective and preserve cross-country comparability, we collect available data on average and sectoral legal tariffs and import liberalisation ratios. Together with these measures of trade protection, we account for export promotion schemes with data on disbursements for fiscal and financial incentives.

3.5.3 Indicators of investment policy

In the domain of investment policies, the thesis concentrates on the role of SOEs and development banks, and gathers estimations of financial and fiscal incentives to investments. We collect data on the share of SOEs' value added in GDP, the share of SOEs in gross fixed capital formation, and the budgetary burden of SOEs (Short, 1984).[26] Following Amsden (2001), we use development banks' disbursements to manufacturing and disaggregated data on loans to the manufacturing industry. These data indicate if governments stuck to announced priorities and how priorities changed over time. Finally, we collect data on financial and fiscal incentives (amounts of tax reductions and tax revenue losses due to industrial promotion schemes) as percentages of GDP.

The level of heterogeneity of existing data in the area of fiscal and financial incentives is considerable. This reflects the complexity of the regimes in place and their variability, but also the different reporting practices adopted by governments and the preferences of researchers. For example, Argentine, Brazilian, and Mexican data rarely distinguish between fiscal and financial incentives and data on approved investments are often collected instead of actual disbursements (e.g. Ferrucci, 1986; Aspiazu, 1986; NAFINSA, 1984).

We keep financial and fiscal incentives separate in order to distinguish between more and less entrepreneurial states. However, we do not distinguish between loans and subsidies. While this is an important difference, data often do not allow to make such a distinction and the high rates of non-performing loans both in East Asia and Latin America do not make this distinction necessary (CEPAL, 1979; Smith, 2000). Finally, because data on fiscal incentives are often not sectorally dis-

[26] Budgetary burden is defined as the sum of central government subsidies, transfers and net lending to public enterprises less dividends and interest payments to central governments.

aggregated, we gather and summarise information on objectives, targeted industries, and conditions to obtain fiscal incentives in the countries where these incentives were present (namely, Korea, Taiwan, and Mexico).

3.5.4 Indicators of science, technology, and innovation policy

Innovation studies traditionally measured innovative efforts by indicators like R&D expenditures, number of patents, and number of scientific publications. Because we are interested in government commitments, rather than policy outcomes, we restrict our analysis to input measures.

We measure science policies by budgets (or expenditures) of most important national research institutes.[27] In Latin America, research councils and universities had a much larger role than research centres, so we collect data on the budgets of research councils. Support to firms R&D (i.e. innovation policy) is measured by the amount of R&D subsidies and tax incentives, as percentages of R&D expenditures and GDP. Because sectorally disaggregated data are scarce, we rely on policy documents and existing literature to summarise the main beneficiaries of these policies.

With respect to technology policy, we focus on technology transfer through FDI, licensing agreements, and capital goods' imports. Technology transfer requires conscious efforts from the two parts involved, so it could be encouraged but not guaranteed by law. Consequently, quantifying policies for technology transfer is practically impossible. As proxy, we use data on royalties and license fees, capital goods' imports, and total and sectoral FDI inflows. FDI attraction can be classified as an investment or a technology policy, depending on the existence and nature of industry-specific regulations (restrictions or incentives). For this reason, it will be discussed in Section 3.5.5.

Finally, despite acknowledging the role of the Taiwanese and Korean governments in establishing joint ventures with foreign firms and in regulating subcontracting, we do not attempt at quantifying these instruments.

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[27] In this regard, it is important to consider that high budgets or large numbers of professionals do not necessarily translate in positive S&T outcomes, as the case of the Brazilian telecom research unit CPqD of Telebras shows (Dahlman and Frischtak, 1992).

3.5.5 Country-specific and unquantifiable instruments of industrial policy

Finding comparable quantitative indicators for industrial policy is not straightforward: some policies are country-specific and many aspects of industrial policy are unquantifiable. Industrial policies are often idiosyncratic to the history of the country and the evolution of its institutions. For instance, the Korean c*haebol* represented the major engine of growth of the economy during the Korean catch up process, leading the process of structural change and industrial upgrading. It is difficult to find an equivalent of c*haebol* in the other four country cases. Moreover, given their intricate relationships with the Korean government, the role of the *chaebol* can only be qualitatively described.

As mentioned, some industrial policies could be classified differently in different countries. This is, for example, the case of FDI attraction policies, public procurement, spatial industrial policy, and SMEs support. All these policy instruments could be designed as investment policies -when they simply aim at spurring investments- or as innovation policies -if beneficiaries are innovative industries or firms. Therefore, the analysis of these policies requires a case-by-case evaluation. In the case of FDI attraction, one way to address this issue is to look at sectoral distributions of FDI inflows: depending on which industries received foreign investments, it is possible to have an idea of how governments used FDI attraction instruments. Data on public procurement, spatial industrial policy, and SMEs support are virtually inexistent, so we omit them from our analysis.

We also indicate some of the unquantifiable policy instruments used and requirements for support. For instance, in Taiwan, firms had to pass strict quality controls in order to have permission to export (Wade, 1990).

3.6 Conclusions

As a first step towards the quantification of industrial policies in East Asia and Latin America, this chapter critically reviewed the debate on industrial policy. At the centre of this debate is the interpretation of the so-called East Asian miracle, in comparison with the less successful industrialisation of Latin America. According to neoclassical economists, the East Asian catch up was the result of functional industrial policies and export promotion strategies. Neoclassical economists denied, or downsized the role of selective policies and did not sufficiently emphasise the role of the state in fostering technological change via science, technology, and in-

novation policies. By contrast, Latin American selective industrial policies drove structural change towards comparative-advantage inconsistent industries, maintained inefficient firms, and diffused corruption. Selective industrial policies, part of import substitution strategies, were not abandoned in time, i.e. when import substitution possibilities were exhausted.

Industrial strategists contended that Latin American industrial policies spurred manufacturing growth during the period of import substitution. However, excessive reliance on FDI, weak knowledge transfer mechanisms between the public and private sector, lack of discipline, and excessive trade protection hampered further manufacturing growth in Latin America.

According to industrial strategists, selective industrial policies did play a crucial role also in East Asia. The East Asian model was described as a combination of import substitution and export promotion, where firms received subsidies for investments and capabilities' accumulation. According to this interpretation, industrial policies in East Asia were comparative-advantage-defying: selective industrial policies created the preconditions for the success of strategic industries and directed structural and technological change towards increasingly sophisticated goods (mainly ICTs and electronics). These processes, it was argued, were made possible by high government expenditures aimed at promoting capabilities' accumulation within public research centres and domestic firms.

The policy implication from the neoclassical interpretation is that functional industrial policies are growth-enhancing, while selective industrial policies are growth-reducing. The policy implication from the industrial strategists' interpretation is that the problem of industrial policy is not selectivity *per se*: by creating rather than picking winners, entrepreneurial states can become important engines of industrialisation. The success of an industrial strategy depends, instead, on policy implementation and economic conditions.

Building on this literature, this chapter sets the ground for a quantification of industrial policies in five of the most studied countries in East Asia and Latin America, namely Argentina, Brazil, Mexico, Korea, and Taiwan. Firstly, we schematised industrial policy instruments and sectoral targets of these five countries. This list of policy instruments was then ordered by means of a detailed taxonomy. The taxonomy distinguished policy instruments that are naturally functional or selective from policy instruments that can be either functional or selective depending on how

they are designed. Given the multiple domains of intervention of industrial policies, the taxonomy distinguishes instruments according to whether they affect framework conditions, trade, investments, or science, technology and innovation.

As a final step, indicators of industrial policy instruments for each of these domains are presented and discussed. This discussion allowed identifying suitable indicators that can systematically describe the nature of industrial policy in these five countries. Preferred indicators are actual government disbursements by industrial policy instrument. Sectorally disaggregated data allow assessing the degree of selectivity of industrial policy instruments and checking to what extent governments' expenditures were consistent with the priorities declared in official plans.

The review of policy indicators evidenced that data on policy inputs are much more limited than data on policy outputs. Moreover, because governments and scholars do not adopt the same criteria for reporting and estimating policy incentives, cross-country comparisons are difficult. This issue is further exacerbated by country-specific elements of industrial policies. Finally, it is important to keep in mind that measuring industrial policies only with quantitative indicators is impossible (and not even desirable). Expenditures are the least ambiguous indicator of government commitments, but are not entirely comprehensive of the whole range of government interventions and do not capture many aspects of industrial policy-making.

Chapter 4

Quantifying Industrial Policy in Argentina, Brazil, Mexico, South Korea, and Taiwan

4.1 Introduction

It is often underemphasised that in the 1970s it was commonly believed that Brazil, Mexico, and Argentina were going to be the next countries to industrialise (Leontief, 1977). This is not surprising if we consider that after the Second World War, Argentina, Mexico, and Brazil enjoyed higher GDP per capita and larger manufacturing industries than Korea and Taiwan did.

Today, East Asia and Latin America can be considered exemplar cases of divergence in economic growth. In a span of two decades, East Asian countries managed to catch up and change their production structure, replacing traditional with increasingly sophisticated manufacturing goods. In the same two decades, Latin American countries failed to sustain their growth and industrialisation rates. This resulted in stagnation and premature deindustrialisation.

As discussed in Chapter 3, the literature has extensively studied how such divergent outcomes came about and agreed that catch up was fuelled by structural and technological change. What is disputed is the role of the state in these processes. Two alternative interpretations emerged. According neoclassical economists, the success of East Asia *vis a vis* Latin America was the result of functional industrial policies that only guaranteed macroeconomic stability, favourable business conditions, and free trade (Wolf, 1988; Edwards, 1988; Krueger, 1997). According to industrial strategists, instead, East Asian governments selectively intervened in market functioning by promoting individual industries and firms (Pack and Westphal, 1986; Amsden, 1989; Wade 1990; Chang, 2002).

In this chapter, we build upon the historical-comparative literature on East Asia and Latin America reviewed in the previous chapter and present systematic empirical evidence on the extent and nature of industrial policy in the most studied and exemplar cases of successful and less successful industrialisation, namely Argentina, Mexico, Brazil, Korea, and Taiwan.

Focusing on industrial policy as a determinant of industrialisation is not to deny the complexity of this dynamic phenomenon. Industrialisation depends on multiple and interrelated economic, historical, institutional, and cultural causes whose individual effects cannot be disentangled. The evidence brought in this chapter should be read keeping this idea in mind.

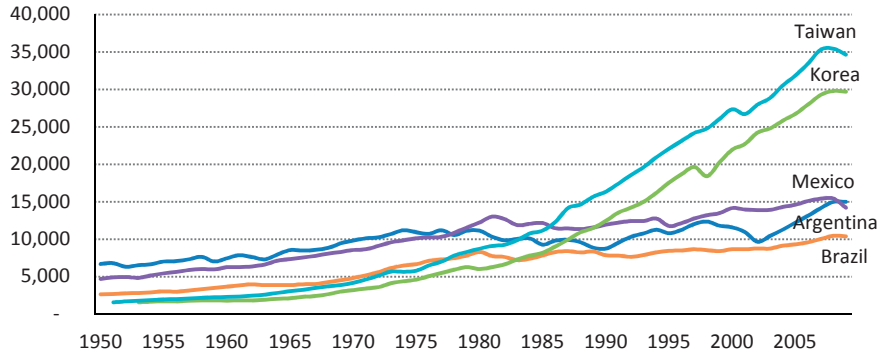
The next sections present data on industrial policies, as categorized in Chapter 3. Section 4.3 briefly concludes.

4.2 The context

This section tries to understand the context in which industrial policies were implemented in the five countries under analysis. In order to do so, we present data on GDP trends and its composition, investments, exports and export structures, and R&D expenditures. These (outcome) indicators are used as denominators of many of the indicators of industrial policies presented in this chapter.

Figure 4.1 shows GDP per capita trends from 1950 to 2005.

Figure 4.1. GDP per capita, 1950-2005



Source: Total Economy Database.

Notes: GDP per capita, 2009 US$ converted to 2009 price level with updated 2005 EKS PPPs.

As the figure shows, before the 1980s, GDP per capita was smaller in the East Asian than in the Latin American countries. In roughly two decades, Korea and Taiwan (together with the other East Asian Tigers) caught up and overcame first Brazil, then Argentina and Mexico.

Table 4.1 presents data on the composition of manufacturing value-added by industry in Korea and Taiwan, and Argentina, Brazil, and Mexico.

Table 4.1. Manufacturing value added by industry, as % of manufacturing value added, 5-year averages, 1970-00

	Argentina						Brazil						Mexico					
	70-75	75-80	80-85	85-90	90-95	95-00	70-75	75-80	80-85	85-90	90-95	95-00	70-75	75-80	80-85	85-90	90-95	95-00
Food	30.0	31.2	32.2	34.7	37.6	38.6	13.7	13.8	15.1	13.1	13.8	14.6	16.3	14.7	15.0	15.6	15.2	14.7
Textiles	13.6	12.9	10.2	9.3	9.4	7.5	14.3	11.7	12.6	11.2	10.7	8.3	16.0	15.1	12.7	11.6	10.3	10.0
Wood	1.4	1.3	1.0	0.7	0.6	0.6	2.7	2.2	1.9	1.3	0.6	0.6	1.9	1.6	1.6	1.5	1.0	0.9
Paper	4.1	4.0	3.6	3.7	4.3	4.7	6.0	4.7	5.4	5.3	6.6	8.3	4.1	3.9	3.9	4.2	4.0	3.8
Coke and refined petroleum products	6.1	5.8	6.9	7.3	7.6	7.1	3.7	4.3	4.2	6.0	7.2	7.8	3.7	3.7	4.5	4.9	4.3	4.3
Chemicals	7.5	7.9	8.6	9.6	9.4	9.7	12.9	12.5	12.9	13.1	11.3	11.1	12.9	13.8	13.7	15.6	15.0	14.7
Plastics	2.5	2.7	2.7	2.6	2.8	2.8	3.8	3.9	3.8	4.2	3.8	3.5	4.7	4.2	4.6	4.8	4.3	4.3
Other non-metallic mineral products	3.4	3.4	3.1	2.6	2.7	2.5	4.9	5.2	4.7	3.4	2.4	2.4	5.8	6.2	6.3	6.0	5.7	5.0
Basic metals and metal products	11.4	11.4	14.9	15.1	12.8	13.3	12.8	11.7	11.0	13.2	15.0	13.8	9.7	9.5	9.2	8.6	8.0	8.5
Machinery NEC	4.0	5.2	3.5	2.5	2.2	2.3	9.6	11.6	9.7	9.9	9.0	9.8	6.3	8.0	8.3	8.1	8.5	8.8
Electrical and optical eq.	3.9	3.6	2.7	2.7	2.6	2.5	5.5	7.4	8.0	9.2	9.3	10.8	3.0	3.4	3.5	3.5	3.9	4.6
Transport eq.	10.9	9.6	9.5	8.2	7.0	7.3	6.4	7.5	7.7	6.8	8.0	7.2	12.0	12.9	13.6	12.5	16.8	18.0
Furniture and manuf. n.e.c.	1.1	1.0	1.1	1.0	1.0	1.0	3.5	3.6	3.0	3.2	2.3	1.9	3.6	3.0	3.1	3.0	2.8	2.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4.1. Manufacturing value added by industry, as % of manufacturing value added, 5-year averages, 1970-00 (Cont.d)

	Korea						Taiwan					
	70-75	75-80	80-85	85-90	90-95	95-00	70-75	75-80	80-85	85-90	90-95	95-00
Food	19.2	12.7	11.0	8.3	5.7	4.4			12.9	11.1	10.0	8.1
Textiles	25.9	25.7	20.4	14.8	7.2	4.3			21.3	17.6	9.7	6.4
Wood	2.2	1.7	1.1	0.7	0.5	0.3			1.6	1.8	0.9	0.5
Paper	5.9	4.8	5.2	4.9	4.5	3.9			4.3	3.8	2.8	2.4
Coke and refined petroleum products	6.5	5.1	4.7	3.4	4.5	5.3			4.1	3.6	3.3	4.5
Chemicals	7.6	9.8	10.7	10.2	12.3	11.7			7.6	8.7	10.3	11.2
Plastics	2.7	3.3	3.2	4.1	3.9	3.3			4.4	6.8	7.8	6.3
Other non-metallic mineral products	7.8	6.6	6.0	5.9	5.8	4.4			4.2	3.6	4.3	3.8
Basic metals and metal products	6.1	9.0	11.9	12.2	12.4	11.3			9.3	10.5	13.2	12.8
Machinery n.e.c.	2.0	3.3	3.4	4.5	5.5	5.6			2.8	3.0	4.0	3.8
Electrical and optical eq.	5.0	9.0	12.3	18.0	21.7	30.4			13.0	15.5	20.9	30.0
Transport eq.	5.4	5.8	7.2	9.6	13.7	13.6			6.7	5.8	6.7	5.3
Furniture and manuf. n.e.c.	3.7	3.0	2.9	3.4	2.2	1.4			7.9	8.1	6.2	4.9
Total	100.0	100.0	100.0	100.0	100.0	100.0			100.0	100.0	100.0	100.0

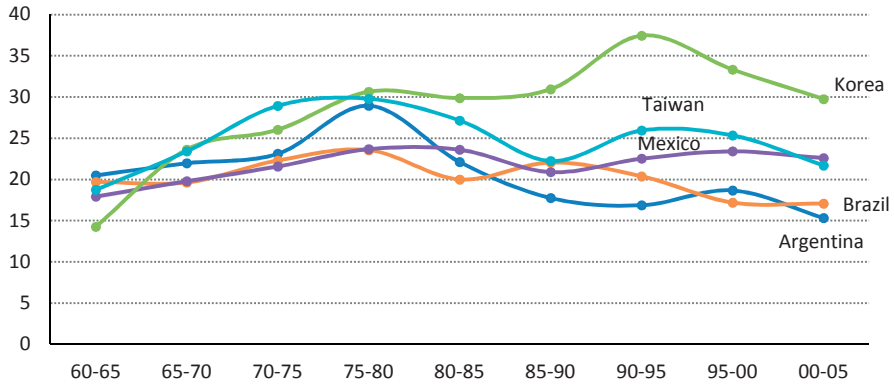
Sources: Argentina, Brazil, and Mexico: PADI. Korea: EU-KLEMS. Taiwan: DGBAS Statistical Yearbook online.

Notes: Argentina, Brazil, and Mexico: Original data in constant USD dollars (1985 prices). Korea and Taiwan: Original data were transformed into constant USD dollars (1985 prices). Food includes beverages and tobacco. Textiles include leather and footwear. Wood includes wood products, and cork. Paper includes pulp, paper, paper products, and publishing. Chemicals include chemical products. Plastics refer to rubber and plastics products.

In Latin America, the shares of traditional manufacturing industries, such as food processing, remained high. By contrast, in East Asia traditional industries were gradually replaced by modern industries, such as electrical and optical equipment. This structural change pattern spurred economic growth, thanks to the properties of the ICTs industry as the new radical technological innovation of the time (Freeman and Soete, 1997; Fagerberg and Verspagen, 2002).

It is commonplace to cite investment rates and exports as the main ingredients of the East Asian catch up. Figure 4.2 presents data on gross fixed capital formation as percentage of GDP.

Figure 4.2. Gross Fixed Capital Formation, as % of GDP, 5-year averages, 1960-2005

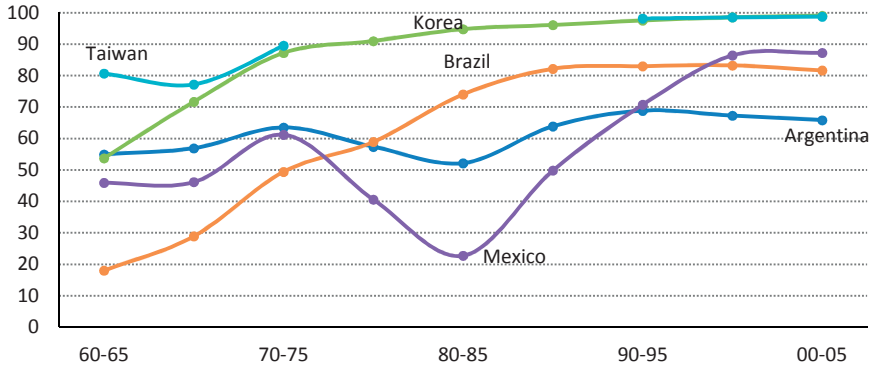


Sources: Argentina, Brazil, Mexico, and Korea: WDI. Taiwan: DGBAS Statistical Yearbook online.

This figure resembles the one of GDP per capita: while Korea and Taiwan started at lower levels of investments, they quickly caught up and overcame Latin American economies. This pattern is clear in the case of Korea whose investment share in GDP was less than 15% in the early 1960s and reached almost 40% by the early 1990s.

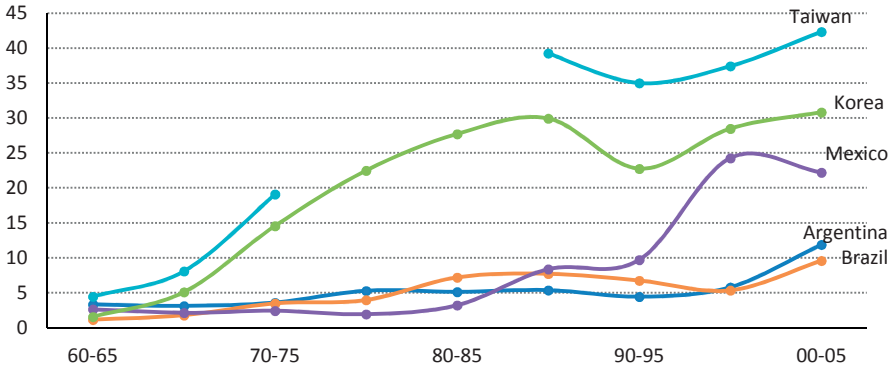
Figure 4.3 and Figure 4.4 show manufacturing export as percentage of merchandise exports and GDP respectively.

Figure 4.3. Manufacturing exports, as % of merchandise exports, 5-year averages, 1960-2005



Source: Lavopa and Szirmai (2011).

Figure 4.4. Manufacturing exports, as% of GDP; 5-year averages, 1960-2005



Sources: Argentina, Brazil, Mexico, and Korea: Lavopa and Szirmai (2011) and WDI. Taiwan: Lavopa and Szirmai (2011), WTO statistics database online, and DGBAS Statistical Yearbook online.

While GDP and investment trends diverged in later stages, data on manufacturing exports were polarised already in the mid-1960s (early 1970s if we look at manufacturing exports as percentage of GDP). Latin American manufacturing exports increased over time, but did not reach the East Asian levels. There are two non-mutually exclusive explanations for this. First, Latin American domestic markets were larger, which made them less dependent on exports. Second, abundant natu-

ral resources tended to appreciate the exchange rate and so penalised manufacturing exports (Bresser-Pereira, 2008).

The nature of the East Asian process of structural change is also reflected in the composition of exports. Table 4.2 shows data on exports' composition by industry.

Table 4.2. Manufacturing export by industry, as % of total exports, 5-year averages

	60-65					65-70					70-75					75-80				
	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn
Manufacture of food, beverages, and tobacco	46.2	10.4	14.8	5.2	36.6	44.8	15.8	14.4	2.6	17.5	41.5	27.0	13.8	2.7	8.8	30.1	26.5	6.7	3.3	
Manufacture of textiles, textile, leather and footwear	4.0	0.9	4.6	13.1	16.5	4.0	1.8	3.8	33.7	21.3	6.6	5.9	6.1	39.9	32.7	8.4	7.8	3.9	35.5	
Manufacture of wood, wood products, and cork	0.0	3.4	0.5	5.7	6.7	0.0	4.3	0.6	12.6	9.0	0.0	3.3	0.9	10.2	8.1	0.0	1.7	0.9	4.9	
Manufacture of pulp, paper, paper products, and publishing	0.4	0.1	1.5	0.1	1.4	1.0	0.2	1.4	0.3	1.5	1.2	0.8	1.5	0.6	0.8	1.1	1.1	1.2	0.9	
Chemicals and chemical, petroleum, coal, rubber and plastic products	2.2	1.5	6.4	1.6	8.1	3.4	1.7	8.3	3.2	8.3	3.9	2.7	10.5	6.0	9.2	4.3	3.5	7.7	7.8	
Other non-metallic mineral products	0.0	0.1	1.1	0.7	4.1	0.1	0.3	1.1	0.7	3.3	0.2	0.5	1.8	1.4	2.4	0.4	0.5	2.3	2.4	
Basic metals and metal products	1.0	0.5	14.4	6.8	3.7	1.2	2.2	11.4	3.5	2.9	2.9	2.5	10.6	5.8	3.7	2.4	3.4	7.7	6.2	
Manufacture of fabricated metal products, machinery and equipment	1.1	1.1	2.0	2.6	2.6	2.3	2.5	4.3	7.0	11.4	7.1	6.0	14.6	13.5	19.9	10.5	13.8	9.5	25.9	
Other manufacturing industries	0.0	0.1	0.6	1.8	0.6	0.0	0.2	0.8	7.9	1.9	0.1	0.7	1.3	7.1	4.0	0.1	0.5	0.8	4.2	
Total	54.9	18.0	45.9	37.6	80.3	56.9	28.9	46.2	71.7	77.2	63.5	49.4	61.2	87.2	89.5	57.3	58.9	40.6	91.0	

Table 4.2. Manufacturing exports by industry, as % of total exports, 5-year averages (Cont.d)

	80-85					85-90					90-95					95-00				
	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn	Arg	Bra	Mex	Kor	Twn
Manufacture of food, beverages, and tobacco	23.3	25.6	1.6	1.9		25.8	15.2	3.1	1.4	2.3	31.4	17.2	2.6	1.2	2.8	28.9	19.6	2.4	1.2	1.3
Manufacture of textiles, textile, leather and footwear	7.2	7.7	1.2	28.9		8.6	8.9	2.3	27.2	18.0	7.5	8.9	3.1	23.2	17.0	6.1	6.9	5.7	13.0	12.8
Manufacture of wood, wood products, and cork	0.0	1.4	0.4	1.7		0.1	1.2	0.6	0.6	3.7	0.2	1.9	1.3	0.4	2.6	0.6	2.9	1.8	0.2	1.5
Manufacture of pulp, paper, paper products, and publishing	0.7	2.6	0.5	0.7		1.3	3.4	1.1	0.7	0.8	1.3	4.2	1.0	0.9	1.0	1.7	4.4	1.0	1.3	1.1
Chemicals and chemical, petroleum, coal, rubber and plastic products	10.4	10.9	5.9	8.6		10.3	14.1	9.6	8.0	11.5	11.8	10.0	9.0	10.8	10.9	10.3	10.0	6.6	13.6	10.7
Other non-metallic mineral products	0.3	0.7	0.8	2.3		0.6	1.0	2.0	1.3	1.9	0.6	1.2	1.8	0.8	1.5	0.5	1.4	1.4	0.5	0.9
Basic metals and metal products	4.5	7.2	3.6	10.1		9.4	15.5	5.6	7.1	2.8	5.3	16.2	4.4	7.2	2.7	3.8	12.6	3.8	9.6	4.0
Manufacture of fabricated metal products, machinery and equipment	5.7	17.5	8.4	36.8		7.8	22.3	24.5	44.3	48.7	10.1	22.8	45.6	49.0	53.4	14.9	24.9	61.6	56.8	62.4
Other manufacturing industries	0.1	0.4	0.4	3.8		0.1	0.5	0.9	5.5	7.6	0.6	0.7	1.8	4.0	6.3	0.3	0.6	2.1	2.3	3.9
Total	52.1	74.0	22.7	94.8		63.9	82.2	49.8	96.1	97.4	68.8	83.0	70.7	97.5	98.2	67.3	83.2	86.4	98.6	98.5

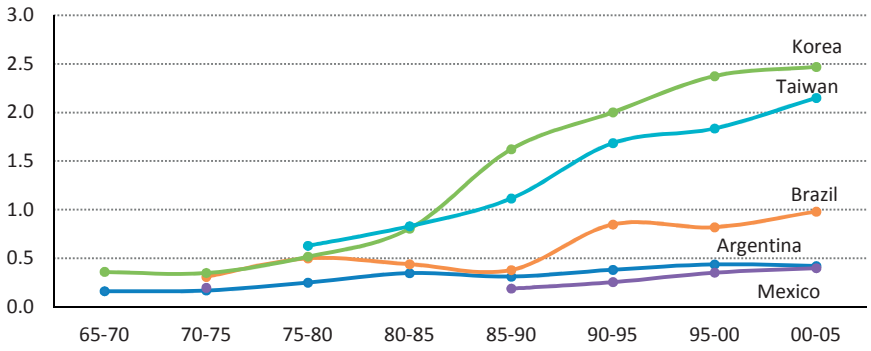
Sources: Lavopa and Szirmai (2011).

Notes: Taiwan: data for 1985-89 refer to 1989 only.

Since the 1960s, in Korea and Taiwan the composition of manufacturing exports changed in favour of increasingly sophisticated goods: from export structures dominated by traditional manufacturing industries -food processing, beverages, tobacco, and textiles- Korea and Taiwan managed to improve their export profiles by increasing their exports of machinery. While the shares of machinery increased also in Brazil and Mexico, they never reached the levels of the East Asian countries. By contrast, until the early 2000s Argentine exports were still concentrated in food, beverages, and tobacco.

The move towards increasingly sophisticated goods of East Asian countries was enabled by high R&D expenditures. Figure 4.5 shows data on R&D expenditures as percentage of GDP.

Figure 4.5. R&D expenditures as % of GDP, 5-year averages, 1965-2005



Sources: Author's calculations based on: Argentina: UNESCO (various issues) and RICYT. Brazil: UNESCO, CEPAL, and Guimaraes et al. (1985), p. 69. Korea: Lim (1995) table 5 and OECD. Taiwan: Smith (2000), table 2.12 and National Science Council (2003).

Until the 1980s, Latin American and East Asian investments in R&D were very low. From the 1980s, Korea and Taiwan expenditures increased and reached the levels of world leading economies. By contrast, R&D expenditures in Argentina, Brazil, and Mexico stagnated or only marginally increased (in Brazil).

4.3 Framework conditions

As explained in Section 3.4, framework conditions refer to policies that ensure fair and favourable business conditions. These include infrastructure development, education policy, and competition policy.

Table 4.3 shows disbursements of national development banks to infrastructure as percentages of total lending. This data might underestimate the levels of investments in infrastructures because ministries or other government bodies might have directly financed infrastructure projects. Time series of government investments in infrastructures do not exist.

Table 4.3. Disbursements in infrastructures by development banks, as % of total lending, 10-year averages, Argentina, Brazil, Mexico, and Korea, 1960-90

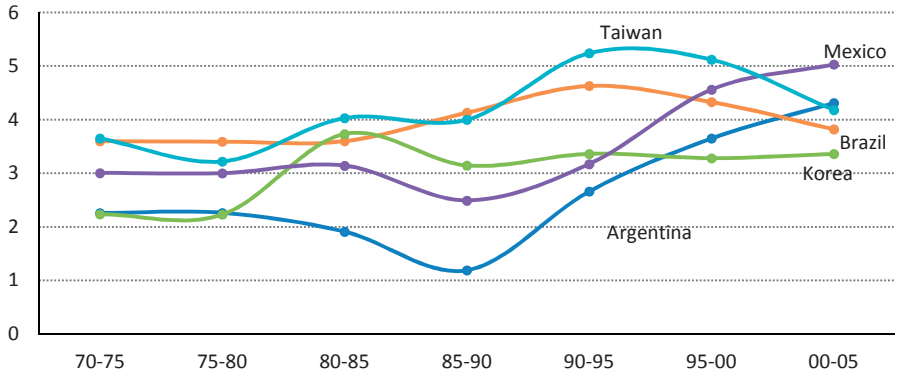
	60s	70s	80s	90s
Argentina	6.9	6.7		--
Brazil	25.0	27.0	31.0	31.0
Mexico	40.0	33.9	27.5	13.8
Korea	17.9	23.9	11.0	

Source: Amsden (2001), table 6.1; Brazil for the 1990s: BNDES (various issues).

As the table shows, Mexico was the most committed to infrastructure development. Indeed, in the 1970s, Mexico had among the highest shares of paved roads (World Bank, 1993).

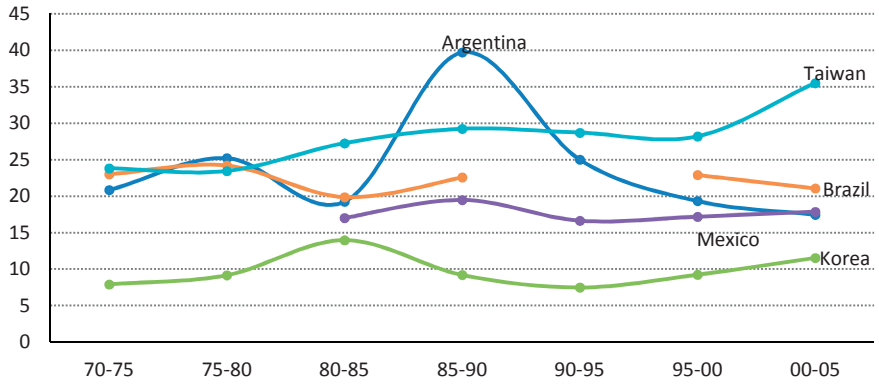
Human capital is an essential element in most of the neoclassical explanations of the divergence between East Asia and Latin America (e.g. World Bank, 1991, 1993). Figure 4.6 and Figure 4.7 show data on public expenditures in education and tertiary education respectively.

Figure 4.6. Public expenditures in education, as % of GNP, 5-year averages, 1970-05



Sources: Argentina, Brazil, Mexico, and Korea: WDI. Taiwan: MOE Education Statistical Indicators.

Figure 4.7. Public current expenditure on tertiary education, as % of expenditure on education, 5-year averages, 1970-05



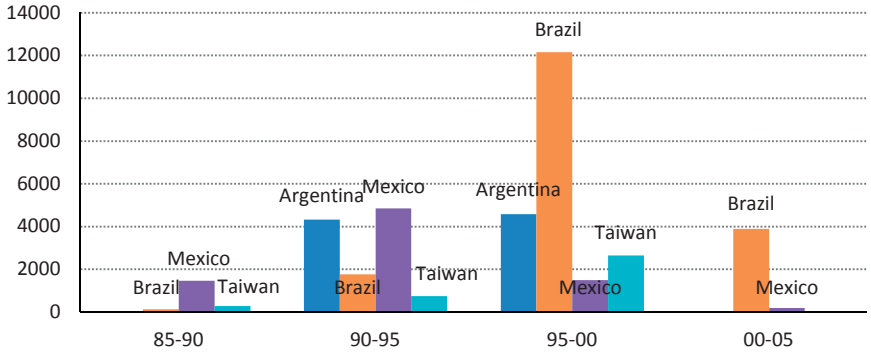
Sources: Argentina, Brazil, Mexico, and Korea: UNESCO Statistical Yearbook (various issues). Taiwan: MOE Educational Statistical Indicators.

In line with World Bank (1993), data on public expenditures in education do not seem to show any clear pattern. With respect to expenditures on tertiary education, Korean shares of public expenditures in tertiary education are lower than the Latin American ones, while the Taiwanese shares are usually higher than the Latin American ones, at least from the 1980s. This at least partly contradicts the analysis of the World Bank (1993) according to which East Asian countries invested more in basic than in higher education compared to Latin American countries.

Data on the value of privatisations for Argentina, Brazil, Mexico, and Taiwan (Figure 4.8) start in the mid-1980s, when waves of privatisation started all over the world.[28] These data confirm that privatisations were much slower and less invasive in East Asia than in Latin America.

[28] Data for Korea are not available.

Figure 4.8. Value of privatisations (in US dollars), 5-year averages, Argentina, Brazil, Mexico, and Taiwan, 1985-2005



Sources: Argentina, Brazil, and Mexico: Privatisation Database. [29] Taiwan: Parker (1999), table 3.

4.4 Trade policy

4.4.1 Import substitution

In the literature, there is broad consensus that all five countries started their industrialisation race with import substitution industrialisation. What is disputed is the timing, pace, and extent of trade liberalisation in East Asia. In order to check whether our data cover the major phases of reforms, Table 4.4 summarises tariff reforms by specifying the year of reform and whether tariffs increased (+) or decreased (-).

[29] http://go.worldbank.org/W1ET8RG1Q0 (Last accessed: November 2014).

Table 4.4. Summary of tariff reforms

	1950s	1960s	1970s	1980s	1990s
Argentina	1958	1967 (-)	1977 (-); 1978 (-)	1988 (-)	1992 (-)
Brazil		1967 (-); 1968 (+)	1973 (-)	1988 (-)	
Mexico			1973 (+)	1984 (-); 1985 (-)	
Korea	1950 (+); 1957 (+)		1974 (-)	1984 (-)	
Taiwan				1983 (-)	

Sources: Argentina: Sourrouille and Lucangeli (1983). Brazil: World Bank (1990) and Suzigan and Villela (1997). Mexico: Moreno-Brid and Ros (2009). Korea: Corbo and Suh (1992). Taiwan: Tu and Wang (1988) and Smith (2000).

For Argentina, data cover the 1967 and 1977 regimes, so we do not have data for the 1958 reform. We do not provide data for the first half of the 1980s, because the 1978 program to reform gradually the tariff system was not honoured. Instead, frequent reforms decreased tariff levels by more than programmed and considerably reduced their sectoral dispersion (Sourrouille and Lucangeli, 1983). These reforms continued until the mid-1990s.

For Brazil, data capture the major reforms from 1950s to the 2000s, but these legal tariffs were not always effective, due to special import regimes that allowed circumventing tariffs. These special regimes were largely reformed in 1988 (World Bank, 1990; Suzigan and Villela, 1997).

In Mexico, domestic protection was achieved via a mix of policy instruments, with tariffs playing only a minor role. The system of protection, in place since the 1940s, was substantially reformed in 1984 when the number and dispersion of tariffs was reduced (Moreno-Brid and Ros, 2009). Because we have data for 1960 and the 1980s and tariffs were not as important as other non-tariff barriers, data coverage can be considered satisfactory.

Moving to East Asia, the Korean multiple tariff system replaced the system of single tariff in the 1950s. Since then, Korean tariffs were high and selective. Attempts to reforming this system started in the early 1970s, but the actual process of tariff reduction began in 1984 (Corbo and Suh, 1992). Because our data start in the mid-1950s, data coverage for Korea is very satisfactory.

The same cannot be said about Taiwan, where data on average tariffs are available from the 1950s but data on tariff dispersion start in the mid-1980s. In Taiwan, domestic market protection was achieved by a system of tariffs, import controls, and licenses. A program of gradual decrease of tariffs and import controls started in 1983 and ended at the end of the 1990s (Tu and Wang, 1986; Smith, 2000). This means that we cannot assess how selective tariffs were in the period in which tariffs were higher.

Table 4.5 presents data on average tariffs and tariff dispersion. As discussed in Section 3.5.2, these are good indicators of the degree of domestic market protection and its selectivity.

Table 4.5. Average tariffs and tariff dispersion (in parenthesis), 1955-2005

	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05
Argentina							27	14	14	14
							(14)	(7)	(7)	(7)
Brazil		54	39	49		51	45	22	14	14
						(26)	(18)	(14)	(7)	(7)
Mexico		22				25	16	14	15	18
						(24)	(10)	(4)	(11)	(15)
Korea	30	40	39	31	27	22	17	13	11	12
	(21)	(31)	(28)	(22)	(18)	(13)	(8)	(7)	(7)	(53)
Taiwan	38	17	17	13	11	8	8	9	8	8
							(11)	(10)	(11)	(15)

Sources: Average tariffs: Argentina: Damill and Keifman (1992), table 4 and WITS. Brazil: von Doellinger et al. (1974), table VI.13, Suzigan and Villela (1997), table 5.1, and WITS. Mexico: UNIDO (1979), table 10, Moreno-Brid and Ros (2009), table 7.4, and WITS. Korea: Kim (1988), table 1 and WITS. Taiwan: Tu and Wang (1988), table 2 and WITS. Dispersion: Argentina: Damill and Keifman (1992), table 4, Porta and Lugones (2011), table 1, and WITS. Brazil: Suzigan and Villela (1997), table 5.1 and WITS. Mexico: Moreno-Brid and Ros (2009), table 7.4 and WITS. Korea: Kim (1988), table 1 and WITS.

Notes: Argentina: for 1985-89 average tariff and tariff dispersion refer to 1988-89. Tariff dispersion for 1990-94 refers to 1990-92. Mexico: average tariff for 1960-65 refers to 1960. Korea: average tariff for 1985-90 refers to 1985 and tariff dispersion in 1975-80 refers to 1978 and in 1980-85 to 1982.

As the table shows, East Asian average tariffs were generally lower than Latin American tariffs, but in few periods, Korea had equal average tariffs than Brazil. Data on tariff dispersion are scant but if we look at the beginning of the 1980s

(where most data are available), Brazilian and Mexican tariffs were roughly twice as dispersed as Korean tariffs.

In order to identify the most protected industries within manufacturing, Table 4.6 shows sectoral legal tariffs. Two caveats apply. First, industries' definition might be too broad, meaning that these averages might still disguise differences in products' tariff rates. Second, nominal legal tariffs might not tell the whole story, or might not be representative at least for two reasons. The first is associated with the presence of other non-tariff barriers (see Table 4.7 and Table 4.9): if a certain product cannot be imported due to import restrictions, its effective tariff is infinite. Moreover, firms or industries could be subject to special import regimes which implies that firms could import free of duties.

Table 4.6. Legal sectoral tariffs, 1960-2005

		60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05
Argentina	Metallurgy			96.7	46.2			10.7	12.8	11.7
	Food							6.8	13.3	14.0
	Textiles			153.9	76.2			17.3	19.1	19.1
	Paper			28.9	29.0			13.1	13.4	12.8
	Chemicals			88.7	26.1			9.0	10.3	10.5
	Machinery			104.8	71.3			14.4	14.6	14.5
	Electrical eq.			89.1	61.2			15.5	15.5	15.2
	Transport eq.			127.0	87.2			14.8	14.3	15.5
Brazil	Metallurgy		54.0	40.0	54.3	72.8	46.7	12.3	11.5	11.8
	Food		82.0	73.0	107.8	84.2	42.9	20.0	13.4	14.4
	Textiles		203.5	98.5	174.3	176.9	83.1	28.5	18.8	19.0
	Paper		93.0	49.0	120.2	82.2	37.2	11.8	12.0	13.0
	Chemicals		53.0	22.0	50.3	34.2	42.3	16.9	10.4	10.9
	Machinery		90.0	45.6	85.8	92.8	52.8	26.6	17.6	15.6
	Electrical eq.		114.0	56.0	99.1	100.4	54.5	28.4	17.8	16.3
	Transport eq.		108.0	43.0	101.9	115.9	52.2	31.1	20.3	17.8
Mexico	Metallurgy	19.3				23.7	23.9	10.6	10.9	13.4
	Food	55.9				27.7	30.1	14.8	23.4	28.9
	Textiles	55.2				46.6	44.6	16.6	21.3	24.1
	Paper	33.8				21.9	19.2	9.4	10.4	13.2
	Chemicals	17.8				11.8	14.0	11.7	11.5	13.4
	Machinery	31.6				36.9	41.4	14.1	12.9	15.3
	Electrical eq.					28.5	39.1	14.2	14.1	16.5
	Transport eq.	18.0				42.8	41.2	14.0	14.6	17.6

Table 4.6. Legal sectoral tariffs, 1960-2005 (Cont.d)

		60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05
Korea	Metallurgy		46.3	54.3	48.7	30.0	13.0	9.2	6.6	3.7
	Food		68.0	77.0	60.0	49.0	25.7	23.8	30.4	42.8
	Textiles		78.0	103.0	81.0	52.0	16.9	12.4	8.4	9.9
	Paper		58.0	68.0	56.0	39.0	14.9	9.9	6.5	2.7
	Chemicals		28.5	31.5	30.5	27.0	16.2	11.4	7.7	6.8
	Machinery		31.5	32.4	26.2	22.8	16.8	11.7	7.6	6.2
	Electrical eq.		47.5	45.0	36.8	31.3	16.9	12.3	7.7	6.1
	Transport eq.		21.0	22.8	17.8	15.3	14.5	9.9	6.2	5.3
Taiwan	Metallurgy						9.7	5.8	4.9	4.3
	Food		79.0				27.2	24.2	23.4	21.6
	Textiles						9.9	9.3	9.2	9.1
	Paper						8.6	5.2	4.9	4.0
	Chemicals						9.0	4.2	4.2	3.9
	Machinery		47.0				11.4	6.7	6.5	5.7
	Electrical eq.						11.2	7.1	6.7	5.6
	Transport eq.		59.0				15.8	11.6	11.5	11.7

Sources: WITS-TRAINS. Argentina: Sourrouille and Lucangeli (1983), table 7 and 9. Brazil: Braga and Tyler (1992), table 17.1. Mexico: King (1970), table 6.1, UNIDO (1979), table 10, and World Bank (1986), table VIII.6. Korea: Lee (1996), table A5. Taiwan: Lee and Liang (1982), table 10.7.

Notes: Argentina: 1970-75 refers to 1975 and 1975-80 refers to the 1976 reform. Brazil: It includes import surcharges. Mexico: data refer to 1960, 1983, and 1986. For Taiwan: For 1969, it refers to adjusted tariffs.

If we compare data for the period of most active intervention (1965-1980), the most protected industry is textiles.[30] Huge differences in degrees of protection apply to transport equipment, a strategic industry for industrialising countries. Transport equipment was highly protected in Argentina and Brazil (tariffs were as high as 127% and 116% respectively) and much less so in Korea (the peak was 23% in the early 1970s). Finally, while in Korea there were large differences between more and less protected industries, these differences were not as large as in Latin America.

Tariffs are often only a small element of the commercial strategy of a country. In order to evaluate the degree of trade protection of these five countries, quantitative import restrictions are analysed. Table 4.7 reports import liberalisation ratios for all countries and periods where data are found. The import liberalisation ratio is computed as the proportion of importable trade items over total tradable items.[31]

Table 4.7. Import liberalisation ratio, Brazil, Mexico, Korea, and Taiwan, 1950-90

	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90
Brazil								84.7
Mexico		28.0	52.0	63.0	61.5	77.7	79.6	
Korea		4.4	3.4	56.1	51.2	55.5	77.9	92.6
Taiwan	55.2	48.1	53.7	55.1	79.0	97.5	97.0	97.8

Sources: Brazil: Braga and Tyler (1992), table 17.1. Mexico: World Bank (1986), table VIII.2. Korea: Kim (1988), table 5 and Smith (2000), table 3.1. Taiwan: Smith (2000), table 2.4.

Notes: Brazil: for 1985-90, data refer to 1989.

In the mid-1960s, Mexico, Taiwan, and Korea imposed similar levels of trade restrictions. From the mid-1970s, Taiwan relaxed its import restrictions. The same process took more time in Korea where in the first half of the 1980s, shares of restricted items were still similar to those of Mexico.

In order to check the degree of selectivity of import restrictions and whether the processes of relaxation were biased in favour of targeted industries, Table 4.8

[30] Brazilian tariffs include import surcharges. So, higher tariff rates might be partly explained by import surcharges.

[31] Import liberalisation ratios are imperfect measures of domestic market protection. If many items are subject to licenses but licenses are issued rapidly and more or less automatically, liberalisation ratios might not reflect true degrees of restrictiveness.

shows sectoral import liberalisation ratios for Brazil, Mexico, and Korea (the only countries for which sectoral data were found).

Table 4.8. Import liberalisation ratios, by industry, Brazil, Mexico, Korea, 1955-90

		55-60	60-65	65-70	70-75	75-80	80-85	85-90
Brazil	Metallurgy						53.9	72.6
	Food						94.3	90.3
	Textiles						94.9	37.0
	Paper						71.4	85.9
	Chemicals						19.2	97.7
	Machinery						61.6	90.0
	Electrical eq.						90.5	69.2
	Transport eq.						60.6	66.9
Mexico	Metallurgy							
	Food	28.9	57.7					
	Textiles							
	Paper							
	Chemicals	40.8	51.0					
	Machinery	35.8	54.1					
	Electrical eq.							
	Transport eq.							
Korea	Metallurgy		94.5	91.8	42.1	42.1	76.3	99.0
	Food		100.0	85.5	86.6	77.6	67.9	80.3
	Textiles		98.8	98.8	84.9	79.9	67.6	96.9
	Paper		97.1	97.1	60.0	80.0	36.8	99.6
	Chemicals		86.4	86.4	59.1	56.7	86.7	97.8
	Machinery		100.0	90.0	34.0	67.1	67.0	93.1
	Electrical eq.		100.0	100.0	77.0	82.8	54.8	91.3
	Transport eq.		100.0	100.0	21.3	28.1	27.9	

Sources: Brazil: Suzigan and Villela (1997), table 23, and Braga and Tyler (1992), table 17.1. Mexico: King (1970), table 4.4. Korea: Lee (1996), table A6, Leipziger et al. (1987) table 3.2, and Moreira (1995), table 13.

Notes: Brazil: it refers to 1984 and 1989. Korea: For the 1980s, food includes beverages.

In the 1960s, Mexico imposed higher import restrictions than Korea. For example, in the chemical industry, 51% of tradable items were allowed to enter the Mexican territory, while in Korea 86%. However, when the Korean government implemented the Heavy and Chemical Industry (HCI) investment plan, import restrictions increased and became more selective. For example, in the transport equipment industry, only between 21% and 28% of total tradable items were importable from the 1970s.[32] Finally, a comparison of Brazil and Korea in the only periods when data are available for both countries shows that at the beginning of the 1980s, restrictions were high and selective in both countries, while by the end of the 1980s, the process of trade liberalisation was more advanced in Korea than Brazil.

Table 4.9 provides a summary of all the other policy instruments of domestic market protection implemented in the five countries from the 1950s to the 1980s.

[32] In the early 1970s, the Korean Heavy and Chemical Industry (HCI) investment plan imposed high import restrictions in the metallurgical, machinery, and chemical industries.

Table 4.9. Other policies to protect the domestic market, 1950-1980

	1950s	1960s	1970s	1980s
Argentina		Licenses; surcharges; official prices	Licenses; surcharges; official prices	Licenses; surcharges; official prices
Brazil	Multiple exchange rates; LCRs; similarity test	Unified exchange rate; LCRs; import reference prices; 15 margin for national firms in tenders; similarity test; special import regimes	Licenses; import surcharges; LCRs; import reference prices; system of advance deposits for imports; direct controls on import purchases by SOEs; margins for national firms in tenders; similarity test	Licenses; import surcharges; temporary suspension for license issues; import financing requirements; foreign exchange controls; import negotiations
Mexico	Import licenses	Import licenses; LCRs	Import licenses; LCRs	Import licenses; import reference prices
Korea	Multiple exchange rates; Foreign exchange tax	Tariffs on inessential commodities; import licenses; link system; foreign exchange allocation ceiling; special laws for some industries; LCRs	Tariffs on inessential commodities; import licenses; link system; foreign exchange allocation ceiling; special laws for some industries; LCRs	Special laws for some industries; import licenses
Taiwan	Multiple exchange rates; preferential allocation of foreign exchange; licenses; import surcharges; LCRs	Unified exchange rate; foreign exchange controls; licenses; import surcharges; LCRs; quality standards	Licenses; foreign exchange controls; LCRs	Foreign exchange controls; LCRs

Sources: Author's elaboration based on: Argentina: Berlinski (1992) and Nogues (1988). Brazil: Suzigan and Villela (1997) and Braga and Tyler (1992). Mexico: Page (1992). Korea: Hong (1992). Taiwan: Tu and Wang (1988) and Wade (1990).

As the table shows, the most common non-tariff measures (apart from quantitative restrictions) are multiple exchange rates, licenses, and local content requirements (LCRs).

4.4.2 Export promotion

Export promotion measures consist of export financial and fiscal incentives, and business support services.[33] Financial incentives are directed credit and subsidised loans provided to exporting firms. Fiscal incentives include tax refunds, tax deductions, and tax holidays. In terms of data, some studies estimated the extent of export subsidies by putting together all (or the most important) policy instruments (Baumann, 1989; Pinheiro et al., 1993; Moreira and Panariello, 2005; Bisang and Kosacoff, 1990; Kim, 1991). Others gathered data on financial and fiscal schemes separately. Table 4.10 summarises the type of data available.

[33] While here we focus on fiscal and financial incentives, it is important to acknowledge the role of KOTRA and CETRA, the agencies for export promotion services in Korea and Taiwan.

Table 4.10. Summary of export promotion data, 1960-2000

	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Argentina	x	x	Fiscal & financial incentives	Fiscal & financial incentives	Gross subsidies	Gross subsidies	x	x
Brazil	x	x	Gross subsidies	Gross subsidies	Gross subsidies	Gross subsidies	Gross subsidies	Gross subsidies
Mexico	x	Fiscal & financial incentives	Fiscal & financial incentives	Fiscal & financial incentives	Fiscal & financial incentives	x	Financial incentives	Financial incentives
Korea	Gross subsidies	Gross subsidies	Gross subsidies	Gross subsidies	Financial incentives	Financial incentives	Financial incentives	Financial incentives
Taiwan	Fiscal incentives	Fiscal incentives	Fiscal & financial incentives	Fiscal & financial incentives	Fiscal & financial incentives	Fiscal & financial incentives	Fiscal incentives	Fiscal incentives

Source: Author's elaboration.

For Argentina, Brazil, and Korea estimations of gross subsidies are available. In the Argentina, the coverage is quite low.[34] In Brazil, our data do not capture the 1960s, but cover the 1970s, when export promotion was considered a cornerstone of the Brazilian development strategy. In Korea, estimations of gross subsidies are available from 1960 (when export promotion began) to 1980. After 1980, only data on export loans are available. These data, however, are still satisfactory. According to estimations of gross subsidies, tariff exemptions were the strongest export incentive, implying that the degree of export promotion after the 1980s might be underestimated by our data. Nevertheless, we still think that our data are good proxies of the degree of export promotion in Korea because the reforms of import liberalisation of the 1980s reduced the level of tariffs, and so of the export incentives induced by them.

For Mexico and Taiwan, estimations of gross subsidies are not available. For Mexico, data on the principal financial and fiscal incentive schemes are available from 1965 to 1985. Starting from the mid-1980s, neoliberal reforms affected the management of export incentives: export promotion was centralized and trade liberalisation decreased the impact of tariff exemptions. This means that for 1965-1985 and 1990-1996 our data capture the main instruments of export promotion. For Taiwan, data on tax incentives are available from 1960 to 1998 and data on loan subsidies from the 1970s to the end of the 1980s. We believe that these data are representative of the degree of export promotion: tax incentives were used more than financial incentives and from the mid-1980s, both fiscal and financial incentives were wound back. Hence, even if for the 1990s data cover just tax incentives, they might only slightly underestimate the extent of export promotion.

In the literature, export subsidies are often shown as percentages of manufacturing exports. This measure directly relates export incentives with their performance. This, however, overestimates the extent of export promotion when manufacturing exports are low -Argentina, Brazil, and Mexico- and underestimate it when manufacturing exports are high -Korea and Taiwan. Therefore, the extent of export incentives is computed as a percentage of both manufacturing exports and GDP (Table 4.11).

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[34] Even if it would be interesting to compare also the levels of export promotion in the 1960s -when export promotion incentives were first introduced- and in the 1990s -when neoliberal reforms were implemented, it should be mentioned that export promotion became effective only at the beginning of the 1970s (World Bank, 1979).

Table 4.11. Export incentives, as % of manufacturing exports and GDP, 5-year averages, 1960-2005

	60-65		65-70		70-75		75-80		80-85		85-90		90-95		95-00		00-05	
	% of man. exp.	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*	*% of man. exp.*	*% of GDP*
Argentina						0.6		0.8	12.5	0.7	7.9	0.3						
Brazil			42.7	0.3	55.6	0.7	66.0	1.3	61.0	2.3	49.2	2.3	32.2	1.5	32.6	1.1	34.4	2.2
Mexico			4.9	0.0	2.6	0.0	4.5	0.1	4.6	0.1			30.3	2.6	4.2	0.9		
Korea	49.8	0.3	22.5	1.1	25.9	3.4	18.5	3.9	4.6	1.1	0.1	0.0	0.0	0.0				
Taiwan	15.2	0.9	17.7	1.7	13.6	3.7	9.0	3.3	4.6	1.9	2.0	0.9	0.3	0.1	0.1	0.1		

Sources: Argentina: World Bank (1979), table 5 and Bisang and Kosacoff (1990), table 21. Brazil: Pinheiro et al. (1993), table 1 and Moreira and Panariello (2005), table 26. Mexico: NAFINSA (1971), table 95, Jimenez (1987), table 4 and 5, and Mattar (1998), table 7. Korea: KOSIS online and Moreira (1995), table A.12. Taiwan: Smith (2000), table 2.7 and Jenkins et al. (2003), table 5.9.

Notes: Manufacturing exports are calculated using the WDI and for Taiwan: DGBAS, WITS, and WTO. Argentina: Estimations based on data on financial incentives, refunds of direct taxes (reembolsos) and drawback, excluding refunds of direct taxes. Brazil: It refers to estimations of gross subsidies, i.e. direct tax reduction, tax credit, interest rate subsidy, indirect tax reduction and tariff exemptions. Mexico: Incentives refer to costs of drawback (CEDI) and financial subsidies (FOMEX). Incentives by NAFINSA are not included. Korea: It includes export loans and gross subsidies (direct cash subsidies, export dollar premium, direct tax reduction, interest rate subsidy, indirect tax reduction and tariff exemptions) from 1958-1983.Taiwan: It includes export loan subsidies and refunds of various taxes (customs duty, commodity tax and other taxes). From 1972 to 1979, manufacturing exports were estimated by interpolation.

Computed as percentages of manufacturing exports, export incentives in Brazil were the highest: in the 1970s, approximately 60% of Brazilian manufacturing exports received some forms of government support. By contrast, less than 20% of Korean manufacturing exports received support. In terms of percentages of GDP, only in few periods Brazil and Mexico came close to the high levels of export promotion of Taiwan and Korea, and did so much later. In the 1970s, Korea and Taiwan reached peaks of 3.9% and 3.7% respectively; Brazil reached 2.3% in the 1980s, and Mexico 2.6% in the beginning of the 1990s.

This discrepancy between export incentives as percentage of manufacturing export and GDP is explained by the lower shares of manufacturing exports that characterise Latin American countries (Figure 4.3).[35] For example, in Brazil, the largest export incentives were tax reductions. This means that, had Brazilian manufacturing exports been more competitive, the state would have disbursed more and this would have translated into a higher share of export incentives in GDP. It could be argued that, in these circumstances, subsidised long-term loans and directed credits could have been more effective in turning Brazilian manufacturing firms into exporters. Compared to fiscal incentives, these instruments could have allowed accumulation of exporting capabilities, and so could have increased the number of exporting firms in the country.

Data for Taiwan show that export promotion incentives decreased already in the 1980s. Because loan subsidies were much lower that tax refunds (data not reported here), the lack of data on loan subsidies does not excessively damage the estimation of export promotion. Hence, it is credible that export promotion incentives decreased already in the 1980s.

In Korea, the highest level of export promotion was registered in the 1970s. While the level of export promotion might be slightly underestimated in the 1980s, the difference between general and subsidised export interest rates decreased in the 1980s (Sakong and Koh, 2010). Hence, although our indicator is slightly underestimating the degree of export promotion of Korea at least in the first half of the 1980s, the decrease in export promotion was real.

Sectoral data on export promotion in Argentina, Brazil, Mexico, and Taiwan are shown in Table 4.12.

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[35] In Latin America, manufacturing exports are not competitive also because abundance of natural resources appreciates the exchange rate (Bresser-Pereira, 2008).

Table 4.12. Export promotion by industry, as % of total, 5-year averages, Argentina, Brazil, Mexico, and Taiwan, 1965-2005

		65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05
Argentina	Metallurgy				12.1	20.6			
	Food								
	Textiles								
	Paper				5.8	3.1			
	Chemicals								
	Machinery				14.8	8.8			
	Subtotal				*29.2*	*31.5*			
Brazil	Metallurgy				11.5	9.8	12.4	10.6	9.2
	Food				11.1	7.9	8.3	9.6	9.1
	Textiles				10.9	9.1	3.0	1.9	1.7
	Paper				2.2	2.4	3.9	4.1	3.3
	Chemicals				11.5	11.3	6.9	6.7	7.4
	Machinery				40.2	48.3	25.4	27.0	28.8
	of which: electrical eq.				9.4	11.4	1.7	1.8	1.7
	of which: transport eq.				22.2	28.7	14.3	16.3	17.5
	Subtotal				*87.5*	*88.8*	*59.9*	*60.0*	*59.5*
Mexico	Metallurgy								
	Food	22.6							
	Textiles	16.8							
	Paper								
	Chemicals	17.5							
	Machinery	9.8							
	of which: transport eq.	4.4							
	Subtotal	*66.7*							
Taiwan	Metallurgy				6.2				
	Food				20.5				
	Textiles				31.8				
	Paper								
	Chemicals				2.9				
	Machinery								
	of which: electrical eq.				6.1				
	Subtotal				*67.5*				

Sources: Argentina: Bisang and Kosacoff (1990), table 22. Brazil: Moreira and Panariello (2005), table II and XXVI, and Pinheiro et al. (1993), table 3. Mexico: NAFINSA (1971), table 95. Taiwan: Smith (2000), table 4.3.

Notes: Brazil: Food includes beverages from 1990 to 2004. Textiles include apparel. Taiwan: data refer to 1981. Metallurgy includes machinery.

Because of limited comparative data, our analysis is restricted to few observations. In the early 1980s, 40% of Brazilian export incentives went to machinery, with transport equipment absorbing more than half of them. In Taiwan, most promoted industries were textiles and food that together accounted for over 50% of total export incentives. After the 1990s reforms, the Brazilian shares of export incentives to manufacturing decreased and also the machinery and transport equipment industries received a much smaller share of total export incentives.

Eligibility criteria for export promotion schemes were present in several countries. In Argentina, export incentives were larger for (and in some periods, restricted to) capital and durable goods (World Bank, 1979; Bisang and Kosacoff, 1990). In Mexico, there were local content requirements of 50% in the 1960s (King, 1970) and 30% in the 1970s (United States International Trade Commission, 1985). In Taiwan, rather than local content requirements, quality inspections and quality control systems reduced the chances that one low-quality producer would penalise other producers. In particular, textiles, electronics and electrical appliances, and food companies were required to apply for a grading of their quality control system in order to have permission to export (Wade, 1990).

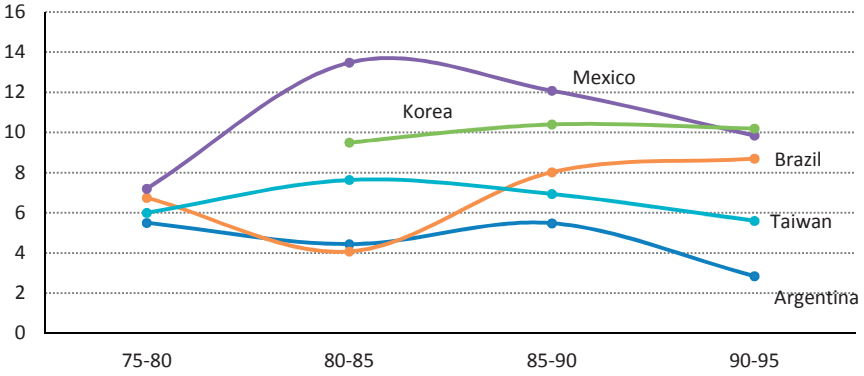
4.5 Investment policy

A key area of industrial policy aims at spurring firms' investments. Investment policies include direct production via state-owned enterprises (SOEs), loans by national development banks, and financial and fiscal incentives in the form of preferential credits, tax reductions, tax holidays, tax credits, and tax deferrals.

4.5.1 State-owned enterprises

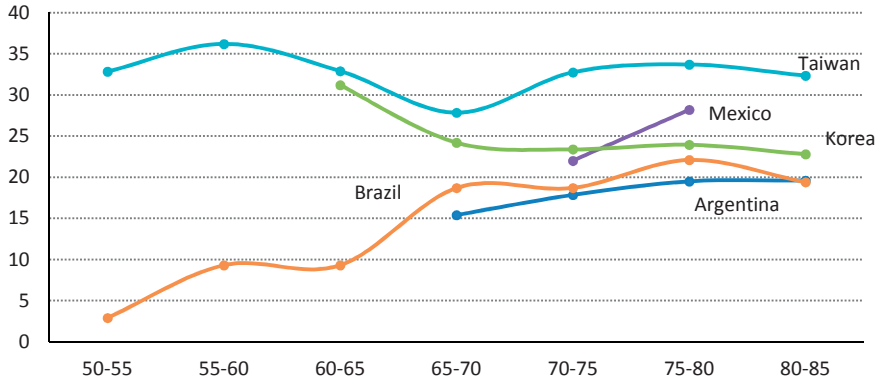
SOEs played an important role in all five countries under analysis. The data collected to quantify the role of SOEs is quite satisfactory, ranging from the 1950s-60s to the mid-1980s and 1990s. Since the mid-1980s, waves of privatisations affected all five countries, leading to a smaller role of SOEs. Figure 4.9 and Figure 4.10 present data on the share of SOEs' value added in GDP and SOE's share in total gross fixed capital formation respectively.

Figure 4.9. SOEs' value added, as % of GDP, 5-year averages, 1975-95



Source: World Bank (1995), table A1.

Figure 4.10. SOEs' share in gross fixed capital formation, 5-year averages, 1950-85



Sources: Argentina, Mexico, Korea, and Taiwan: Short (1984), table 2. Brazil: Moreira (1995), table A.34.

Data on SOEs' value added in GDP do not show any dramatic polarisation between Latin America and East Asia. Instead, if we look at SOEs' share in value added, two groups can be identified. In Mexico and Korea, SOEs' value added shares were around 10-12% of GDP from the 1980s to mid-1990s, in Taiwan and Argentina between 7% and 3%. In the first half of the 1980s, Brazil shifted from levels similar to Argentina and Taiwan to levels similar to Mexico and Korea.

Taiwanese SOEs, whose value added shares in GDP were smaller than the Koreans and Mexicans, invested the most: roughly 30% of total investments in the country were made by SOEs. While in the 1960s, Korean SOEs were investing as much as Taiwanese SOEs (in percentage of total investments), since the 1970s

their investments became similar to those of Latin American SOEs, in the range of 20-25% of gross fixed capital formation.

Table 4.13 presents data on SOEs' budgetary burden, defined as subsidies, transfers, and loans to public firms less dividends and interest payment.

Table 4.13. Budgetary burden, as % of GDP, 5-year averages, Argentina, Brazil, Mexico, and Korea, 1970-95

	70-75	75-80	80-85	85-90	90-95
Argentina	1.8	1.9	3.0	2.8	
Brazil		-0.5	1.3	1.8	0.2
Mexico		1.9	-3.2	-2.4	-3.2
Korea	0.1	0.4	0.6	-0.2	-0.1

Sources: Argentina, Mexico, and Korea: Short (1984), table 7 and World Bank (1995), table A.7. Brazil: World Bank (1995), table A.7 and Pinheiro and Giambiagi (1997), table 3.

Notes: Brazil: 1980-93 data refer to Treasure's resources to SOEs. Argentina: 1985-90 data refer to 1985-87. Mexico and Korea: 1990-95 figure refers to the average of 1990-91.

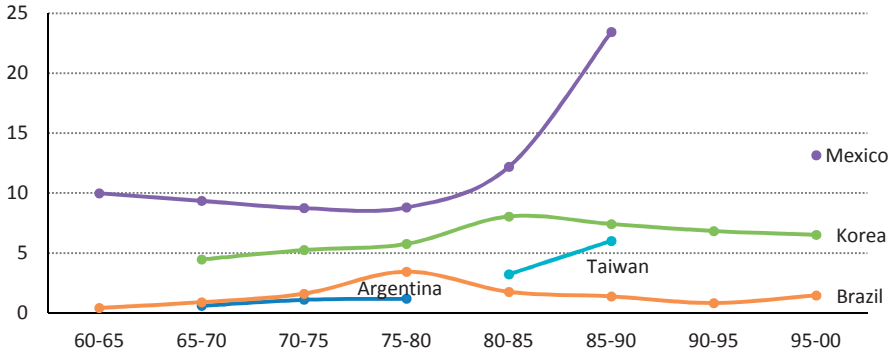
With the exception of Brazil in the mid-1970s, Latin American SOEs' burdens on the state were much larger than the East Asian ones. As seen in Figure 4.8, privatisations were much more abrupt in Latin America than East Asia, possibly also because maintaining SOEs was more costly.

4.5.2 National development banks

Particularly important to industrial development were (and are) development banks, the state's agent for financing of industrial investments (Amsden, 2001). Brazil, Mexico, and Korea had national development banks, namely BNDES (Banco Nacional do Desenvolvimento Econômico e Social), NAFINSA (Nacional Financiera), and KDB (Korean Development Bank). In Argentina, the national development bank, Banco Nacional de Desarrollo (BND), was established in 1944 but from the mid-1970s, it was slowly dismantled. In Taiwan, a system of specialised development banks existed.

Data on national development banks are satisfactory for all countries but Taiwan for which data are only available for the 1980s. The role of development banks is captured by several indicators. Figure 4.11 shows the share of development banks' lending in GDP.

Figure 4.11. Development banks' lending, as % of GDP, 5-year averages, 1960-2000



Sources: Argentina: BND (various issues). Brazil: IBGE (various issues). Mexico: NAFINSA (various issues). Korea: Bank of Korea (various issues). Taiwan: Smith (2000), table 4.4(a) and (b).

Notes: Taiwan: it refers to the Bank of Communications in 1982 and 1989.

Apart from Mexico whose values from the mid-1980s are exceptional, the Korean and Taiwanese development banks lent roughly 5 times more than the Argentine and Brazilian banks, with the latter approaching East Asian levels only sporadically.

Table 4.14 shows the share of manufacturing lending in total lending.

Table 4.14. Development banks' lending to the manufacturing industry, as % of total lending, 5-year averages, 1950-2000

	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Argentina					67.8	63.7	80.4			
Brazil	14.4	58.3	60.8	63.0	67.5	80.9	50.7	54.2	55.4	43.5
Mexico	27.3	39.3	31.1	24.4	23.9	38.3	25.6	9.3		5.0
Korea	29.2	36.8							65.3	59.6
Taiwan							38.6	53.4		

Sources: Argentina: BND (various issues). Brazil: IBGE (various issues), World Bank (1983), table 2.16, and Suzigan and Villela (1997), table 14. Mexico: NAFINSA (various issues). Korea: Bank of Korea (various issues). Taiwan: Smith (2000), tables 4.4 (a) and (b).

Notes: Taiwan: it refers to 1982 and 1989.

Given the scarcity of data for Korea and Taiwan, comparisons are hard. Nevertheless, data seem to suggest that at least the Brazilian, Argentine, and Taiwanese banks were allocating more than half of their loans to the manufacturing industry. Instead, the percentages of the Mexican NAFINSA were much lower because

manufacturing financing was undertaken primarily by domestic private banks, while NAFINSA was mostly engaged in infrastructure investments (as seen in Section 4.3).

Table 4.15 shows the sectoral distribution of loans to manufacturing. For the sake of simplicity, the table displays five major industries, namely metallurgy, food processing, textiles, paper, chemicals, and machinery and equipment (as in previous tables, wherever possible we report also data for transport equipment).

Table 4.15. Development banks' lending by industry, as % of manufacturing lending, 5-year averages, 1950-2000

		50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Argentina	Metallurgy	9.0	14.0	12.5	19.2	14.4	18.8	7.8	12.5		
	Food	14.0	16.0	14.5	16.0	17.9	16.6	5.9	19.2		
	Textiles	20.0	21.0	20.0	14.1	15.6	8.6	2.8	10.9		
	Paper	1.0	3.0	3.5	3.6	5.9	9.3	30.6	3.3		
	Chemicals	6.0	8.0	6.5	4.1	4.3	21.7	17.0	36.1		
	Machinery and eq.	15.0	16.0	12.5	17.2	21.7	10.5	29.4	9.4		
	of which: transport eq.					8.8		24.0			
	Subtotal	*65.0*	*78.0*	*70.0*	*74.0*	*81.5*	*86.5*	*94.2*	*92.5*		
Brazil	Metallurgy	34.5	57.3	78.9	52.4	21.5	45.4	47.1	28.3	12.4	11.5
	Food				6.5	8.4	5.6	5.3	9.1	9.7	20.3
	Textiles				4.8	7.7	3.5	3.9	7.8	6.7	5.8
	Paper	6.3	6.3	0.2	10.9	5.1	7.0	7.3	12.6	23.2	7.7
	Chemicals	35.7	2.5	16.4	3.5	21.7	15.5	12.7	10.7	11.6	5.6
	Machinery and eq.	23.4	33.8	3.9	14.7	13.3	9.6	6.9	16.4	16.4	30.1
	of which: transport eq.	12.6	30.9	2.8	6.9	6.6	2.3	1.4	3.9	6.8	18.4
	Subtotal	*100.0*	*99.9*	*99.5*	*92.6*	*77.6*	*86.7*	*81.8*	*85.0*	*80.0*	*81.0*
Mexico	Metallurgy	21.8	17.4	16.5	21.0	26.9	59	44.1	28.7		17.2
	Food	24.0	12.4	9.2	8.5	12.4	3.8	2.8			71.3
	Textiles	8.1	5.5	4.8	8.1	9.1	4.7	4.0			0.5
	Paper	6.5	7.1	7.0	7.0	7.8	3.1	2.8			1.8
	Chemicals	9.3	8.3	9.2	18.7	14.3	6.3	8.4			1.4
	Machinery and eq.	4.1	17.2	21.6	23.2	24.3	18.4	12.7	4.4		4.9
	of which: transport eq.	3.9	17.2	18.5	20.3	23.2	17.1	13.9			
	Subtotal	*73*	*67.9*	*68.3*	*86.6*	*94.9*	*95.5*	*93.6*			*79.3*

Table 4.15. Development banks' lending by industry, as % of manufacturing lending, 5-year averages, 1950-2000 (Cont.d)

		50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Korea	Metallurgy					14.0					
	Food					6.7					
	Textiles					14.6					
	Paper					3.8					
	Chemicals					18.2					
	Machinery and eq.					29.7					
	of which: transport eq.										
	Subtotal					*86.9*					
Taiwan	Metallurgy							18.3	6.1		
	Food										
	Textiles							13.7	22.2		
	Paper										
	Chemicals							36.9	29.9		
	Machinery and eq.							31.1	41.8		
	of which: transport eq.										
	Subtotal							*100.0*	*100.0*		

Sources: Argentina: Rogier (2011), table I.3 and BND (various issues). Brazil: IBGE (various issues), World Bank (1983), table 2.16, and Suzigan and Villela (1997), table 14. Mexico: NAFINSA (various issues). Korea: Bank of Korea (various issues). Taiwan: Smith (2000), table 4.4(a) and (b).

Notes: Argentina: for 80-85, data refer to 1983; for 85-89, to 1985 and 1986. Brazil: for 50-55, data refer to 52-57. Mexico: For 80-85, data refer to 80-82 (preliminary figures). Taiwan: data refers to 1982 and 1989.

In most of the countries and periods, lending is concentrated in machinery and equipment (and in particular transport equipment), metallurgy, and chemicals. This is not surprising because these were priority industries in all five countries. Brazil is probably the most selective country in this respect, with almost 50% of loans devoted to the metallurgical industry. This tendency reduced from the mid-1980s when less strategic industries (e.g. paper) took over and the share of loans to the metallurgical industry decreased to 28% in the mid-1980s and roughly 12% in the 1990s.

4.5.3 Financial and fiscal incentives to investments

Table 4.16 compares government expenditures in programs that granted long-term loans for the acquisition of domestic capital goods in Brazil, Mexico, and Korea - the three countries where this type of programs existed. These programs were FINAME (Fund for the acquisition of machinery and equipment) in Brazil, FONEI (Fund for industrial development) in Mexico and NIF (National Investment Fund) in Korea. FINAME was established in 1964 and was the "most important official source of financing of machinery and equipment production" (World Bank, 1990, p. 56). Because our data start in 1965 and end in the mid-1990s, data coverage for Brazil is very satisfactory. In Mexico, FONEI was established in 1971. As part of the reforms of the early 1990s, FONEI was absorbed within the programs run by the development bank NAFINSA. Hence, data cover the whole period of implementation of FONEI. The Korean NIF was among the instruments used to implement the HCI drive. Because the HCI was implemented in the early 1970s, our data cover the entire history of the NIF.

Table 4.16. Financial incentives, as % of GDP, 5-year averages, Brazil, Mexico, and Korea, 1965-2005

	65-70	70-75	75-80	80-85	85-90	90-95	95-00	00-05
Brazil	0.1	0.3	1.5	0.8	0.3	0.3		
Mexico		0.1	0.1	0.1	0.0			
Korea		0.3	0.9	1.1	0.9	0.3	0.0	0.0

Sources: Brazil: World Bank (1983), table 9.14, IBGE (1984), table 21, and Villela (1995), table 7. Mexico: Banco de Mexico (various issues). Korea: Bank of Korea online[36].

Notes: Brazil: FINAME disbursements. Mexico: FONEI authorized credits. Korea: NIF loans.

[36] Available at: http://ecos.bok.or.kr (Last Accessed: November 2014).

As the table shows, similar levels of support were provided by the Brazilian and Korean programs. As for Mexico, low disbursements might reflect low state capacity to allocate sufficient resources or might be because this program did not constitute the main source of financing for firms.[37]

Table 4.17 shows fiscal incentives (where possible only to the manufacturing industry) as percentages of GDP. In Taiwan, fiscal incentives were part both of the Statute for the Encouragement of Investment (SEI), in place from the 1960s to the 1990s and the Statute for the Upgrading of Industry (SUI) that substituted the SEI in the 1990s. The regimes of fiscal incentives of the SEI and SUI differed in their level of selectivity. In the SEI, fiscal incentives were given only to targeted industries; in the SUI, it was given in a more functional way, i.e. in favour of more general objectives like R&D, training, and environmental causes (Smith, 2000). Similarly to Taiwan, in Korea tax incentives were firstly designed for the HCI drive and, at the beginning of the 1980s, were re-modelled to encourage R&D investments (Leipziger et al., 1987).

Among the Latin American countries under analysis, similar tax schemes were present only in Mexico. Mexican tax schemes discriminated between industries and types of firms (benefiting mostly nationally owned firms). These schemes were discontinued in the 1990s. In Brazil, there were no fiscal incentives to promote investments. In Argentina, fiscal incentives were introduced and cyclically removed, so data are not available.

[37] In terms of most benefited industries, FONEI credits were allocated mostly to metallurgical products, machinery, chemical and petrochemical industry, plastics and coal (Banco de Mexico, 1988). FINAME subsidies were not selective, in the sense that there were no specific requirements on the sectors that could be supported. However, according to data on sectoral distribution of FINAME disbursements for the 1970s, most benefitted sectors were steel, machinery and transport equipment, petrochemicals, textiles, railroads, energy generation and transmission (IBGE Anuario Estatistico do Brasil, various issues; World Bank, 1986). NIF loans were mostly supplied to the steel, petrochemical, electric power, and shipbuilding industries (Cho and Kim, 1995).

Table 4.17. Fiscal incentives, as % of GDP, 5-year averages, Mexico, Korea, and Taiwan, 1960-2000

	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Mexico	0.1	0.1		0.3	0.1	0.0		
Korea	1.3	0.8	0.6	0.6	0.4			
Taiwan	0.4	0.5	1.0	1.1	1.1	0.9	0.7	0.1

Sources: Mexico: NAFINSA (1971), CEPAL (1979), table 18, World Bank (1986), table 2, and Feltestein and Shah (1992), table A6 and table A9. Korea: Lee and Yamazawa (1990), table 2.3. Taiwan: Jenkins et al. (2003), table 4.3.

Notes: Mexico: For 1976, data refer to tax subsidies of annual agreements and incentives under the Law for the Development of New and Necessary Industries. For 1977-79, it refers to total fiscal incentives. For 1979-89, it refers to fiscal revenue loss under CEPROFIS. For 1983-85, it includes also agreements of annual validity to the automobile industry. Taiwan: Data refer to tax reductions under SEI.

As for financial incentives, the Korean and Taiwanese fiscal schemes provided much more support than the Mexican scheme. That fiscal incentives were particularly important in Taiwan is not surprising because the Taiwanese industrial policy strategy was generally more oriented towards fiscal rather than financial incentives.

Table 4.18 summarises objectives, targeted industries, and conditions to obtain fiscal incentives in Mexico, Korea, and Taiwan from the 1960s to the 1990s.[38]

[38] The table (intentionally) does not capture the level of complexity of these regimes. We list only main eligibility criteria. These, however, were often more complex and involved aspects like quantity and quality of employment generated, lists of eligible products, technical efficiency, etc. (e.g. King, 1970; Wade, 1990).

Table 4.18. Targeted industries and conditions of fiscal incentives, Mexico, Korea, and Taiwan, 1960-1990

		1960s	1970s	1980s	1990s
Mexico	**Objectives**	Import-substitution		Channel investments in strategic areas	
	Industries			Automobiles; chemicals and petroleum derivatives; basic metals and metallic products; machinery and equipment	
	Conditions	Necessary and new industries; LCRs		LCRs	
Korea	**Objectives**	Promote HCIs		Channel investments in strategic areas	Spur R&D and facilitate industrial rationalization
	Industries	HCIs		Naphtha cracking; steel; machinery; electronics; shipbuilding; aviation	None
	Conditions	--	--	--	--
Taiwan	**Objectives**	Channel investments in strategic areas	Encourage capital-intensive industries	Encourage technology-intensive industries	Encourage R&D, training, and promote anti-pollution measures
	Industries	Textiles and footwear	Basic Metals; petrochemicals; machinery; electronics	Basic Metals; petrochemicals; machinery; electronics	All industries
	Conditions	Newly established enterprises; economies of scale; upgrading equipment; LCRs; export targets			None

Sources: Author's elaboration based on: Mexico: King (1970), CEPAL (1979), Feltestein and Shah (1992), and OECD (1992). Korea: Smith (2000). Taiwan: Smith (2000) and Jenkins et al. (2003).

4.6 Science, technology, and innovation policy

4.6.1 Science policy

Research was organized differently in the East Asian and Latin American countries. In Korea and Taiwan, research institutes directly received funds to conduct their research projects. In Argentina, Brazil, and Mexico governments transferred resources to research councils (CONICET in Argentina, CONACYT in Mexico, and CNPq in Brazil) that distributed grants and scholarships to researchers.[39] In order to account for this, we separately account for research financing to research councils (Table 4.19) and to main research institutes (Table 4.20). In Korea, Lee et al. (1991) describe the role of KIST, the Korea Institute of Science and Technology, since its establishment in 1966. In Taiwan, ITRI, Industrial Technology Research Institute, was the most important research centre and the beneficiary of the largest government transfers (Hsu and Chiang, 2001). The closest equivalent to ITRI and KIST in Brazil is the Institute of Technological Research (IPT). This institute had the closest linkages with the industrial sector. However, its role in the Brazilian national innovation system was much smaller (Dahlman and Frischtak, 1992). In Argentina, Katz and Bercovich (1992) evidence the role of CNEA (Atomic Energy Commission).[40] Finally, Wionczek and Marquez (1993) highlight the role of the Mexican Petroleum Institute (IMP) for the creation of domestic technological capabilities in the most important industry of the Mexican economy.

[39] In Mexico, CONACYT also distributes funds to public research institutes (Dutrenit et al., 2011).
[40] Argentina has an institute similar to the KIST, the INTI (National Institute for Industrial Technology), but its role is very limited (Lopez, 2002).

Table 4.19. Research financing, as % of R&D and GDP, 5-year averages, Argentina, Brazil, and Mexico, 1965-2000

	65-70		70-75		75-80		80-85		85-90		90-95		95-00	
	% R&D	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*
Argentina							15.9	0.0	20.1	0.0	29.0	0.0		
Brazil		0.1		0.3		0.2		0.0		0.1		0.1		
Mexico			8.6	0.0		0.0		0.0	12.3	0.0	26.7	0.1	19.6	0.1

Sources: Argentina: Bisang (1994), table II.4 and Correa (1998), table 5. Brazil: World Bank (1983), table 9.2 and 9.3 and Suzigan and Villela (1997), table 17. Mexico: CONACYT (2007), p. 113 and 110 and UNESCO (various issues).

Notes: Argentina: Data refer to CONICET's budget as percentage of national S&T budget and GDP (constant prices). Because S&T budget comprises only the public share of S&T expenditures, our data are overestimating the importance of CONICET. However, because the public share of R&D expenditures in 1988 was 85% of total S&T expenditures (Chudnovsky et al., 2000) and 83% in 1993 (Correa, 1998), our data are only slightly overestimated. Brazil: Effective disbursements of CNPq grants (includes graduate studies, research projects, postdoctoral courses and research, undergraduate students' participation in research projects, and other) and FNDCT financing. FNDCT was established in 1969 so data start in 1970. Data are in constant 1978 prices for 1965-1979 and constant 1991 prices for 1980-1991. Constant R&D data are not available for this period, so only percentages of GDP are computed. Mexico: Budget administered by CONACYT as a percentage of R&D expenditures (current prices).

Table 4.20. Research institutes' budget/expenditures, as % of R&D and GDP, 5-year averages, Argentina, Brazil, Korea, and Taiwan, 1965-2000

	Research institute	Specialisation	65-70		70-75		75-80		80-85		85-90		90-95		95-00	
			% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP
Argentina	CNEA	Nuclear energy									14.2	0.0	7.8	0.0		
Brazil	IPT					0.0										
Korea	KIST	Chemical, metallurgical, and mechanical engineering	0.2	0.0	1.5	0.0	1.0	0.0	1.1	0.0	0.7	0.0	0.5	0.0		
Taiwan	ITRI	Information, optoelectronics, automotive, machine tools					5.8	0.0	9.3	0.1	15.8	0.2	8.4	0.1	8.1	0.1

Sources: Argentina: Bisang (1994), table II.4, Correa (1998), table 5, and WDI. Brazil: Ferreira (1980), table 3. Korea: Lim (1995), table 5 and WDI. Taiwan: Jan and Chen (2006), figure 1, Smith (2000), table 2.12, NSC Indicators of Science and Technology, and DGBAS.

Notes: Argentina: Data refer to 1986-93. CNEA budget is expressed in constant LCU (1992 prices). Because of data availability, instead of R&D expenditures, S&T expenditures are used (constant LCU, 1994 prices). GDP is in constant 1993 prices. Due to similar levels of inflation from 1992 to 1994, we think that we can use S&T expenditures in constant 1994 prices and GDP in constant 1993 prices. Korea: Data refer to the government share of research contracts of KIST, period 1968-1990 (current prices). Data on industries come from Lee et al. (1991). Taiwan: Data refer to 1977-2004 (current prices). Information on industries comes from Jan and Chen (2006).

Data show that the Brazilian government transferred at most 0.3% of the Brazilian GDP to its research council, but 0.00003% to IPT, the institute that conducted the most applied research and the closest linkages to the private sector. By contrast, the Taiwanese government transferred between 0.03% and 0.16% of its GDP to ITRI, the most important research institute in the country. This institute conducted basic and applied research and intensively cooperated with the private sector.

This shows that East Asian and Latin American policies did not necessarily differ in amounts of financial resources spent, but rather in their implementation. Whether universities or research institutes are financed makes a difference: by financing research institutes, Korean and Taiwanese science policies proved to be more industry-oriented and (indirectly) more selective than those of Argentina, Brazil, and Mexico.

4.6.2 Innovation policy

Private R&D is promoted through R&D subsidies and tax incentives. The pioneers of R&D incentives were Brazil and Korea. In Brazil, the Agency for the Financing of Studies and Projects (FINEP) grants subsidised loans and offers risk-sharing instruments and equity participation since 1965. After FINEP, financial incentives for training of engineers of national firms (FUNTEC) and fiscal incentives (PADCT) were put in place. For Brazil, data are satisfactory because they cover all these programs for a long period (for details, see the notes of Table 4.21). Korea grants financial and fiscal incentives since the mid-1960s (Sakakibara and Cho, 2002). Among the various incentive schemes, preferential financing, in the form of loans by state-controlled banks and public funds (namely, the National Research Projects, NRP, and the Industrial Base Technology Development Programs, IBTDP), was the major form of R&D financing (Kim, 1992). Therefore, even if data on fiscal incentives are not available, we are confident that preferential financing satisfactorily approximates innovation policies in Korea.

Taiwan implemented a more gradual strategy by which firms were directly financed only after a period in which they only commercialized research that had been financed and executed by research institutes (ITRI *in primis*). In this second stage, financing was given for joint-R&D development projects between firms and research institutes, procurements, and R&D projects with matching grants (Hsu and

Chiang, 2001). For Taiwan, we have data on both fiscal and financial incentives but the time coverage is limited to the 1990s.

In Argentina, incentives to private R&D were available only from mid-1990s via the program FONTAR that grants credits, subsidies, and tax incentives. In Mexico, innovation policies were implemented at the end of the 1990s. So Mexico is excluded from this analysis. Data on R&D financial and fiscal incentives are presented in Table 4.21.

Table 4.21. Incentives to private R&D, as % R&D and GDP, 5-year averages, Argentina, Brazil, Korea, and Taiwan, 1965-2000

	65-70		70-75		75-80		80-85		85-90		90-95		95-00	
	% R&D	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*	*% R&D*	*% GDP*
Argentina													9.67	0.04
Brazil		0.02		0.03		0.01		0.04		0.04		0.02		
Korea							21.96	0.21	26.19	0.41				
Taiwan											8.19	0.14	14.33	0.27

Sources: Argentina: Yoguel et al. (2007), table 1. Brazil: Suzigan and Villela (1997), table 15 and 17. Taiwan: Hsu et al. (2009), table 1 and Jenkins et al. (2003), table 4.4. Korea: Kim (1992), table 11.5 and Lim (1995), table 5.

Notes: Argentina: FONTAR, 1995-2001. Brazil: For 1965-80, it refers to FINEP and FUNTEC.[41] For 1980-95, it refers to FINEP and from 1984-89 fiscal incentives (PADCT) are also included. Korea: Financial incentives refer to direct R&D subsidies and preferential financing. Taiwan: Financial incentives refer to ITDP, period 1997-2005. Fiscal incentives refer to fiscal incentives under the Statute for the Upgrading of Industry, period 1993-97. R&D data come from NSC Indicators of Science and Technology.

[41] FUNTEC was designed to provide support for training in national firms, but data show that from the mid- 60s to the mid-70s, these funds were used almost exclusively by education and research institutes. Only after the mid-70s, this trend reversed (Ferreira, 1980).

Data confirm that R&D incentives were much larger in East Asia than Latin America. While Korea spent between 0.2% and 0.4% of its GDP on incentives for private R&D, Brazil and Argentina spent at most 0.04%. This might (at least partly) explain why the private sector occupied a more prominent role in the Korean and Taiwanese NSI than in the Argentine, Brazilian, and Mexican NSI. In Appendix B, we provide data on financial and fiscal incentives separately. Data show that the Korean model of financing was different from the Taiwanese one at least in two aspects: the preference for credits over tax incentives and the entrustment of private firms. This demonstrates the exceptionally entrepreneurial attitude of the Korean government.

Table 4.22 summarises targeted or most benefited industries by innovation policies in Argentina, Brazil, Korea, and Taiwan. These data come from figures on disbursements, policy documents, or existing literature.

Table 4.22. Targeted/benefited industries of financial and fiscal R&D incentives

	Industries targeted
Argentina	Chemical industry, food and beverages, leather and plastics; machinery and equipment
Brazil	Electronics, electric machinery, communications, machinery, and metallurgy
Korea	Machinery, new materials development, semiconductor design, super-mini computers, energy conservation, nuclear energy fuel, chemicals, biotechnology
Taiwan	Electronics and telecommunications

Sources: Argentina: CEP (2009). Brazil: Erber (1980) and Ferreira (1980). Korea: Kim (1992). Taiwan: Hsu et al. (2009).

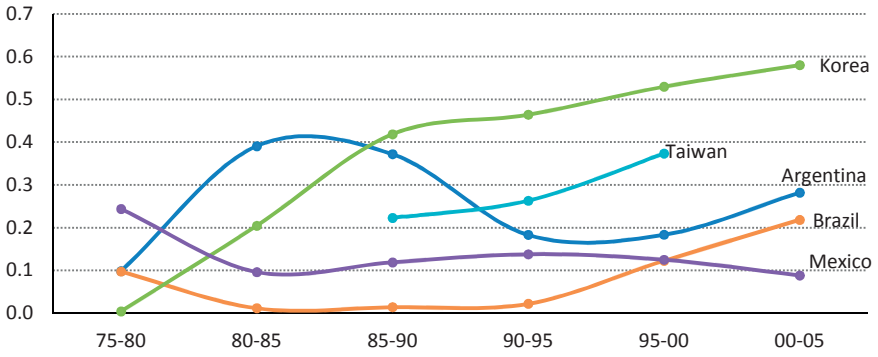
In Taiwan, data show that subsidies targeted electronics and telecommunications and benefited mostly large firms (Hsu et al., 2009). According to data for the mid-1970s, Brazilian funds were allocated mainly to private large firms and most benefited industries were electronics, electric machinery, communications, machinery, and metallurgy (Erber, 1980). In Argentina, R&D incentives were directed mainly to traditional industries.

4.6.3 Technology policy

In the area of technology policies, we limit the analysis to policies for technology transfer. Figure 4.12 captures the extent of countries' reliance on technology licensing by the share of royalty and license fees as a percentage of GDP. Figure 4.13

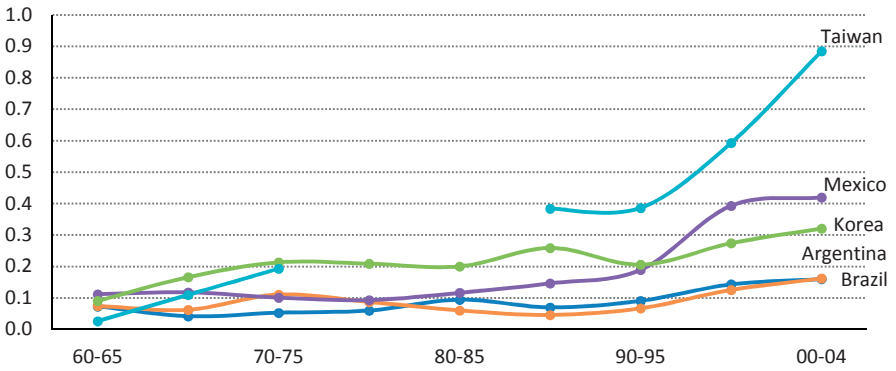
shows data on capital goods' imports as a percentage of gross domestic investments.

Figure 4.12. Royalty and license fees, as % of GDP; 5-year averages, 1975-2005



Sources: Argentina, Brazil, Mexico, and Korea: WDI. Taiwan: Amsden and Chu (2003), table 2.14.

Figure 4.13. Capital goods' imports, as % of gross domestic investments, 5-year averages, 1960-2005



Sources: WITS online.

The two figures clearly show the preference of Korea for technology licensing and Taiwan for capital goods' imports as channels of technology transfer. In Latin America, choices of technology acquisitions were driven by foreign exchange considerations and governments were regulating the amount of royalties that national firms could pay (Dalhman and Frischtak, 1992). That Latin American countries re-

lied less on capital goods' imports should not surprise because capital goods' imports were largely restricted under ISI.[42]

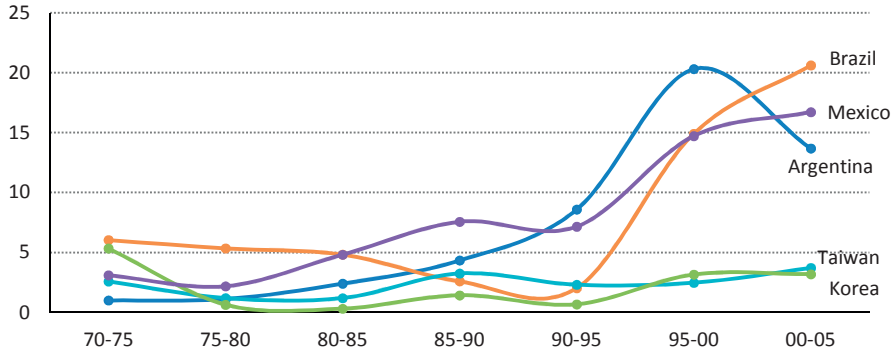
FDI are generally attracted via fiscal and financial incentives (in the form of tariff exemptions and preferential access to foreign exchange) or localisation advantages (such as good quality infrastructures). As discussed in Section 3.5.5, countries attract FDI to get additional investments and benefit from technology transfers.

In order to achieve both objectives, East Asian governments often imposed local content requirements and duties of knowledge transfers and discouraged or restricted entry of foreign firms in industries where the chances and returns of technology transfer were lower (Wade, 1990; Amsden, 1989; Sakakibara and Cho, 2002). In Argentina, attraction and regulation of FDI were cyclical: some governments strove to attract them, and some others restricted them. The Brazilian attitude towards FDI was much more stable. FDI faced virtually no limitations apart from few strategic industries in which foreign firms were required to cooperate with local firms. At the beginning of the 1980s, more restrictions were introduced (in some strategic industries, such as ICTs, foreign ownership was not allowed). This trend was reverted in the 1990s, when neoliberal reforms lifted virtually all restrictions (da Motta-Veiga, 2004). In Mexico, FDI inflows were heavily regulated until the 1980s when restrictions were gradually relaxed starting from capital and technology-intensive industries (Moreno-Brid et al., 2005). Even if FDI were regulated in Mexico, empirical estimates point at roughly 40% of manufacturing sales originating from affiliates of international firms in 1979 (Weiss, 1990).

Figure 4.14 shows the trend of FDI inflows as a percentage of gross fixed capital formation from 1970 to 2005.

[42] With respect to capital goods' imports, it has been argued that higher imports might also be detrimental to industrial development, if imported capital goods are of very low quality. This was the case in some small and medium firms in Latin America (Katz, 1987).

Figure 4.14. FDI inflows, as % of Gross Fixed Capital Formation, 5-year averages, 1970-05



Source: UNCTAD online.

Also in this case, data clearly differentiate between Latin American and East Asian countries, where Latin American countries made a much more intensive use of FDI than East Asian countries did. This became even more evident from the mid-1980s. In East Asia, domestic investments were generally larger and foreign investments in some strategic industries were restricted until the 1990s (Amsden, 2001; Chan, 2000).

Table 4.23 reports FDI inflows disaggregated by industry within manufacturing. Data are aggregated into five industries: metal industries, food processing, textiles, chemical industries, and machinery and equipment. In Argentina, the two periods of major FDI expansion were in the 1960s and 1970s. Because data start in the mid-1970s, only the latest phase of FDI expansion is captured. For Brazil, data cover the entire period from 1960 to 2000, so it is possible to observe the entire evolution of FDI inflows. Sectoral data of Mexican FDI inflows start in the 1990s, so it captures only the period of FDI liberalisation. Data for Korea are quite complete and range from 1960 to 2000. Data for Taiwan are complete but are computed as 10-year averages rather than 5-year averages.

Table 4.23. FDI inflows by industry, as % of total inflows, 5-year averages, 1960-2000

		60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Argentina	Metallurgy					1.5	0.4	1.7	1.6
	Food					4.8	24.9	16.2	6.5
	Textiles					0.1	6.4	0.3	0.4
	Chemicals					9.6	3.1	8.8	8.5
	Machinery and eq.					24.2	4.5	3.7	7.2
	of which: transport eq.					17.4		4.6	5.9
	Subtotal					*40.2*	*39.3*	*30.6*	*24.2*
Brazil	Metallurgy		2.8	7.8	8.7	6.1	8.4	1.7	1.5
	Food		0.0	9.7	4.2	7.0	4.9	1.6	3.0
	Textiles		1.3	3.6	2.3	8.9	5.8	0.5	1.0
	Chemicals		0.0	17.5	13.7	9.0	8.6	3.6	3.7
	Machinery and eq.		94.2	22.3	32.9	32.6	22.3	10.6	8.3
	of which: transport eq.		65.2	9.7	12.5	15.6	6.3	7.8	5.0
	Subtotal		*98.2*	*61.0*	*61.7*	*63.7*	*50.1*	*18.1*	*17.5*
Mexico	Metallurgy							12.6	1.9
	Food							17.0	10.7
	Textiles							2.5	2.8
	Chemicals							6.1	10.0
	Machinery and eq.							17.7	30.6
	Subtotal							*55.8*	*56.0*

Table 4.24. FDI inflows by industry, as % of total inflows, 5-year averages, 1960-2000 (Cont.d)

		60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-00
Korea	Metallurgy	0.0	9.7	6.8	7.5	2.9	2.0		
	Food	6.5	1.0	2.6	7.3	9.1	4.2	4.3	7.5
	Textiles	2.2	11.3	24.7	1.0	1.8	2.2		
	Chemicals	10.9	33.4	30.1	31.2	13.2	29.4	31.4	12.4
	Machinery and eq.	21.7	32.9	27.2	45.8	60.4	52.3	17.5	22.2
	of which: transport eq.	0.0	2.2	5.9	8.1	27.4	10.7	5.2	7.2
	Subtotal	*41.3*	*88.3*	*91.4*	*92.8*	*87.4*	*90.1*	*53.3*	*42.1*
Taiwan	Metallurgy	5.6		10.1		10.9		10.4	
	Food	4.8		0.6		5.6		6.8	
	Textiles	4.0		3.5		1.5		3.6	
	Chemicals	41.9		17.9		26.9		20.3	
	Machinery and eq.	42.3		64.7		51.6		55.9	
	of which: transport eq.	0.0		0.0		0.0		5.0	
	Subtotal	*98.6*		*96.8*		*96.3*		*96.9*	

Sources: Argentina: Aspiazu (1995), table 6 and UNCTAD (2004a). Brazil: APEC (various issues), Banco do Brasil[43], and UNCTAD (2004b). Mexico: Peters (2007), table 3.A.3. Korea: Moreira (1995), table A.20 and Kim and Hwang (2000), table 9.2. Taiwan: Chan (2000), table 12.2.

Notes: Argentina: Data refer to average of 77-83 and 84-89. Brazil: From 65-95, flows are calculated as differences between stocks. Mexico: for 90-95, data refer to 94. Taiwan: 10-year averages. Food includes beverages and tobacco in Argentina, Brazil (at least from 1970), Mexico, and Taiwan. In Korea, it is not specified. Textiles include apparel in Korea and Brazil (at least from 1970) and apparel and leather in Argentina, Mexico, and Taiwan. Chemicals include rubber and plastics in Argentina and Mexico, and oil derivatives in Mexico, Brazil, and Korea. Machinery and equipment include precision instruments in Taiwan and Mexico.

[43] Available at: http://www.bcb.gov.br/?INVEDIR

In Korea and Taiwan, FDI inflows concentrated in chemicals, and machinery and equipment. The latter also absorbed the largest inflows of FDI in Brazil. In Argentina (and in Brazil since the 1990s), the bulk of FDI inflows went to utilities and mining, rather than manufacturing. A similar trend is observable also in Korea where since the 1990s foreign capital was allowed in more industries and so inflows to manufacturing decreased. It is plausible to expect fewer opportunities for investment spawning and technology transfer in primary and tertiary rather than manufacturing activities. This pattern of inflows might be attributed to FDI liberalisation reforms.

What is also interesting to note is the role of FDI in transport equipment, a key industry in ISI strategies. In Brazil, at the beginning of the development of the industry, the share of FDI in the transport equipment industry was very large (65%). In Korea, instead, FDI inflows were restricted until the mid-1980s. Inflows increased, from 8% at the end of the 1970s to 27% in the first half of the 1980s.

4.7 Conclusions

A large body of literature investigated the factors behind the divergence between the East Asian and Latin American industrial development and catch up trajectories. A great deal of the discussion focused on the role of industrial policies. As Chapter 3 showed, the debate is trapped into an unfruitful confrontation between advocates of functional and advocates of selective industrial policies. This impedes a neutral interpretation of the historical experiences of East Asia and Latin America and biases evidence-based policy recommendations for newly industrialising countries. This paper contributes to this long debate by constructing systematic empirical evidence on the extent and nature of industrial policy in five of the most studied countries in East Asia and Latin America, namely Argentina, Brazil, Mexico, Korea, and Taiwan.

The empirical evidence presented in this chapter confirms most of the accepted stylized facts about the divergence of East Asia and Latin America. Data confirm that Latin American countries more strongly protected their domestic markets, and above all the industries involved in the import substitution strategy (transport equipment and capital goods). However, that East Asian degrees of protection of domestic industries were lower does not mean that East Asian countries did not protect their industries at all. In Korea (where more data are available), especially non-tariff barriers were high until the mid-1980s. Moreover, significant differences

existed among industries, with heavy and chemical industries enjoying the highest protection.

Our data also confirm that efforts towards export promotion were more intense in East Asia than Latin America. This, again, does not mean that Latin American countries did not try to spur their exports. For example, in the 1970s, roughly 60% of the Brazilian manufacturing exports benefited from some form of export incentives. Manufacturing exports, however, represented roughly 55% of total exports and negligible percentages of GDP. Therefore, the meagre success of export promotion in Brazil can be partly explained by the low competitiveness of Brazilian manufacturing exports.

The divergence between East Asian and Latin American investment rates widened from the mid-1960s. Substantially higher investment rates of East Asian SOEs might have contributed to this. Publicly owned firms are often blamed for not investing enough and being inefficient. Data, however, demonstrate that state ownership does not necessarily imply high budgetary burdens and low investment rates. In trying to account for investment rate differentials, we also analyse the role of financial and fiscal incentives. Our data confirm the role of East Asian governments in directing finance to priority industries. According to available data, fiscal and financial incentives were higher in Korea and Taiwan than in any other Latin American country. Strategic finance allocation was not only achieved via development banks' subsidised loans, but also via tax incentives. Tax incentives are normally considered functional industrial policies, but in the countries under analysis, they were often restricted to specific industries.

Differences between East Asian and Latin American industrial policies existed also in the domain of science, technology, and innovation policies. In Latin America, state intervention was geared more towards human capital formation than firms' innovation. East Asian policies, instead, were more balanced between science and innovation and involved more interactions between these two. The magnitude of the difference between Latin American and East Asian countries is evident in the data. Moreover, while it is commonly believed that science polices are horizontal, research financing in East Asia was more strategically oriented and more selective than in Latin America. Finally, in East Asia, technological change has also been sustained by wise strategies of technology transfer, based more on licensing and capital goods' imports than FDI.

This chapter accounted for the nature and extent of industrial policy in East Asia and Latin America. It could be argued that it is of greater interest to analyse *how* states intervened -types of interventions (Evans, 1995) and processes of industrial policy-making (e.g. Rodrik, 2007; Szirmai et al., 2013). Despite our analysis does not explicitly address these issues, our data illustrate some of the characteristics of industrial policy-making in the two regions.

First, targeted industries were different in East Asia and Latin America: high technology industries (mainly electronics and ICTs) were supported more in East Asia than in Latin America. These industries were part of the new wave of radical innovations that drove economic growth in the last decades. Hence, both the amounts of public spending and the kinds of intervention differed. Moreover, by combining financial and fiscal incentives, East Asian governments proved to be much more entrepreneurial than Latin American governments.

Second, especially in Argentina and to a lesser extent Brazil, industrial policies changed drastically with every new government. This created uncertainty and undermined the relationship between the state and the private sector. This was an important difference with the East Asian approach towards industrial policies and industrial development.

Latin America's slow return to industrial policy, documented by Peres (2009), calls for a careful analysis of what did not work in the past and can be done under the current global trading order. While it is clear that old-days trade policies, such as import restrictions, export subsidies, and FDI restrictions are less viable options today; other areas of industrial policies also contribute to structural change. When export promotion absorbed up to 3.9% of GDP in East Asia, loans of the Korean Development Bank, fiscal and financial incentives to investments, and STI policies together represented roughly 8% of the Korean GDP. In Brazil, the same indicators sum up to roughly 2.5% of GDP, and in Argentina and Mexico, even less. This suggests that some industrial policies were underfinanced in the past and there is some space for industrial policies today.

To conclude, this chapter confirms parts of the interpretation of neoclassical economists and parts of the interpretations of industrial strategists. By using sectoral data, we try to assess the level of selectivity of industrial policy, but also to check whether industrial policies are ultimately serving their purpose. Industrial policies should foster productive activities and facilitate the process of structural

change towards dynamic industrial sectors. If industrial policies reinforce industrial structures that lack the potential to lift the economy to higher levels of productivity and income, results in terms of industrialisation and economic growth are likely to be poor.

Despite the effort to construct systematic comparative empirical evidence, this subject matter bears evident limitations in terms of comparability and measurability. Especially with respect to the latter, our data refer to official programs and so could potentially underestimate the degree of assistance. Policy-making is subject to lobbying activities and non-transparent financing. Therefore, our indicators are to be considered proxies of state intervention. Even if these are only proxy of industrial policy, it would be interesting to expand this analysis to other countries. Comparative studies would help to understand how much intervention is enough, too little, or too much. Comparisons would also shed more light on the impact of different types of industrial policies in different contexts.

While it would be interesting to expand the analysis to more countries, this type of exercises requires considerable preparatory work. Collecting data requires knowing what exactly to look for, i.e. building a taxonomy of policies implemented in the countries and period under analysis. It is crucial to ensure that data are capturing the essence of industrial policy in a certain country and period. All these issues indicate why it was not possible at this stage to include more countries in our analysis and why we believe that it would be valuable to pursue more of these studies in the future.

Appendix B

Table B.1. R&D financial incentives, as % of R&D and GDP, 5-year averages, Argentina, Brazil, Korea, and Taiwan, 1965-00

	65-70		70-75		75-80		80-85		85-90		90-95		95-00	
	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP
Argentina													9.68	0.04
Brazil		0.02		0.03		0.01		0.04		0.04		0.02		
Korea							21.96	0.21	26.19	0.41				
Taiwan													2.16	0.05

Sources: Argentina: Yoguel et al. (2007), table 1. Brazil: Suzigan and Villela (1997), table 15 and 17. Taiwan: Hsu et al. (2009), table 1. Korea: Kim (1992), table 11.5 and Lim (1995), table 5.

Table B.2. R&D fiscal incentives, as % of R&D and GDP, 5-year averages, Brazil and Taiwan, 1980-2000

	80-85		85-90		90-95		95-00	
	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP	% R&D	% GDP
Brazil		0.00		0.01				
Taiwan					8.19	0.14	12.17	0.22

Sources: Brazil: Suzigan and Villela (1997), table 17 and 15. Taiwan: Jenkins et al. (2003), table 4.4.

Chapter 5

The Role of Macroeconomic Policies in Firms' Investments in Manufacturing

5.1 Introduction

Low investment rates are the key problem of development. Adverse macroeconomic conditions are often identified as the main determinants of low investments in developing countries. Different policy approaches historically tried to neutralize them. Following the debt crisis of the 1980s, several developing countries were pressured to adopt neoliberal policy agendas. Under the Washington Consensus, markets were freed from distortive government interventions and governments were only required to achieve and maintain macroeconomic stability and fiscal discipline. Together with inflation targeting and fiscal discipline, Washington Consensus prescribed trade and financial liberalisations, privatisations, deregulations, price and tax reforms. In the neoliberal view, these reforms would create favourable conditions for private investments.

In the literature, there is little agreement on the impact of these policies. Much of the criticism came from structuralist economists who in turn had been heavily criticised by the neoliberals during the period of state-led industrialisation. The mixed evidence on the effects of Washington Consensus type of policies, together with the current adoption of austerity measures in Europe and countercyclical policies in emerging countries, kept the debate on the role of macroeconomic policies hot and burning. This paper contributes to this debate and investigates how firms adjust their investment decisions in response to macroeconomic factors. In particular, the paper tries to understand if macroeconomic conditions matter for firms' investment behaviours as structural factors.

Our approach is novel in several aspects. First, it uses firm-level data, rather than data on national aggregate investments. Micro data allow exploring the micro-macro interdependencies that shape aggregate investments and so contribute to a better understanding of the micro-foundations of investment patterns. Secondly, this study covers the period 2002-2010.[44] During this period, structural adjustment programs imposed by international organizations, such as the IMF and the World Bank, had ended and developing countries were applying novel macroeconomic approaches. Finally, by estimating a multilevel Heckman section model, this paper takes into account country heterogeneities and explores the role of within and between countries variations in firms' investment behaviours.

[44] Only for Sri Lanka, the last survey refers to 2011.

The remainder of the Chapter is organized as follows: the next section reviews the neoliberal and structuralist views on the role of macroeconomic policies in economic growth and investments. Section 5.3 sets the scene by describing the data and methodology. In Section 5.4, we show some descriptive statistics and discuss the results of our econometric exercise. In Section 5.5, we check the robustness of our results. Section 5.6 draws some brief conclusions.

5.2 Literature review

There is little agreement about the effects of neoliberal macroeconomic policies on investments and economic growth. After the wave of neoliberal reforms and structural adjustment programs of the late 1970s, 1980s, and 1990s, empirical studies evaluating their effects mushroomed. Some of these studies analysed the joint effect of several policies, while others focused on one particular aspect of the neoliberal agenda.

A series of papers measured the extent of economic reforms in Latin America by developing indexes of structural reforms (Lora, 1997, 2001; Morley et al., 1999; Lora and Panizza, 2002). These indexes comprise trade and financial policy, privatisations, tax and labour reforms. Eicher and Schreiber (2010) developed a similar index to explain economic growth in 26 transition economies during the 1990s. According to their results, a 10% increase in their index is associated with 2.7% increase in economic growth. Other empirical studies investigated the effect of variables such as fiscal budget surpluses, exchange rates, interest rates, inflation, and debt on private investments (Greene and Villanueva, 1991; Serven and Solimano, 1991; Fischer, 1993), GDP growth (Bleaney, 1996; Easterly et al. 1997), or both (Easterly and Rebelo, 1993). Among non-econometric studies, the World Bank (1991, 1994) and Edwards (1996) described East Asian, African, and Latin American macroeconomic conditions and experiences with neoliberal reforms. All these studies concluded that macroeconomic stability and Washington Consensus type of policies spurred investments and economic growth.

Other studies focused only on one or few aspects of the neoliberal agenda, such as inflation targeting (Bruno and Easterly, 1998; de Gregorio, 1993; Dornbusch and Fischer, 1993) and trade liberalisation (Edwards, 1992, 1993; Pritchett, 1996; Wacziarg and Welch, 2007). Since the pioneering work by Gurley and Shaw (1955), Shaw (1973), and McKinnon (1973), a large literature on financial deepening

emerged. [45] Some of these studies (e.g. Levine and Zervos, 1993; King and Levine, 1993a, 1993b; Rajan and Zingales, 1998; Levine et al. 2000; Beck et al., 2000) found a strong and positive relationship between financial deepening and economic growth. After witnessing the consequences of financial reforms, some authors began to question their effects, especially in Latin America (Diaz-Alejandro, 1985; De Gregorio and Guidotti, 1995). A *vanishing effect* of financial deepening, meaning that after a certain level more financial depth is detrimental to growth, was found (Rousseau and Wachtel, 2011; Arcand et al., 2012; Cecchetti and Kharroubi, 2012).[46]

Comprehensive indexes of financial reforms were recently developed (Laeven, 2003; Chinn and Ito, 2008; Abiad et al., 2009). These indexes incorporate elimination of credit controls, reserve requirements, interest rates controls, restrictions to the banking sector and international financial transactions, and reforms to develop security markets. Using these indexes, some empirical studies confirmed the positive effect of financial reforms on economic growth (e.g. Galindo et al., 2007; Christiansen et al., 2013).

The strongest critiques to neoliberal policies are attributable to structuralists. Neoliberal policies have been criticised for being too pro-cyclical and short-termed (ECLAC, 1998; Nayyar, 2008, 2011; Stiglitz et al., 2006). Despite acknowledging the desirability of macroeconomic stability, structuralists claim that this goal should not be pursued at the cost of economic recession (Taylor, 1993; Ocampo, 2002, 2003; Moreno-Bid et al., 2005). Moreover, inflation is considered harmful only when it is too high (hyperinflation). Low to moderate levels of inflation, instead, can increase economic growth to levels that would not be attainable otherwise and efforts to further decrease it might bring higher costs than benefits (Taylor, 1993). Finally, in the structuralist view, inflation might be tolerated as a by-product of economic growth (e.g. Lustig and Ros, 1993).

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[45] According to this literature, the main constraint on private investments in developing countries is the quantity rather than the cost of financial resources. Limited financial resources would be the results of distortive policies that direct credit and push interest rates down. When real interest rates become negative (a situation called financial repression), a rise in real interest rates increases financial savings, and so investment funds available to firms. This theory served as a justification to the financial reforms adopted in developing countries. These reforms eliminated "distortive" policies and raised real interest rates. Early empirical studies could not prove a positive effect of real interest rates on private investments, but credit availability was found to be a big constraint on private investments in developing countries (e.g. Blejer and Khan, 1984; de Melo and Tybout, 1986).

[46] See Levine (2005) for a comprehensive review of this strand of literature.

The most fundamental critiques to neoliberal policies, however, concern the interpretation of -and consequent approach towards- macroeconomic instability and its effects on structural and technological change and income distribution.[47] First, structuralists question the neoliberal understanding of macroeconomic instability. The argument is as follows. In developing countries, macroeconomic instability is the result of a variety of mechanisms that essentially depend on production structures. Abundance of natural resources makes developing countries specialise in primary commodities. This has two effects. Unbalanced production structures emerge. These are constituted by a (more productive) resource-based and an (less productive) industrial sector. These productive dualities generate a situation by which the industry most in need of foreign currency (manufacturing) depends on the export-oriented resource-based sector. The divergence between these two sectors is responsible for balance of payment crisis (Diamand, 1972).

Dependence on natural resources makes these countries vulnerable to (volatile) commodity prices and causes cyclical overvaluations of the exchange rate that penalise the manufacturing industry (Bresser-Pereira, 2008, 2012).[48] Exchange rates' movements and commodity prices also affect inflation. Given this, inflation cannot be seen as a mere consequence of monetary expansion, but rather as a structural phenomenon (Noyola, 1956; Sunkel, 1958; Olivera, 1964; Pinto, 1968; Prebisch, 1981). Because of these interrelations, coordinated macroeconomic -exchange rate, monetary, and fiscal- policies are necessary (Frenkel, 2008; Rapetti, 2013).

These mechanisms affect each other and have long lasting and reinforcing effects on investments. In the old days of state-led industrialisation, these forces were offset by policy tools like multiple exchange rates, foreign exchange and capital controls, import duties and quantitative restrictions, taxes on traditional exports, and incentives to non-traditional exports. The abandonment of these instruments and the adoption of neoliberal policies aggravated the tendency of the exchange rate to appreciate (Ocampo, 2011; Bresser-Pereira, 2008, 2012).

Latin American hostile macroeconomic conditions generated permanent mutations in firms' investment behaviours. These induced firms to prefer flexibility and low-

[47] In this section we will focus on the first two aspects. For a discussion of the latter, see Ocampo (2002, 2004).

[48] In the structuralist interpretation, investments are discouraged by cyclical overvaluation of the exchange rate. These overvaluations are caused by two structural factors: the Dutch disease and excessive capital inflows.

risk high-returns investments (e.g. Fanelli and Frenkel, 1996; Katz, 1996, 2001; Cimoli and Katz, 2003). What is more, the elimination of these mechanisms and the unsuccessful attempts at macroeconomic stabilisation perpetuated and reinforced the adaptive defensive behaviours described above. In so doing, they redirected structural and technological change in Latin America towards natural resource-based industries. Firms in natural-resource based industries reacted better to the reforms, while firms in knowledge-intensive industries were the most hit (Cimoli and Katz, 2003). By removing protection and incentive mechanisms to the development of national engineering-intensive industries, neoliberal policies halted processes of capability accumulation in Latin American R&D and engineering-intensive firms (Katz, 2000b, 2001; Cimoli and Katz, 2003; Cimoli and Correa, 2005).

In all industries, trade liberalisation pushed imports up and macroeconomic stabilisation contracted domestic demand. Consequently, many Latin American firms were forced out of the market. Evidence of these dynamics is based on a long series of case studies (e.g. Katz, 1986; Mizala, 1992; Bercovich and Katz, 1997).

In light of all this, structuralists conclude that the lack of recognition of macroeconomic instability as a structural phenomenon explains why neoliberal policies failed to generate truly stable and favourable macroeconomic conditions.

5.3 Methodology and approach

Methodology

This paper explores the determinants of firms' investments in manufacturing using the World Bank Enterprise Surveys. The World Bank ran comparable surveys from 2002 to 2013 in several developed and developing countries. Details on the countries and years covered by this study can be found in Table C.1 (Appendix C).

Our dependent variable is the logarithm of firms' investments over sales, where investment is defined as expenditure for the acquisition of machinery and equipment.[49] In the dataset, 52% of the firms report zero investments. Any regression

[49] In the literature, firms' investments were also introduced as the logarithm of the ratio of investment over sales (Farla, 2014) and the ratio of investments over capital stock or value added (Bigsten et al., 1999, 2005).

that ignores these zeros and non-randomness of this selection would produce biased results. In these cases, Heckman selection models should be estimated.[50]

Heckman selection models correct for the selection bias by estimating two separate equations: a selection and an outcome equation. The selection equation models the choice of whether to invest or not and is estimated by a probit model. The outcome equation models firms' investment levels. In Heckman selection models, the two equations are linked by the inverse Mill's ratio (λ) that corrects for the selection bias. Given that these two equations are separately estimated, the Heckman selection model allows for investment choices and investment levels to be explained by different factors. Having different variables in the two equations also limits the collinearity caused by the insertion of λ.[51]

This study postulates that firms' investment behaviours are determined by firms and countries' characteristics. Because firms are nested within countries, data present a hierarchical structure. Single-level models are not suitable because the assumption that observations are independent is violated. Therefore, we estimate multilevel models, also referred to as mixed effects models (because they contain fixed and random effects). The random component is made of the random country effects that are added to the fixed effect model, so that:

$$y_{ij} = \beta_0 + \beta_1 X_{ij} + u_j + e_{ij}$$

Where β_0 and β_1 are the fixed effect parameters to be estimated, u_j are the country effects, and e_{ij} is the error term. Because country effects are modelled as random effects, they are not directly estimated. Instead, σ_v^2, the variance of the country effects, is estimated and reported.

Multilevel models have been mostly used in behavioural economics, sociology, geography, and biology. However, because it is reasonable to assume that several economic data present hierarchical structures, scholars have recently started to use multilevel analysis to explain firms' innovation (Srholec, 2011), entrepreneurship (Sanditov and Verspagen, 2011), and firms' investments (Farla, 2014).

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[50] Another way to handle selection problems in panel data models like ours is discussed in Wooldridge (1995).

[51] In order to check for collinearity, we regress λ against the explanatory variables and check the R^2. High R^2 is a symptom of high collinearity.

In order to test whether firms' investment behaviours are associated with structural macroeconomic conditions, we estimate regressions with country means and within transformations of the country variables. This is feasible because during 2002-2010, the Enterprise Surveys covered some countries more than once. Estimating a model with macroeconomic variables transformed into country means corresponds to estimating a between-effects model, common in panel data analysis. This model is generally used to look at cross-country differences. Estimating a model using within transformations of macroeconomic variables corresponds to estimating a within, or fixed effect, model. In contrast to between-effects models, these models are designed to analyse variations within countries over time.[52]

Approach

Macroeconomic variables

This paper investigates the effect of macroeconomic policies on firms' investment decisions. Policy areas of interest can be summarised under the following headings: macroeconomic stability, financial reforms, trade reforms -which include trade liberalisation and exchange rate management-, and tax reforms.

In the empirical literature, efforts towards macroeconomic stabilisation are captured by fiscal balance and external debt as percentages of GDP, and inflation (e.g. Serven and Solimano, 1991; Bleaney, 1996).53 According to neoliberals, fiscal balances are expected to have a positive effect on investments, while a negative sign is expected on the coefficient of external debt and inflation.

The average ratio of broad money (M2) to GDP is a common measure of financial deepening and is expected to have a positive and significant impact on investments. Following neoclassical theory, a negative coefficient of real interest rates is expected.54

Trade liberalisation entails the reduction of tariffs and other barriers to import and a competitive exchange rate that promotes exports. We use two indicators of domestic trade protection: average tariffs and an index of selectivity of tariffs (the

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[52] It is worth mentioning that despite estimating a fixed effect model, our estimations do include country fixed effects because multilevel models include country effects.

[53] Alternatively, government consumption in GDP has also been used in the literature (e.g. Easterly et al., 1997; Bengoa and Sanchez-Robles, 2003).

[54] Most developing countries cannot be considered financially repressed anymore. Moreover, already in early studies (e.g. Greene and Villanueva, 1991), negative relationship between investments and interest rates was found.

share of tariff lines with international peaks).55 Negative coefficients of these indicators would be in line with Washington Consensus prescriptions. For the exchange rate, we rely on the undervaluation index developed by Rodrik (2008). The expected sign of the undervaluation index is uncertain. In the tradable sector, undervalued exchange rates push exports; this stimulates investments and generates foreign exchange to acquire imported goods. This would justify a positive coefficient of the undervaluation index. In the non-tradable sector or in cases of high dependence on imported capital goods, the cost of new imported goods is higher than the benefit in terms of exports. This would justify a negative coefficient of the undervaluation index.

In the literature (e.g. Dincecco, 2011; Besley and Persson, 2008), tax revenues are used as a proxy of state capacity. Following this interpretation, a positive sign on tax revenues is expected.

As mentioned, structuralists advocate for countercyclical fiscal and monetary policies. Because the years under analysis comprise the international financial crisis, fiscal and monetary expansionary policies can be seen as counter-cyclical. This would justify a negative coefficient of fiscal balance and a positive coefficient of external debt. Because few countries in our sample have an inflation rate higher than 20 or 30%, a significant negative impact of inflation on investments is not expected. With respect to financial deepening, a negative sign of M2 to GDP would be explained in light of the negative effects that excessive capital inflow exerts on investments in manufacturing by worsening the tendency of the exchange rate to appreciate. As for trade policies, positive and significant coefficients of average tariffs and tariff selectivity are justified because tariffs ensure protection of the domestic market and so guarantee returns on investments and because import restrictions can be used to neutralize the Dutch disease.

Firm-level variables

The choice of whether to invest or not also depends on some firms' characteristics. In particular, we assume that established large firms are more likely to invest than small and young firms are. Firms' size and age also affect firms' investment levels: established larger firms are expected to invest more than small and young firms (e.g. Bigsten et al., 1999). We also hypothesise that exporting firms are more likely

55 In the literature trade openness indexes, like the ratio of manufactured exports in GDP or total exports, or the ratio of import plus exports over GDP have also been used.

to invest than non-exporting firms are and that their export shares in sales do not affect current investment levels (even though they might affect future investment levels). This means that the variable export is a selection variable and will be only included in the selection equation.

The literature on firms' investments (e.g. Chirinko, 1993; Abel and Eberly, 1995; Barnett and Sakellaris, 1998) evidences the role of adjustment costs, intended as the costs that firms incur to acquire new capital goods (search costs, time to organise finances, and so on) and adjust production after the acquisition of new capital goods (licenses, installation, training of personnel, and so on). The World Bank Enterprise Surveys do not contain information to account for firms' adjustment costs. These, however, are at least partially captured by firms' sizes, because larger firms are expected to face lower adjustment costs than smaller firms.

Previous studies also identified labour costs and financial constraints as important determinants of firms' investments. The inclusion of variables that account for labour costs (wages as percentage of sales) and financial obstacles would reduce the number of observations by 16% and 69% respectively. For this reason, these variables are not included in the base model, but robustness checks are conducted to verify that their exclusion does not affect the main results of the study.

Control variables

In all specifications, we control for GDP per capita, GDP growth, and terms of trade. We expect firms in countries with higher GDP and higher GDP growth to be more prone to invest. Firms' investment levels, however, are not expected to be larger if the country where the firm operates is richer, or grows faster. We include terms of trade to control for issues related to the Dutch disease, assuming that high terms of trade in developing countries are a sign of high dependence on natural resources. Manufacturers in resource-dependent countries are expected to have lower propensities to invest. We also assume that terms of trade do not affect the size of investments, which are more related to industry characteristics. Hence, GDP per capita, GDP growth, and terms of trade are included only as selection variables.

We account for sectoral heterogeneities and industry differences in the cost of capital goods by including industry dummies in all models. Industries are defined in the following way: 1) leather, garments, and textiles; 2) agroindustry, food, and beverages; 3) metals and machinery; 4) electronics; 5) auto, auto components, and

other transport equipment; 6) chemicals and pharmaceuticals; 7) wood and furniture, non-metallic and plastic materials, paper and other manufacturing.

5.4 Results

Descriptive statistics

Table 2.1 present basic descriptive statistics for the variables of interest. Details on the definition and sources of our variables are in Table C.2 (Appendix C).

Table 5.1. Basic descriptive statistics

Variable	Observations	Mean	Standard Deviation		
			Overall	Between	Within
Micro-variables					
Investment to sales (ln)	27507	-4.21	2.56		
Investment to capital (ln)	23274	-1.69	1.93		
Age (ln)	76997	2.72	0.85		
Size (ln)	77154	3.62	1.52		
Export (% of sales)	77684	16.99	32.13		
Indicators of macroeconomic policies					
Fiscal balance (% of GDP)	64914	-1.50	3.50	4.39	1.56
External debt (% of GDP)	70292	42.58	28.66	33.34	14.03
Inflation (ln)[56]	76885	1.74	0.77	0.73	0.42
M2 (% of GDP)	76164	59.70	38.61	39.10	6.65
Interest rate	67496	7.53	9.92	7.60	3.43
Undervaluation index	69565	0.15	0.43	0.39	0.17
Tax revenues (% of GDP)	66103	15.10	5.81	6.20	1.11
Average tariff	52285	10.24	4.16	3.90	1.05
Tariff selectivity	52285	1.56	3.48	3.17	0.87
Country-level control variables					
GDP per capita (ln)	77249	8.47	0.91	1.10	0.14
GDP per capita growth	77725	3.68	3.89	3.85	2.58
Terms of trade (ln)	77598	4.67	0.26	0.25	0.11

[56] Following Easterly et al. (1997), we include inflation as the logarithm of 1 plus inflation.

The average firm is small and young and exports a small share of its production. With respect to macroeconomic variables, small fiscal deficits prevail, average inflation is low, and average external debt is around 40% of GDP. Average tariffs are roughly 10%, with a maximum value of 21%. Given the time span of this study, these numbers are no surprising. After the Washington Consensus, several countries have kept their macroeconomics in order. Moreover, also because of WTO's regulations, the room for trade protection and export-based subsidies is at best reduced. Finally, when we look at within and between countries variations in country-level variables, we notice that between countries variations are larger than within variations for all variables.

By taking only the subsample of firms for which all explanatory variables are available, the sample shrinks to 37333 firms. Sample means for the subsample of investors and non-investors and for the pooled sample are reported in Table 5.2.

Table 5.2. Sample means: investors, non-investors, and pooled sample

Variable	Investors	Non-investors	Pooled
Micro-variables			
Age	2.78	2.70	2.74
Employees	4.13	3.41	3.78
Export	0.20	0.15	0.17
Indicators of macroeconomic policies			
Fiscal balance	-1.23	-1.34	-1.28
External debt	39.03	40.70	39.83
Inflation	1.71	1.82	1.77
M2	58.72	57.47	58.12
Interest rate	9.21	7.33	8.31
Undervaluation index	0.15	0.33	0.24
Tax revenue	16.11	15.09	15.67
Average tariffs	10.27	10.99	10.58
Selectivity index	0.75	1.18	0.93
Country-level control variables			
GDP per capita	8.49	8.34	8.42
GDP per capita growth	3.84	4.61	4.21
Terms of trade	4.69	4.65	4.67

Sample means by and large support our hypotheses. Investors are older and larger and export more than non-investors. Investors face slightly smaller fiscal deficits and external debts, lower inflation, and lower and less selective import tariffs. Investing firms are in countries with higher GDP per capita and tax revenues, and more developed financial systems (higher ratios of broad money as percentage of GDP). Surprisingly, investing firms face lower GDP growth and higher interest rates than non-investors.

Several country-level macroeconomic variables included in the analysis are likely to be highly correlated. Table C.3 in Appendix C reports the correlation table for the macroeconomic variables and the country random effects. Few variables show particularly high correlations. As it could be expected, the correlation between M2 and inflation is -0.6166. Because of the higher fiscal capacity of richer countries, GDP per capita and tax revenues are also highly correlated (0.629). Country random effects show a particularly high correlation with interest rates (-0.705).

Results

Table 5.3 reports the results of the probit selection and outcome models for two specifications of our base model. In the first specification (Colums 1 and 2), we include all explanatory variables, except for average tariffs and the index of tariff selectivity. In the second specification (Columns 3 and 4), average tariffs and tariff selectivity are added. This is because of the high number of missing values for these two variables.

The output of the multilevel Heckman selection model is divided in two parts: a fixed and random part. The first part includes all the β of the explanatory variables. The second part refers to the country unobserved effects. For these effects, the standard deviations σ_υ are estimated and reported. In the table, we also report *rho*, the intraclass correlation coefficient. *Rho* is the ratio of the level 2 variance over total residual variance ($\rho = \frac{\sigma_\upsilon}{\sigma_\upsilon + \sigma_e}$). *Rho* accounts for how the variance divides among levels. Therefore, in cases of 2-levels models like ours, *rho* represents the percentage of variance at the country level.

Table 5.3. Base model

	Selection – Model 1			Outcome – Model 1			Selection – Model 2			Outcome – Model 2		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.089	0.010	***	-0.171	0.023	***	-0.115	0.013	***	-0.226	0.027	***
size	0.237	0.006	***	-0.122	0.013	***	0.235	0.008	***	-0.108	0.016	***
export	0.029	0.027					0.054	0.035				
balance	-0.196	0.012	***	-0.413	0.013	***	-0.170	0.017	***	-0.345	0.016	***
debt	0.006	0.001	***	0.012	0.002	***	0.026	0.002	***	0.078	0.004	***
inflation	-0.314	0.027	***	-0.178	0.051	***	0.721	0.127	***	-0.145	0.178	
M2	-0.020	0.004	***	-0.003	0.005		0.008	0.006		-0.006	0.009	
interest rate	0.011	0.007		0.053	0.009	***	0.064	0.011	***	0.158	0.016	***
underval	-4.079	0.172	***	-3.293	0.174	***	-5.092	0.226	***	-7.117	0.309	***
tax revenue	0.235	0.021	***	0.244	0.018	***	0.102	0.035	**	0.486	0.033	***
tariff							-0.121	0.015	***	-0.251	0.028	***
selectivity							0.001	0.054		0.028	0.076	
GDP	3.894	0.280	***				2.062	0.421	***			
growth	-0.307	0.010	***				-0.057	0.013	***			
tot	-1.247	0.146	***				1.006	0.262	***			
λ				0.182	0.037	***				0.464	0.085	***
ind1	-0.149	0.024	***	-0.180	0.053	***	-0.201	0.030	***	-0.152	0.061	*
ind2	-0.034	0.025		-0.023	0.054		-0.077	0.030	*	0.003	0.061	
ind3	-0.097	0.030	**	0.147	0.063	*	-0.101	0.039	**	0.146	0.073	*
ind4	0.063	0.039		-0.032	0.088		-0.013	0.054		-0.085	0.116	
ind5	0.105	0.046	*	0.088	0.104		0.131	0.071	+	0.083	0.145	
ind6	0.045	0.031		-0.323	0.066	***	0.026	0.038		-0.256	0.073	***
σ_u	4.595	1.000	***	2.123	0.231	***	2.822	0.783	***	5.155	0.591	***
firms	36992			18694			25881			14151		
countries	55			53			45			44		
rho	0.955			0.453			0.888			0.829		
LR	-17881.947			-42532.48			-11626.751			-32307.592		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: The constant is included in the estimations, but is not reported.

Results suggest that macroeconomic factors are important determinants of firms' investments. Fiscal deficits and external debts are associated with higher investments. The impact of inflation is difficult to assess. In the base model, inflation negatively affects investment choices and levels. In the second specification, inflation becomes positive and significant in the probit model and negative and insignificant in the outcome equation. When we move to financial reforms, the coefficient of the ratio of broad money to GDP (M2) is significant only in the probit equation of the base model. Its negative sign supports the view against financial deepening reforms. Contrary to expectations, the coefficient of interest rates is positive and significant in almost all equations.

With respect to trade policies, the consistently negative sign of the undervaluation index can be justified in light of the high dependence of developing countries on imported capital goods and the low shares of export over sales of the firms in our sample. The coefficient of average tariff is negative and highly significant in both equations, while the tariff selectivity index is positive, but not significant.

With respect to firm level variables, results suggest that younger and larger firms are more likely to invest. However, smaller firms are those that invest more. Firms' exports, instead, do not affect the choice of whether to invest or not. As a final remark, the high values of *rho*, the intraclass correlation coefficient, show that including country effects is necessary, owing to the high degree of cross-country heterogeneity in the data.[57]

Because macroeconomic factors are important determinant of firms' investments, we continue our analysis by investigating how these macroeconomic factors influence investment behaviours. In particular, we are interested in understanding if the structural component of macroeconomic factors is associated with firms' investments; that is, if macroeconomic conditions affect investments because they are structurally adverse or favourable. We distinguish two forms by which macroeconomic factors can affect investments: by acting as structural conditions or as business cycles. Methodologically, we account for the structural component by taking country means and for business cycles by looking at within country variations of macroeconomic factors.

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[57] These results are by and large robust to the exclusion of highly correlated variables (Table C.4 and Table C.5) and inclusion of time dummies (Table C.6).

In Table 5.4, we report the results of our base model expressed in terms of within variations (columns 1 and 2) and country averages (columns 3 and 4). In our third model (columns 5 and 6), we include both within variations and country means. Within transformations are denoted by the prefix *w* and country means by *av*. Country means also represent the Mundlak (1978) covariates, which act as controls for possible endogenous variables.

Table 5.4. Within and between country variations

	Selection – Model 1			Outcome – Model 1			Selection – Model 2			Outcome – Model 2			Selection – Model 3			Outcome – Model 3		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.087	0.011	***	-0.146	0.026	***	-0.051	0.010	***	-0.190	0.037	***	-0.087	0.011	***	-0.138	0.026	***
size	0.244	0.007	***	-0.177	0.017	***	0.216	0.006	***	0.358	0.105	***	0.244	0.007	***	-0.194	0.016	***
export	0.037	0.030					0.002	0.027					0.038	0.030				
w_balance	-0.194	0.012	***	-0.362	0.016	***							-0.194	0.012	***	-0.362	0.015	***
w_debt	0.006	0.001	***	0.014	0.002	***							0.006	0.001	***	0.014	0.002	***
w_infl	-0.325	0.027	***	-0.135	0.054	*							-0.324	0.027	***	-0.148	0.053	**
w_M2	-0.022	0.004	***	-0.015	0.006	**							-0.022	0.004	***	-0.014	0.006	*
w_intrate	0.008	0.007		0.021	0.010	*							0.008	0.007		0.012	0.010	
w_underval	-3.895	0.173	***	-2.432	0.307	***							-3.889	0.173	***	-2.023	0.283	***
w_taxrev	0.241	0.021	***	0.242	0.021	***							0.241	0.021	***	0.236	0.021	***
w_gdppc	4.218	0.283	***										4.222	0.283	***			
w_gdpgrowth	-0.313	0.010	***										-0.314	0.010	***			
w_tot	-1.319	0.146	***										-1.317	0.146	***			
av _balance							0.021	0.028		-0.082	0.056		0.085	0.106		-0.128	0.062	*
av_debt							-0.006	0.003	+	-0.009	0.008		-0.011	0.012		-0.005	0.009	
av _infl							-0.090	0.143		0.001	0.339		0.926	0.548	+	-0.013	0.387	
av _M2							0.003	0.003		0.006	0.008		0.033	0.012	**	0.005	0.009	
av _intrate							0.009	0.009		0.045	0.023	+	-0.025	0.035		0.016	0.026	
av_underal							-0.734	0.282	**	-0.041	0.772		-3.097	1.081	**	0.583	0.784	
av_taxrev							0.031	0.017	+	0.093	0.037	*	-0.054	0.066		0.040	0.042	

Table 5.4. Within and between country variations: the base model (Cont.d)

	Selection – Model 1			Outcome – Model 1			Selection – Model 2			Outcome – Model 2			Selection – Model 3			Outcome – Model 3		
	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig	coef	se	sig
av_gdppc							-0.188	0.102	+				-0.016	0.393				
av_growth							0.015	0.031					-0.033	0.118				
av_tot							0.113	0.480					-0.161	1.852				
λ				-0.286	0.082	***				3.922	0.820	***		.		-0.463	0.079	***
constant	-0.517	0.327		-3.472	0.232	***	0.337	2.412		-9.733	1.430	***	-0.638	9.299		-4.194	1.243	
σ_u	1.995	0.480	***	1.151	0.140		0.403	0.096	***	1.047	0.144		1.569	0.379	***	1.200	0.162	
firms	31763			15995			31763			15995			31763			15995		
countries	38			38			38			38			38			38		
rho	0.799			0.187			0.140			0.147			0.711			0.200		
LR	-15637.726			-36795.951			-19236.232			-37573.33			-15628.654			-36794.784		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Notes: Industry dummies included but not reported.

Despite descriptive statistics in Table 5.1 showed that variation in the data is mainly between countries rather than within countries, results of the econometric analysis demonstrate that within country variations explain investment behaviours more than their structural component. In model 1 and 3, coefficients of variables taken as within country variations are always significant, while in model 2 and 3 very few coefficients of country means are significant. This occurs although descriptive statistics showed that the higher variation in the data is between rather than within countries.

If we look at within country variations, previous results are largely confirmed: fiscal deficits and external debts are positively associated with investments, while the undervaluation index is negatively associated with investments. Compared to previous estimations, more stable results are found on inflation, ratio of broad money to GDP (M2), and terms of trade. The coefficient of inflation is always significant and negative. The coefficient of M2 to GDP is always negative and significant, which seems to corroborate the interpretation of negative effects of financial deepening. Finally, the negative sign of the terms of trade's coefficient seems to support structuralist theories on the consequences of the Dutch disease. According to structuralists, in resource-abundant developing countries higher terms of trade have two undesirable effects: they hinder export diversification and appreciate the exchange rate. However, given the negative sign of the coefficient of the undervaluation index, our results only partially confirm the structuralist story.

When we look at country means, few variables are significant. In the selection equation, the coefficients of external debt, the undervaluation index, tax revenues, and GDP per capita are significant. In the outcome equation, only the coefficients of interest rates and tax revenues are significant. Both sets of results are largely confirmed when we include within and between country variations simultaneously (model 3 in Table 5.4).

We now investigate if firms within the same region react similarly to macroeconomic conditions. The literature suggests that they might not. As mentioned in Section 5.2, structuralists argue that in Latin America chronic macroeconomic instability permanently changed firms' investment behaviours and induced them to adopt defensive investment strategies. These micro behaviours would explain low aggregate investment rates in Latin America. We check if this is the case by looking

at country effects by region (Table 5.5). These country effects are obtained from the base outcome model in Table 5.3.

Table 5.5. Random country effects by region

	Mean	Standard Deviation	Min	Max
sub-Saharan Africa	-0.436	2.142	-6.376	3.006
Latin America	-0.334	1.230	-2.683	3.673
Europe and Central Asia	-0.029	2.325	-4.577	2.942
Asia	1.912	0.920	-0.269	4.046
Overall	0.516	1.812	-6.376	4.046

Data show that country effects differ among regions and among countries within regions. Firms in Sub-Saharan Africa invest the least, which confirms previous empirical findings (e.g. Bigsten et al., 2005).[58] In order to further investigate if (and how) our explanatory variables affect investment behaviours in different regions we run separate regressions for Latin America, Africa, and Asia. These regressions allow checking how different is the effect of macroeconomic factors in Latin America *vis a vis* Asia and Sub-Saharan Africa. Table 5.6 reports results of the selection model for Latin America, Sub-Saharan Africa, and Asia respectively.

[58] Also, there is more heterogeneity among sub-Saharan countries that among Asian or Latin American countries.

Table 5.6. Selection equations, by region

	Latin America[59]			sub-Saharan Africa			Asia		
	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.097	0.016	***	-0.062	0.025	*	-0.092	0.020	***
size	0.207	0.011	***	0.224	0.017	***	0.255	0.010	***
export	0.148	0.053	**	0.147	0.093		0.032	0.039	
fiscal balance	-0.320	0.024	***	-0.331	0.069	***	-0.381	0.173	*
external debt	0.057	0.005	***	0.002	0.004		0.002	0.025	
inflation	-0.840	0.210	***	1.698	0.271	***	-0.522	0.076	***
M2	0.128	0.007	***	-0.015	0.021		0.000	0.023	
interest rate	-0.082	0.015	***	0.010	0.017		0.034	0.057	
undervaluation	2.796	0.362	***	-6.886	1.042	***	-4.522	1.920	*
tax revenues	0.726	0.038	***	-0.103	0.058	+	-0.135	0.094	
GDP per capita	11.070	0.772	***	2.888	0.736	***	1.227	1.381	
GDP growth	-0.130	0.024	***	-0.138	0.035	***	-0.060	0.085	
terms of trade	2.289	0.318	***	-3.101	1.031	**	-1.916	0.740	**
ind1	-0.195	0.037	***	-0.172	0.061	**	-0.004	0.054	
ind2	-0.031	0.038		-0.067	0.052		0.097	0.060	
ind3	-0.080	0.050		-0.060	0.066		0.085	0.064	
ind4	-0.307	0.106	**	-0.053	0.216		0.247	0.061	***
ind5	0.004	0.118					0.253	0.066	***
ind6	-0.028	0.045		0.115	0.084		0.200	0.069	**
constant	-126.319	6.864	***	-8.459	7.427		1.869	8.865	
σ_υ	6.214	0.609	***	1.937	1.028	*	1.353	0.729	
firms	14401			5420			11863		
countries	15			14			11		
rho	0.975			0.79			0.647		
LR	-6659.789			-2913.234			-6107.686		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Few results vary by region: those that vary the most are precisely those of interest to structuralists. According to these estimations, Latin American firms react to in-

[59] Results are robust to the exclusion of Argentina and Venezuela, the only two Latin American countries that were implementing heterodox macroeconomic policies in the period under analysis.

flation more like Asian firms than like sub-Saharan African firms. The coefficient of inflation is highly significant in all three regressions. Nevertheless, for Latin America and Asia, it is negative, while for Sub-Saharan Africa it is positive. Inflation is generally lower in Asia than in Latin America and sub-Saharan Africa. This means that while it is more likely that Asian firms are sensitive to inflation, Latin American firms should be more used to it.

The coefficient of undervaluation index, negative in all previous estimations, is still negative and significant in Sub-Saharan Africa and Asia, but positive in Latin America. The positive sign of the undervaluation index indicates that firms invest more in the manufacturing industry if the exchange rate is undervalued. This result is interesting and confirms the view that for Latin America the tendency of the exchange rate to appreciate plays an important role in firms' decisions to invest in the manufacturing industry.[60]

The third interesting variable is terms of trade. The coefficient of terms of trade is significant in all three regressions and is positive for Latin America and negative for sub-Saharan Africa and Asia. This result is partly unexpected. Following the structuralist literature, we would have expected that favourable terms of trade divert investments away from manufacturing (because Latin America exports mainly commodities). However, our results show the opposite and support the argument that high terms of trade allowed Latin America to alleviate the impact of the international financial crisis of the second half of the 2000s (e.g. De Gregorio, 2013).

Finally, it is interesting to note that in the electronics industry (industry 4) the probability of investing is negative for firms in Latin America and positive for firms in Asia. Coefficients of the dummies of less traditional industries (transport, chemicals and pharmaceuticals) are positive and significant only in the Asian case. This is consistent with the literature on sectoral catching up (e.g. Malerba and Nelson, 2012).

Table 5.7 reports regression results of the outcome equations for Latin America, Sub-Saharan Africa and Asia.

[60] Interestingly, the positive sign of the undervaluation index coincides with a positive and significant coefficient of firms' export, indicating than undervaluation is crucial when firms export more.

Table 5.7. Outcome equations, by region

	Latin America			Sub-Saharan Africa			Asia		
	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.159	0.040	***	-0.198	0.052	***	-0.220	0.036	***
size	-0.189	0.024	***	-0.095	0.043	*	-0.060	0.028	*
fiscal balance	-0.517	0.034	***	0.058	0.035	+	-0.482	0.116	***
external debt	0.016	0.010		0.017	0.003	***	0.034	0.008	***
inflation	2.394	0.501	***	2.793	0.266	***	-0.492	0.083	***
M2	0.234	0.022	***	0.191	0.024	***	0.028	0.01	**
interest rate	0.655	0.050	***	-0.024	0.012	+	0.082	0.022	***
undervaluation	-9.369	0.530	***	-5.473	0.794	***	-3.863	0.629	***
tax revenues	-0.143	0.104		-1.109	0.086	***	-0.171	0.078	*
λ	0.532	0.084	***	0.051	0.342		0.259	0.201	
ind1	-0.345	0.088	***	-0.082	0.124		-0.214	0.092	*
ind2	-0.194	0.087	*	0.439	0.109	***	-0.249	0.104	*
ind3	0.038	0.102		0.350	0.138	*	0.071	0.113	
ind4	-0.645	0.272	*	-0.133	0.454		-0.023	0.106	
ind5	0.134	0.212					0.068	0.122	
ind6	-0.598	0.102	***	0.103	0.173		0.035	0.119	
constant	-22.465	3.147	***	-0.209	3.122		-4.259	1.137	***
σ_υ	10.702	2.256	***	10.942	2.309	***	1.487	0.404	
firms	8120			3105			5950		
countries	15			14			11		
rho	0.943			0.959			0.393		
LR	-19447.792			-7001.375			-12157.08		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Results are largely stable across regions. Only the effect of inflation varies: the coefficient of inflation is always highly significant, but is negative only for Asia. By comparing these results with those obtained in the selection equation, we can conclude that firms in sub-Saharan Africa are not discouraged by inflation, probably because inflation is a persistent condition. In Latin America, inflation discourages firms' investment, but firms who decide to invest, invest more in presence of inflation. Finally, in contrast with previous estimations where the sign of M2 was most

of the times negative, here we find a significant and positive coefficient of M2. This finding casts doubts on the robustness of previous results.

5.5 Robustness checks

In order to check the robustness of the results obtained so far, we test our model using the log of investment to capital as an alternative dependent variable. Capital is defined as the net book value of machinery, vehicles, and equipment. In terms of definitions, this variable is preferable to the one used so far. However, using investment to capital further reduces the number of observations because of missing data. Table 5.8 below shows the results of the outcome equation of the base model in Table 5.3 (so these lambdas are computed with the probit results of Table 5.3).

Table 5.8. Base model with log of investment to capital as dependent variable

	Outcome –Model 1			**Outcome – Model 2**		
	coef	se	sig	coef	se	Sig
age	-0.148	0.019	***	-0.164	0.022	***
size	-0.197	0.011	***	-0.171	0.013	***
fiscal balance	-0.004	0.010		-0.007	0.011	
external debt	0.000	0.001		-0.001	0.002	
inflation	-0.122	0.036	***	0.314	0.078	***
M2	-0.011	0.002	***	-0.006	0.003	*
interest rate	0.002	0.005		0.008	0.007	
undervaluation	-0.658	0.105	***	-1.069	0.151	***
tax revenue	0.072	0.011	***	0.063	0.014	***
tariff				-0.005	0.016	
selectivity				0.063	0.030	*
λ	0.008	0.024		0.057	0.052	
constant	-0.705	0.255	**	-1.798	0.377	***
σ_{υ}	0.511	0.070	***	0.574	0.089	***
firms	15963			11787		
countries	51			42		
rho	0.078			0.100		
LR	-31785.241			-23224.915		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Industry dummies are included in the estimations.

The coefficient of fiscal balances and external debts lose significance, which partly downsize the role of fiscal discipline. As for Table 5.3, it is difficult to assess the effect of inflation -significant and negative in model 1 but significant and positive in model 2. Findings on M2, undervaluation, and tax revenues are confirmed. Finally, the coefficient of average tariffs is negative and insignificant, while the coefficient of tariff selectivity is significant and positive.

Table 5.9 replicates the regression results of Table 5.4 with the log of investment to capital as the dependent variable.

Table 5.9. Within and between variations with log of investment to capital as dependent variable

	Outcome – Model 1			Outcome – Model 2			Outcome – Model 3		
	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.161	0.021	***	-0.216	0.027	***	-0.165	0.021	***
size	-0.208	0.014	***	0.046	0.070		-0.196	0.013	***
w_balance	0.010	0.014					0.003	0.013	
w_debt	0.004	0.001	*				0.004	0.001	**
w_infl	-0.114	0.041	**				-0.125	0.040	**
w_M2	-0.031	0.005	***				-0.033	0.005	***
w_intrate	-0.011	0.008					-0.007	0.008	
w_lnunderval	-0.920	0.259	***				-1.184	0.236	***
w_taxrev	0.121	0.017	***				0.125	0.017	***
av_balance				0.011	0.024		-0.018	0.027	
av_debt				-0.004	0.004		0.000	0.004	
av_infl				-0.076	0.142		-0.050	0.173	
av_M2				-0.006	0.003	+	-0.010	0.004	*
av_intrate				0.017	0.010	+	0.005	0.011	
av_lnunderval				-0.865	0.377	*	-0.304	0.363	
av_taxrev				0.065	0.016	***	0.048	0.018	**
λ	-0.034	0.069		2.024	0.547	***	0.059	0.065	
constant	-0.366	0.151	*	-2.991	0.768	***	-0.705	0.552	
σ_υ	0.588	0.073	***	0.411	0.062	***	0.506	0.075	***
firms	13534			13534			13534		
countries	38			38			38		
rho	0.099			0.051			0.075		
LR	-27030.328			-27079.202			-27041.764		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Industry dummies are included in the estimations, but are not reported.

Results of Table 5.9 confirm the story emerged from Table 5.4; that is, within country variations are significant determinants of firms' investments more often than between country variations. Signs of coefficients are also largely confirmed.

Table 5.10 replicates the regression results of Table 5.7 with the log of investment to capital as the dependent variable.

Table 5.10. Outcome equation, by region, with log of investment to capital as dependent variable

	Latin America			Sub-Saharan Africa			Asia		
	coef	se	sig	coef	se	sig	coef	se	sig
age	-0.112	0.028	***	-0.053	0.046		-0.290	0.037	***
size	-0.245	0.016	***	-0.136	0.035	***	-0.091	0.029	**
fiscal balance	0.090	0.020	***	-0.081	0.026	**	-0.568	0.126	***
external debt	0.001	0.005		-0.009	0.002	***	0.024	0.008	**
inflation	0.957	0.232	***	0.908	0.218	***	-0.445	0.086	***
M2	-0.059	0.009	***	0.021	0.013		0.022	0.011	*
interest rate	-0.006	0.017		0.029	0.011	**	0.052	0.023	*
underval	-2.739	0.244	***	1.373	0.603	*	-3.359	0.663	***
tax revenue	-0.079	0.040	*	0.061	0.039		-0.067	0.088	
λ	-0.106	0.039	**	0.633	0.248	*	0.516	0.210	*
ind1	0.044	0.063		-0.171	0.112		0.176	0.095	+
ind2	-0.010	0.062		0.091	0.099		0.249	0.107	*
ind3	-0.013	0.071		-0.213	0.123	+	0.310	0.115	**
ind4	-0.042	0.187		1.039	0.382	**	0.338	0.108	**
ind5	0.034	0.146					0.080	0.124	
ind6	0.062	0.072		-0.013	0.156		0.145	0.123	
constant	2.347	0.828	**	-4.945	0.835	***	-3.419	1.291	**
σ_υ	0.794	0.225		1.217	0.521		1.623	0.465	+
firms	6929			2431			5575		
countries	14			14			10		
rho	0.182			0.311			0.450		
LR	-13504.798			-4945.685			-11226.308		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Most stable results are obtained for Asia. As for Latin America, the only confirmed findings are those on inflation and exchange rates.

5.6 Conclusions

Low firms' investments are the key problem of development. Both neoclassical and heterodox economists argued that structural macroeconomic conditions hinder investments in developing countries. These strands of literature, however, do not agree on what *structural* means and how to improve or counterbalance these structural conditions.

According to neoclassical economists, interventionist governments and excessive government spending create macroeconomic instability and so adverse structural macroeconomic conditions. Therefore, the solution is to limit the role of the state that should only aim at maintaining macroeconomic stability and fiscal discipline. Heterodox economists, and especially structuralists, criticised this approach and the neoliberal policies adopted in many developing countries in the 1980s and 1990s. They argue that structural macroeconomic conditions are structural because they are related to productive structures. In order to counterbalance these naturally adverse macroeconomic conditions, governments should act proactively by implementing counter-cyclical fiscal and monetary policies, and designing mechanisms that neutralise the Dutch disease.

Despite the long debate and the variety of macroeconomic approaches experimented so far, there is little agreement on which macroeconomic policies governments should implement to stimulate private investments. This chapter addressed this issue by empirically testing these approaches. It estimates a multilevel Heckman selection model of firms' investments in developing countries from 2002 to 2010. The analysis is novel in various aspects. One of the most important is the use of firm level data: while extant empirical studies used national aggregate investments, the use of micro data allows investigating the micro-macro interactions that shape investment patterns. In this chapter, the thesis tries to understand how firms react to macroeconomic factors and if these macroeconomic factors are structural conditions affecting firms' investment decisions.

With respect to the first question, our econometric exercise indicates that macroeconomic factors are important determinants of firms' investments. In particular, fiscal deficits and external debts are positively related to firms' investments. Because the period of analysis includes the recent international crisis, these policies might be considered counter-cyclical. These results, however, are not robust to different specifications. We also find unstable results for financial deepening and in-

flation: while negative coefficients seem to prevail, the instability of the results calls for cautious interpretations. This instability is consistent with previous studies (e.g. Levine and Renelt, 1992; Levine and Zervos, 1993).

According to structuralists, exchange rate management should be one of the key areas of macroeconomic policy-making in developing countries. Cyclical overvaluations of the exchange rate restrict firms' access to foreign markets. Our data confirm that exchange rate management has a clear impact on private investments and show that undervalued exchange rates are negatively associated with firms' investments. As explained in Section 5.3, the effect of the exchange rate on investments depends on the relative importance of exports *versus* imports. The negative coefficient of the exchange rate indicates that firms are more sensitive to the higher costs of imported goods than to the easier access to international markets. In other words, although undervalued exchange rates could spur investments by making exports more competitive, undervalued exchange rates also increase the cost of imported capital goods. Using these data, the second effect seems to prevail. This might also be related to the low export shares characterising firms in this dataset.

With respect to the second question, we estimated within and between effects models. In the regressions with macroeconomic variables transformed into their within country variations (including country fixed effects that do not vary across countries), macroeconomic factors are more significant than in the regressions with macroeconomic variables transformed into country averages. This occurs although descriptive statistics showed that in the data between countries variations are larger than within country variations for all country-level variables. In light of this, we might have expected between countries variations to be more significantly associated with investments than within country variations.

This finding should not surprise. It is well established that investments are volatile and follow business cycles. A number of studies (Dosi et al., 2005, 2008, 2010; Meijers et al., 2014) developed micro-founded evolutionary models of business cycles where firms generate business cycles fluctuations with their investment decisions. This paper contributes to this literature by providing supporting empirical evidence on the micro-foundations of business cycles.

This study also tests if firms in Latin America react differently to macroeconomic factors, by estimating separate models for firms in Latin America, sub-Saharan Africa, and Asia. Results show that firms in the three regions react similarly to almost

all macroeconomic variables. Dissimilar reactions are found in response to inflation and exchange rates. Inflation discourages firms' investments only in Latin America and Asia, even though inflation levels in Latin America are more likely to be similar to those of Africa than Asia. However, in Latin America and Africa firms that chose to invest, invest more in inflationary periods. The analysis also shows that undervalued exchange rates are positively related to investments only for firms in Latin America. These findings partly confirm structuralist theories on the impact of inflation and exchange rates' overvaluations on investments in manufacturing.

However, the finding that investments are associated more with business cycles rather than structural macroeconomic conditions partly contradicts the structuralist explanation of low investment rates in Latin America. Structuralists argue that in response to chronic macroeconomic instability, firms in Latin America adopted defensive investment strategies. By showing that firms' investments follow business cycles, this paper confirms that macroeconomic volatility is a major determinant of investments.

To conclude, this chapter shows that macroeconomic factors are important determinants of firms' investments. Firms' investment behaviours follow business cycles' fluctuations: by influencing these fluctuations, macroeconomic policies prove to be significant determinants of firms' investments. This result bears important policy implications as it provides empirical evidence in support of counter-cyclical fiscal, monetary, and exchange rate policies. Based on this evidence, macroeconomic policies should therefore *manage* business cycles. This agenda has been strongly advocated for by several strands of heterodox economists, among which structuralist economists.

Appendix C

Table C.1. Countries and number of firms

Country year	N. firms	%	Country year	N. of firms	%
Albania_2002	61	0.16	China_2003	1,156	3.1
Angola_2006	271	0.73	Colombia_2006	648	1.74
Angola_2010	47	0.13	Colombia_2010	392	1.05
Argentina_2006	741	1.98	Costa Rica_2010	185	0.5
Argentina_2010	499	1.34	Dem. Rep. of Congo_2006	191	0.51
Armenia_2005	227	0.61	Dem. Rep. of Congo_2010	46	0.12
Armenia_2009	58	0.16	Dominican Republic_2005	165	0.44
Azerbaijan_2009	52	0.14	Dominican Republic_2010	65	0.17
Bangladesh_2002	976	2.61	Ecuador_2003	427	1.14
Bangladesh_2007	663	1.78	Ecuador_2006	390	1.04
Belarus_2002	42	0.11	Egypt_2004	971	2.6
Belarus_2005	55	0.15	Ethiopia_2002	371	0.99
Belarus_2008	58	0.16	Georgia_2002	34	0.09
Bhutan_2009	37	0.1	Georgia_2005	49	0.13
Bolivia_2006	404	1.08	Georgia_2008	51	0.14
Bolivia_2010	69	0.18	Guatemala_2003	434	1.16
Bosnia and Herzegovina_2009	81	0.22	Guatemala_2006	448	1.2
Botswana_2006	145	0.39	Guatemala_2010	171	0.46
Botswana_2010	53	0.14	Honduras_2003	450	1.21
Brazil_2003	1,630	4.37	Honduras_2006	369	0.99
Brazil_2009	881	2.36	Honduras_2010	21	0.06
Bulgaria_2002	49	0.13	Hungary_2002	49	0.13
Bulgaria_2004	325	0.87	Hungary_2005	359	0.96
Bulgaria_2005	58	0.16	Hungary_2009	56	0.15
Bulgaria_2007	577	1.55	India_2002	1,475	3.95
Bulgaria_2009	55	0.15	India_2006	2,010	5.38
Cape Verde_2006	37	0.1	Indonesia_2003	709	1.9
Cape Verde_2009	25	0.07	Indonesia_2009	291	0.78
Chile_2004	757	2.03	Jordan_2006	353	0.95
Chile_2006	691	1.85	Kenya_2003	209	0.56
Chile_2010	446	1.19	Kenya_2007	214	0.57
China_2002	957	2.56	Lao PDR_2006	102	0.27

Table C.1. Countries and number of firms in the study (Cont.d)

Country year	N. firms	%	Country year	N. firms	%
Lao PDR_2009	47	0.13	Romania_2005	386	1.03
Lesotho_2003	55	0.15	Romania_2009	100	0.27
Madagascar_2005	275	0.74	Serbia_2009	88	0.24
Madagascar_2009	77	0.21	South Africa_2003	573	1.53
Malaysia_2002	561	1.5	South Africa_2007	680	1.82
Mauritius_2009	101	0.27	Sri Lanka_2004	417	1.12
Mexico_2006	1,124	3.01	Sri Lanka_2011	86	0.23
Mexico_2010	615	1.65	Tajikistan_2003	96	0.26
Moldova_2003	103	0.28	Tanzania_2003	242	0.65
Moldova_2005	207	0.55	Tanzania_2006	282	0.76
Moldova_2009	60	0.16	Thailand_2004	1,385	3.71
Mongolia_2009	87	0.23	Uganda_2003	256	0.69
Mozambique_2007	341	0.91	Uganda_2006	334	0.89
Nigeria_2007	463	1.24	Ukraine_2002	136	0.36
Paraguay_2006	431	1.15	Ukraine_2005	180	0.48
Paraguay_2010	83	0.22	Ukraine_2008	250	0.67
Peru_2002	117	0.31	Uruguay_2006	391	1.05
Peru_2006	361	0.97	Uruguay_2010	199	0.53
Peru_2010	515	1.38	Venezuela_2006	282	0.76
Philippines_2003	618	1.66	Zambia_2002	169	0.45
Philippines_2009	286	0.77	Zambia_2007	304	0.81
Romania_2002	82	0.22	Total	37,333	100

Table C.2. Details, source, and coverage of explanatory variables in the study

Variable	Details	Source	Coverage
Indicators of macroeconomic policies			
Inflation	Consumer prices (annual %)	WDI	2002-12
Interest rate	Real interest rate (%)	WDI	2002-12
Undervaluation index	Real exchange rate adjusted for the Balassa-Samuelson effect (Rodrik, 2008)	Built with data from PWT	2002-11
Government budget surplus/GDP	Revenue (including grants) minus expense, minus net acquisition of nonfinancial assets	WDI	2002-12
Foreign debt/GDP	Total external debt stocks to gross national income.	WDI	2002-12
M2/GDP	Ratio of broad money over GDP	WDI	2002-12
Tax revenue/GDP	Compulsory transfers to the central government	WDI	2002-11
Average tariffs	Unweighted average of most favoured nation rates for all products subject to tariffs calculated for all traded goods	WDI	2002-11
Share of tariff lines with international peaks	Share of lines in the tariff schedule that are set on a per unit basis or that combine ad valorem and per unit rates	WDI	2002-11
Country-level control variables			
GDP per capita	GDP per capita based on purchasing power parity (PPP), constant 2005 prices	WDI	2002-12
GDP per capita growth	Annual percentage growth rate of GDP per capita	WDI	2002-12
Terms of trade	Net barter terms of trade (the ratio of the export unit value index to the import unit value index)	UNCTAD and WDI	2002-12
Firm-level control variables			
Age	Logarithm of years since establishment	Enterprise Surveys	2002-13
Size	Logarithm of number of permanent full-time workers	Enterprise Surveys	2002-13
Export	Proportion of total sales that are exported directly and indirectly	Enterprise Surveys	2002-13
Industry	Industry dummies	Enterprise Surveys	2002-13

Table C.3. Correlation table - country effects and macroeconomic variables

	υ_1	balance	debt	M2	inflation	intrate	underval	taxrev	GDP	growth	tot
υ_1	1.000										
balance	0.495	1.000									
debt	-0.049	-0.009	1.000								
M2	0.295	-0.119	-0.169	1.000							
inflation	-0.179	0.119	0.257	-0.616	1.000						
intrate	-0.705	-0.352	0.008	-0.176	0.195	1.000					
underval	0.383	-0.146	0.040	0.472	-0.300	-0.113	1.000				
taxrev	0.324	0.322	0.278	-0.084	0.329	-0.231	-0.213	1.000			
GDP	0.292	0.250	-0.043	0.096	0.002	-0.119	-0.253	0.629	1.000		
growth	0.437	0.437	-0.199	0.216	-0.179	-0.480	0.189	0.049	0.055	1.000	
tot	0.146	0.444	-0.126	-0.186	-0.071	-0.166	-0.350	0.100	0.297	0.194	1.000

Table C.4. Robustness check: selection equation without correlated variables

	Without M2			Without M2 and taxrev		
	coef	se	sig	coef	se	sig
age	-0.089	0.010	***	-0.092	0.010	***
size	0.239	0.006	***	0.237	0.006	***
export	0.029	0.027		0.029	0.027	
fiscal balance	-0.188	0.012	***	-0.117	0.009	***
external debt	0.006	0.001	***	0.008	0.001	***
inflation	-0.329	0.026	***	-0.302	0.026	***
interest rate	0.026	0.007	***	0.046	0.006	***
undervaluation	-3.863	0.166	***	-3.970	0.165	***
tax revenue	0.179	0.016	***			
GDP	3.983	0.282	***	5.055	0.274	***
GDP growth	-0.313	0.010	***	-0.311	0.010	***
tot	-0.856	0.118	***	-0.438	0.111	***
I_industry1	-0.160	0.024	***	-0.151	0.024	***
I_industry2	-0.037	0.025		-0.027	0.025	
I_industry3	-0.030	0.026		-0.025	0.026	
I_industry4	0.038	0.031		0.051	0.031	+
constant	-30.773	2.493	***	-39.086	2.388	***
σ_υ	4.469	0.985	***	4.649	1.032	***
firms	36992			36992		
countries	55			55		
rho	0.952			0.956		
LR	-17906.440			-17979.866		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table C.5. Robustness check: outcome equation without correlated variables

	Without M2			Without M2 and taxrev		
	coef	se	sig	coef	se	sig
age	-0.169	0.023	***	-0.175	0.023	***
size	-0.125	0.013	***	-0.115	0.013	***
fiscal balance	-0.414	0.013	***	-0.372	0.013	***
external debt	0.012	0.002	***	0.010	0.002	***
inflation	-0.180	0.051	***	0.066	0.047	
interest rate	0.054	0.008	***	0.079	0.009	***
undervaluation	-3.247	0.164	***	-3.852	0.168	***
tax revenue	0.241	0.018	***			
λ	0.169	0.037	***	0.211	0.043	***
I_industry1	-0.170	0.053	**	-0.154	0.053	**
I_industry2	-0.021	0.054		-0.014	0.054	
I_industry3	0.098	0.056	+	0.114	0.057	*
I_industry4	-0.320	0.066	***	-0.311	0.067	***
constant	-8.263	0.435	***	-4.956	0.364	***
σ_u	2.127	0.226	***	2.281	0.260	***
firms	18694			18694		
countries	53			53		
rho	0.454			0.487		
LR	-42530.032			-42607.509		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Table C.6. Robustness check: time dummies

	Selection equation			Outcome equation		
	coef	se	sig	coef	se	sig
age	-0.101	0.011	***	-0.157	0.022	***
size	0.229	0.006	***	-0.194	0.015	***
export	0.040	0.028				
fiscal balance	-0.057	0.015	***	0.001	0.017	
external debt	0.004	0.001	***	0.007	0.002	***
inflation	-0.384	0.041	***	-0.299	0.067	***
M2	-0.018	0.004	***	-0.002	0.004	
interest rate	-0.018	0.008	*	-0.025	0.010	*
undervaluation	0.473	0.230	*	-0.835	0.315	**
tax revenue	-0.005	0.019		0.066	0.017	***
GDP per capita	0.067	0.234				
GDP growth	-0.177	0.014	***			
tot	-1.873	0.186	***			
λ				-0.199	0.082	*
I_period1	-1.978	0.347	***	-1.215	0.411	**
I_period2	-1.961	0.334	***	-0.778	0.407	+
I_period3	-2.945	0.318	***	-1.081	0.376	**
I_period4	-3.168	0.399	***	-1.194	0.630	+
I_period5	-0.762	0.320	*	-3.213	0.378	***
I_period6	-0.183	0.315		-1.002	0.394	*
I_period7	4.195	0.606	***	-0.958	0.818	
I_period8	0.165	0.324		-1.271	0.377	***
I_period9	1.829	0.312	***	-0.121	0.366	
constant	10.909	2.202	***	-1.728	0.526	**
σ_υ	1.598	0.372	***	1.072	0.156	
firms	36992			18694		
countries	55			53		
rho	0.719			0.187		
LR	-16838.501			-41686.537		

Legend: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: Industry dummies are included in both equations, but are not reported.

Chapter 6
Conclusions

Since the Industrial Revolution, industrialisation proved to be a powerful engine of socio-economic development. Virtually all countries of the world have strived to industrialise. While few succeeded, most of them did not. In the successful cases, industrialisation fostered economic growth and lifted large portions of the population out of poverty. In the less successful cases, developing countries did not reach high-income levels. Premature deindustrialisation slowed down economic growth and resulted in falling behind. Since the post-war era, successful industrialisers have been mainly Asian countries: the Asian Tigers, namely South Korea, Taiwan, Hong Kong, and Singapore. Today, China, Thailand, Malaysia, and Vietnam seem to be the next countries to industrialise. Among the premature deindustrialisers, we find Latin American and African countries.

The case of Latin America is the most striking. In the 1970s, it was believed that Brazil, Argentina, and Mexico would have been the next countries to catch up with the advanced world. Latin America enjoyed higher GDP levels and possessed more developed industrial sectors than East Asia. The abundant historical-comparative literature on this topic identified public policies as a crucial factor behind this divergence. However, little agreement has been reached about the kind of policies that contributed the most to the success of East Asia and relative failure of Latin America.

Neoclassical economists described the East Asian model as completely market based, where the state only aimed at ensuring favourable basic conditions for business (macroeconomic stability, human capital formation, and provision of infrastructures). According to this strand of literature, in Latin America, industrial policies distorted market incentives and paid too little attention to macroeconomic stability and basic business conditions. After the debt crisis of the 1980s, Latin American governments were pressured to implement structural policies. These were motivated by the idea that firms' investments are negatively affected by structural macroeconomic conditions. Hence, structural policies aimed at restoring favourable macroeconomic conditions by ensuring macroeconomic stability and fiscal discipline.

According to structuralists and industrial strategists, East Asian governments were at least as interventionist as the Latin Americans. In both regions, active industrial policies directed structural and technological change. However, adverse macroeconomic conditions hindered industrialisation in Latin America and permanently mu-

tated firms' investment behaviours. According to the structuralist interpretation, Latin American macroeconomic instability depends on its production structure and, in particular, on its dependence on natural resources. This is what makes macroeconomic conditions *structural* in the structuralist interpretation. Structuralists criticised Washington Consensus policies for being too pro-cyclical and advocated for a dual strategy to industrialise. This strategy encompasses selective industrial policies to foster innovation in industrial sectors with the strongest linkages to domestic production and counter-cyclical fiscal, monetary, and exchange rate policies to counterbalance the external vulnerabilities of developing economies.

This thesis builds on the evidence that manufacturing is still a powerful engine of growth and poverty reduction. Consequently, industrial strategies are an important part of countries' development strategies. This research topic is trapped into ideologies that influence research and cannot enlighten policymakers in designing policies for industrialisation. Functional *versus* selective industrial policies, import substitution *versus* export promotion, orthodox *versus* heterodox macroeconomic policies are among the most powerful dichotomies. This thesis contributed to these debates by shedding light on why some countries industrialised and other did not. By answering this question, this thesis tries to move the debate away from these dichotomies. This is an important effort from an intellectual and a political point of view.

In order to answer this question, the thesis empirically tested alternative theories about the determinants of industrialisation. Empirical studies constitute this thesis. Quantitative analysis, comparative-historical approaches, and macroeconomic and microeconomic perspectives are combined. The first empirical study applies econometric panel data techniques to a large sample of developing and developed countries. The second analyses five country cases in East Asia and Latin America, namely Argentina, Brazil, Mexico, Korea, and Taiwan. The third analysis is a micro-econometric study that uses firm and country-level variables to estimate a multilevel Heckman selection model of firms' investments in manufacturing. Given the underlying question motivating the thesis, cross-country comparisons were carried out. Because determinants of industrialisation changed over the last decades, the historical dimension is also important in this thesis. The main findings of this thesis can be summarised as follows.

First, the thesis shows that while broadly defined institutions (captured by various indexes of democracy) are not significant determinants of industrialisation, public policies are. This result is clear from all our studies and robust across samples and methodologies. More specifically, this thesis analysed the role of industrial policies, intended as trade, investment, and science, technology, and innovation policies, and macroeconomic policies.

The thesis explored the role of trade liberalisation, export promotion, and exchange rate management. In the literature, there is ample consensus on the role of international trade for economic growth. In Chapter 2, we find that trade openness, defined as the share of exports in GDP, has a significant and positive impact on industrialisation. Trade openness is considered one of the key ingredients of the so-called East Asian miracle. In the literature, there is a debate on whether trade openness meant export promotion *with* trade liberalisation. Chapter 4 builds considerable empirical evidence on the degree of import restrictions and export promotion in Argentina, Brazil, Mexico, Korea, and Taiwan. Evidence confirms that Latin American and East Asian countries selectively protected their domestic markets and that these policies remained in place until the 1980s in Taiwan and 1990s in Korea. So, rather than a "virtually free" trade regime as described by neoclassical economists, the East Asian trade regime was quite protective and selective. In our last empirical study, we test the role of average tariffs and tariff selectivity on firms' investments in manufacturing in a sample of developing and developed countries. Our results, however, do not permit to draw firm conclusions with respect to these indicators.

Data unequivocally demonstrate that East Asian governments invested considerably more resources in export promotion than Latin American governments. This, however, does not imply that Latin American governments were not subsiding exports. Contrary to common interpretation, import substitution was never meant to be antithetic to export promotion. Two alternative explanations can be put forth with regard to export promotion policies in Latin America: either insufficient financial resources were allocated to export promotion, or the *stimuli* were not enough or properly designed to offset the low competitiveness of Latin American manufacturing exports. In the structuralist literature, the second hypothesis has been explained by the tendency of the exchange rate to appreciate cyclically, because of the Dutch disease.

The thesis also explores the role of the exchange rate. Findings of our first empirical study (in Chapter 2) indicate that undervalued exchange rates have a positive impact on industrialisation. This confirms existing empirical evidence and structuralist theories. Our last empirical study in Chapter 5, however, shows that undervaluation is negatively associated with firms' investments in manufacturing: when firms' exports are low, higher import costs are not compensated by higher export revenues.

Taken together, these results suggest that trade policies play an important role for industrialisation. More specifically, higher export promotion made a difference in the history of East Asia and Latin America. By contrast, import restrictions do not consistently explain differences in firms' investment behaviours. Moreover, when we look at East Asia and Latin America, our findings show that the extent of domestic market protection was not tremendously dissimilar between the two regions.

Nowadays, industrialising countries, especially in Asia, grow and industrialise via export promotion. Yet, some authors are questioning the export-led model as a viable model of industrialisation. Firstly, it is a contradiction in terms that all industrialising countries can industrialise by exporting. Secondly, in times of economic recession or slow growth in the advanced world, export-led growth might be not profitable enough, especially for large countries that could grow potentially more by targeting their large domestic markets (albeit with lower purchasing capacity).

Governments can influence the direction of structural change also via preferential credits, subsides, and fiscal incentives. When these are directed towards innovative industries, they are referred to as innovation policies. The literature does not always acknowledge that East Asian governments directed financing towards strategic industries. In Chapter 4, we measure and compare incentives to investments and show that East Asian governments influenced financial resources' allocation towards priority industries. In addition, tax incentives, normally considered functional industrial policies, were selectively used, because they were available only to specific industries. According to our data, these incentives were much higher in East Asia than in Latin America. Moreover, targeted industries in East Asia were mostly electronics and ICTs. These industries constituted the new technological revolution of the time and so represented a window of opportunities for industrial-

ising countries. Therefore, East Asian governments not only influenced the process of structural change, but also favoured technology-intensive strategic industries.

With regard to technological change, the findings of this thesis show that structural change is increasingly related to technological change. In Chapter 2, we find that especially since the 1990s, industrialisation is fuelled more by technological capabilities than low labour costs. This result is in line with the Schumpeterian and evolutionary theoretical and empirical literature. Far from a first-world activity, innovation is a key driver of catch up. Learning and adaptation of imported technologies are essential processes that allow capability accumulation in the developing world. This thesis shows that the state plays a great role in these processes.

There is an ample literature on STI policies, especially in East Asia. The evidence in this thesis allows identifying systematic differences between East Asian and Latin American STI policies. First, East Asian governments heavily invested in human capital formation, knowledge and capabilities' accumulation. Second, policies supported knowledge creation both in the public and in the private sector and stimulated interactions between these two. By contrast, Latin American STI policies absorbed much less financial resources and policies were geared more towards human capital formation than firms' innovation. Finally, our data show that STI policies were much more selective and strategically oriented in East Asia than in Latin America. These findings confirm existing empirical evidence and partly explain low innovation rates among Latin American firms.

As already mentioned, the literature has argued that, compared to Latin American countries, East Asian countries benefited from *favourable* macroeconomic conditions. Macroeconomic factors play a key role in industrialisation. Our empirical studies, especially in Chapter 2 and 5, corroborate this statement. In Chapter 2, results show a positive relationship between inflation and industrialisation: inflation can be a by-product of economic growth and, as such, it can be tolerated, if moderate. Our empirical analysis in Chapter 5 shows that firms' investments are positively related to fiscal deficits and external debts.

The main finding of this thesis concerning macroeconomic factors is that firms' investments in manufacturing are related more to the variable component of macroeconomic factors, than their structural component. Hence, these results suggest that firms' investments follow macroeconomic business cycles' fluctuations. This finding, however, is less surprising then it might seem. The theoretical and empiri-

cal literature on business cycles has proved that investments are volatile and follow business cycles. Evolutionary scholars (Dosi et al., 2005, 2008, 2010; Meijers et al., 2014) developed micro-founded evolutionary models of business cycles, in which firms' investment decisions generate business cycles fluctuations. This paper provides supporting empirical evidence on the micro-foundations of business cycles.

This result has clear policy implications because policy advising is often based on the hypothesis that stable macroeconomic conditions are needed for investments. Even today, Southern European countries are urged to implement structural policies that are causing recession and unemployment. Findings of this empirical study suggest that instead of focusing on *structural* macroeconomic conditions, macroeconomic policies should counteract the effects of business cycles via countercyclical macroeconomic policy. These policies are strongly advocated for by heterodox economists.

To conclude, we can summarise the main findings of this thesis as follows. First, public policies are important determinants of industrialisation. In particular, industrial and macroeconomic policies explain divergences in industrialisation. Differences between successful and relatively less successful industrialising countries in amount of resources devoted to industrial policy and targeted industries are noticeable. Macroeconomic policies affect industrialisation. Firms' investment behaviours follow business cycles' fluctuations: by influencing these fluctuations, macroeconomic policies prove to be significant determinants of firms' investments. The thesis also demonstrates that technological capabilities are increasingly important to industrialise. This emerges from econometric evidence and from the comparative analysis of the East Asian and Latin American industrialisation processes.

This thesis contributes to structuralist and evolutionary theories. It confirms that macroeconomic policies should *manage* business cycles, and so offset macroeconomic volatility by counter-cyclical macroeconomic policies. With respect to evolutionary theories, it brings supportive empirical evidence on the role of capabilities and STI policies for structural change.

Results of this thesis contribute to policy debates in a number of ways. First, industrial policies facilitate structural change towards dynamic industries. In order to work, these policies require sufficient funding and sufficient orientation in terms of targeted industries and technologies. In advanced countries, modern industrial policy is mainly innovation policy. Latin American countries and other developing re-

gions should take advantage of this international consensus and re-focus their industrial policies towards knowledge and innovation. The findings of this thesis also bring empirical evidence in support of counter-cyclical macroeconomic policies.

This thesis suggests at least two directions for future research. Quantitative studies that compare industrial policies' indicators improve our understanding of how industrial policies affect structural and technological change and so, how these effects change in different contexts and periods. This type of studies are useful to establish how much intervention is enough, too little, or too much. Moreover, testing the micro-foundations of macroeconomic theories is useful and is made increasingly possible by the recent increase in firms' surveys in both developed and developing countries.

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VALORISATION

In accordance with Article 23 of the regulation governing the attainment of doctoral degrees at Maastricht University, this section discusses the valorisation opportunities of this doctoral thesis.

This thesis investigates why some countries industrialised, while others did not. It takes a long-term perspective and looks at a high number of countries in all world regions. Understanding the determinants of industrialisation across countries and over time is important in a historical perspective, but also to inform present and future policy-makers on what has worked and has not worked in other countries. Countries that successfully industrialised witnessed rising GDP, flourishing employment opportunities, and shrinking poverty. All this makes a strong case for industrialisation as an interesting topic for academic discussions and as a central goal of development strategies.

The focus on industrialisation and the manufacturing sector is relevant to present-day policymaking in both developed and developing regions. The US program "Make it in America", the Brazilian "Brasil Maior Plan", the Indian "Make in India", and the Ethiopian Industrial Development Strategy are just a few examples of how countries at all income levels and in all world regions strive to industrialise or to revive their industrial sectors. Also at the global level, the UN Sustainable Development Goals reiterate the need to reduce global poverty by promoting industrialisation and fostering innovation (proposed Goal 9).

Findings of this thesis show how determinants of industrialisation changed over time, with an increasingly prominent role of innovation. Today, innovation is a hot topic in policy discussions in both the developed and the developing world. This thesis analyses science, technology, and innovation policies intended as all policy measures aimed at stimulating knowledge creation and skill accumulation. These are often considered the new form of industrial policy. Their role for catch up, as for example in the case of the Asian Tigers, is now undisputed.

As discussed in this thesis, the 50-year long debate on industrial policy polarised around two opposite views. This resulted in an unproductive confrontation that cannot enlighten policymakers. This thesis proposed a new methodology to analyse industrial policies across countries and over time and applied it to some of the

most debated country cases of successful and less successful industrialisation. The proposed methodology allows quantifying industrial policies and so differentiating countries by how much they invest in industrial policy instruments. This type of studies can be replicated in more countries and periods, or be applied to other areas of public policies or to specific industries. This could potentially lead to the creation of a new database of industrial policy indicators. This database could improve our understanding of how industrial policies affect structural and technological change and how these effects vary across countries, periods, and industries. It could be also useful to have a sense of how much intervention is enough, too little, or too much.

The policy relevance of this new methodology is evident. New measures of industrial policies are increasingly important in a context in which countries at different income levels are experimenting with industrial policies and governments are held more and more accountable for how they spend public resources. Moreover, indicators of industrial policies could help countries monitoring and benchmarking their industrial efforts and potentially find role models (without assuming that recipes can be copied and pasted from one context to another).

The thesis also contributes to discussions on the role of macroeconomic policies for investments. Investments are key to economic growth. Understanding why firms decide to invest or not, and how macroeconomic policies can influence investment behaviours, is more than an interesting academic question. Various international organisations propose recipes for development and economic growth, but all these recipes must be empirically tested: evidence-based policy cannot be a mere buzzword, given the challenges of budget-constrained governments all over the world.

As shown so far, this thesis has clear economic and social relevance, especially for the developing world. It speaks to policymakers who want to improve the industrial performance of their countries and to international organisations engaged in research and policy dialogues to promote industrialisation. The thesis also contributes to public debates on industrial and macroeconomic policies. These are very hot topics in these times of economic recession in various countries in the global North and rise of new powers from emerging countries.

The chapters of this thesis were presented in international conferences in different parts of the world. Chapter 2 was presented at the 14th International Schumpeter

Society Conference, held in Brisbane (Australia) in June 2012. Chapter 3 was presented at the 25th EAEPE (European Association for Evolutionary Political Economy) Conference in Paris (France) in November 2013. Chapter 4 was presented at the 12th Globelics Conference held in Addis Abeba (Ethiopia) in October 2014. Chapter 5 was presented at the UNU-MERIT international conference held in Maastricht in November 2014. Chapter 3 and 4 were the result of interesting discussions with economists from UN-ECLAC (the UN Economic Commission for Latin America and the Caribbean), and professors and participants to the Fifth Latin American Advanced Programme on Rethinking Macro and Development Economics (LAPORDE), held in São Paulo (Brasil) in January 2014. Chapters 2, 4, and 5 will be readapted to be published in international peer-reviewed journals.

SAMENVATTING

Landen evolueren in hun ontwikkelingsproces van agrarische naar industriële economieën: maak-industrie biedt werk aan een groter deel van de bevolking en draagt meer bij aan het BBP. Empirisch onderzoek heeft aangetoond dat dat structurele verandering richting fabricage consequent wordt geassocieerd met een snellere economische groei. Vandaar dat fabricage al sinds de vroege economische ontwikkelingstheorieën wordt beschouwd als een motor van economische groei. Gezien de rol van industrialisatie in ontwikkeling, is het zeer belangrijk om te begrijpen waarom sommige landen met succes geïndustrialiseerd zijn, terwijl dat voor anderen niet het geval is.

Sinds de industriële revolutie hebben alle landen geprobeerd te industrialiseren: sommigen zijn hierin geslaagd, maar de meesten niet. In de periode na de oorlog waren vooral Aziatische landen succesvol in het industrialiseren, met name Zuid-Korea, Taiwan, Hong Kong en Singapore. Latijns-Amerikaanse en Afrikaanse landen begonnen al in de jaren '80 van de 20e eeuw vroegtijdig te de-industrialiseren. Het geval van Latijns-Amerika is hierin zeker het meest opvallend. In de jaren '70 van de 20e eeuw werd gedacht dat Brazilië, Argentinië en Mexico de volgende landen zouden zijn die zich bij de geavanceerde wereld zouden voegen. De waargenomen onverwachte divergentie in de industriële prestaties van Latijns-Amerika en Oost-Azië heeft de aandacht van academici en beleidsmakers aangetrokken. Dit proefschrift draagt bij aan deze literatuur en onderzoekt de determinanten van de industrialisatie in een historisch-comparatieve setting. Het bestaat uit empirische onderzoeken die kwantitatieve en semi-kwalitatieve onderzoeksmethoden en macro-economische en micro-economische perspectieven combineren.

Het eerste onderzoek van dit proefschrift gaat terug naar het fabricagemodel als motor van groei, ontwikkeld door John Cornwall in 1977. De vergelijking van industriële productiegroei wordt geschat door moderne econometrische datatechnieken toe te passen op een dataset met daarin ongeveer 70 ontwikkelde en ontwikkelingslanden tussen 1960 en 2005. Hierdoor plaatst dit onderzoek de industrialisatie in de kern van de analyse en identificeert het de determinanten en hun ontwikkeling in de tijd. De resultaten geven aan dat landen met relatief onderontwikkelde industriële sectoren, grote binnenlandse markten, sterke

exportprestaties en ondergewaardeerde wisselkoersen sneller industrialiseren. Hoewel arbeidskosten in deze analyse geen significante determinanten van industrialisatie zijn, speelt innovatie een belangrijke rol bij industrialisatie, met name in het midden van de jaren '90 van de 20e eeuw. Deze bevinding is in lijn met de evolutionaire literatuur over innovatie en ontwikkeling en bevestigt dat innovatie een belangrijke motor is van de inhaalslag.

Industrieel beleid en de macro-economische omstandigheden worden vaak aangehaald als belangrijke determinanten van de industrialisatie, vooral in het geval van Oost-Azië en Latijns-Amerika. Het debat over het industriebeleid is gepolariseerd rond twee tegengestelde interpretaties. Volgens de neoklassieke economen hebben Oost-Aziatische overheden markt vriendelijk beleid geïmplementeerd dat alleen gericht is op het waarborgen van gunstige randvoorwaarden voor het bedrijfsleven. Het selectieve industriële beleid in Latijns-Amerika heeft daarentegen te maken met vervormde marktprikkels, aanhoudende inefficiënte industrieën en diffuse corruptie. Volgens structuralisten en industriële strategen waren Oost-Aziatische overheden tenminste net zo interventionistisch als die in Latijns-Amerika. In beide regio's bepaalde selectief industrieel beleid de richting van structurele verandering.

Niet alleen de aard van het beleid wordt in de literatuur besproken, maar ook de empirische gegevens -hoeveel interventie er geweest is- worden fel betwist. Dit proefschrift draagt bij aan deze literatuur door het kwantificeren van industrieel beleid in een aantal van de meest bestudeerde situaties, namelijk Argentinië, Brazilië, Mexico, Zuid-Korea en Taiwan. Dit proefschrift evalueert op kritische wijze de historisch-vergelijkende literatuur over het industriebeleid in Oost-Azië en Latijns-Amerika. Op basis hiervan bouwt het aan een gedetailleerde taxonomie van industriële beleidsinstrumenten en bespreekt de indicatoren die in de literatuur gebruikt worden om ze te kwantificeren. In een tweede fase van dit proefschrift wordt stevig empirisch bewijs met betrekking tot het bereik en de aard van overheidsingrijpen in de geselecteerde gevallen opgebouwd en gepresenteerd. De nieuwigheid van dit onderzoek zit juist in het kwantificeren van industriële beleidsinstrumenten. Dit is van essentieel belang om wat een onvruchtbare confrontatie over de voordelen (en nadelen) van industrieel beleid geworden is te overwinnen.

Het empirische bewijs dat in dit proefschrift gepresenteerd wordt, bevestigt het merendeel van de aanvaarde gestileerde feiten over de divergentie van Oost-Azië en

Latijns-Amerika. Allereerst bevestigen gegevens dat Latijns-Amerikaanse landen hun binnenlandse markten sterker beschermd hebben, hoewel de mate van bescherming van de Oost-Aziatische binnenlandse markt ook niet onderschat moet worden. Ten tweede gaven Oost-Aziatische overheden meer uit aan exportpromotie dan Latijns-Amerikaanse overheden. Onze gegevens bevestigen tevens de rol van de Oost-Aziatische regeringen in het sturen van de financiële middelen richting strategische industrieën. Kosten voor fiscale en financiële prikkels waren hoger in Korea en Taiwan dan in welk onderzocht Latijns-Amerikaans land dan ook. Tot slot ondersteunden Latijns-Amerikaanse regeringen wetenschap meer dan innovatie in bedrijven. Oost-Aziatisch beleid had meer balans in wetenschap en innovatie en stimuleerde de interactie tussen deze beide vlakken. Niet alleen uitgaven voor innovatiestimuli waren groter in Oost-Azië, ook het soort interventie verschilde: door financiële en fiscale stimuli te combineren, bleken Oost-Aziatische overheden ondernemender te zijn dan Latijns-Amerikaanse overheden. Sectoren waarop gericht werd verschilden ook: Oost-Aziatische regeringen stuurden middelen vooral naar strategische industrieën, zoals ICT.

Ongunstige structurele macro-economische omstandigheden worden vaak beschouwd als een van de belangrijkste oorzaken van de lage investeringen in ontwikkelingslanden. De laatste empirische studie van dit proefschrift is een micro-economisch perspectief en analyseert de impact van de macro-economische factoren op investeringsgedrag van bedrijven in de industrie. Met behulp van gegevens uit de Wereldbank Enterprise-onderzoeken schatten we een multilevel-model in van de investeringsbeslissingen van bedrijven. De gegevens dekken ongeveer 50 landen uit verschillende ontwikkelingsregio's, van 2002 tot 2010. De belangrijkste nieuwheid van dit onderzoek bestaat uit het gebruik van data op bedrijfsniveau, in plaats van gecombineerde investeringen op nationaal niveau. Hierdoor kunnen de micromacro-interacties die gecombineerde investeringen vorm gegeven hebben bekeken worden. Bevindingen suggereren dat de macro-economische factoren significante determinanten zijn van de investeringen van bedrijven. Fiscaal beleid, buitenlandse schulden, inflatie en wisselkoersbeheer dragen bij aan het verklaren waarom bedrijven besluiten om te investeren en hoeveel ze investeren. Dit onderzoek gaat ook na of het structurele component van de macro-economische omstandigheden invloed uitoefenen op het investeringsgedrag van bedrijven. Terwijl beschrijvende statistieken aangeven dat de macro-economische factoren meer tussen landen dan binnen landen verschillen, worden investeringen van bedrijven meer geassocieerd met het 'binnen

land'-variatiecomponent van macro-economische factoren in plaats van hun 'tussen landen'-variatiecomponent. Dit resultaat lijkt te suggereren dat het investeringsgedrag van bedrijven de fluctuaties in de conjunctuurcycli volgt, terwijl structurele macro-economische omstandigheden geen significante determinanten zijn voorbedrijfsinvesteringen.

BIOGRAPHY

Francesca Guadagno was born in Bari (Italy), in 1985. She obtained a Bacherlor and a Master degree in Economics and Management of Innovation from Bocconi University (Milan, Italy) and a second Master degree in Management of Innovation from the Rotterdam School of Management (Rotterdam, the Netherlands). After the completion of her masters, she worked as a research assistant at Kites-Cespri (Bocconi University, Milan). Francesca joined UNU-MERIT and the School of Business and Economics of Maastricht University in September 2010. Her research interests cover the broad area of innovation and development, and in particular the role of industrialisation and public policies for development. Francesca worked as a Junior Policy Officer at the European Centre for Development Policy Management (Maastricht) and as an Economist at the World Intellectual Property Organisation in Geneva (Switzerland). She was also involved in projects commissioned by the Asian Development Bank and the Dutch Ministry of Foreign Affairs.

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