

## Title

Foreign ownership structure and labour productivity: Evidence from Chile

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## Abstract

The objective of this paper is to test whether the degree of foreign ownership impacts on firm productivity levels and on the extent of spillovers into the domestic economy. Given that FDI is a key driver in Chile's economic growth and that it is a country with a relatively high absorptive capacity, the study focuses on testing whether the degree of foreign ownership structure in Chile's private productive sector has an impact on labour productivity. The methodology consists in two different levels of analyses; firstly the data is studied from a descriptive statistical perspective, to subsequently develop a regression model and finally compare both results to be able to provide a more consistent appraisal. The database refers to information from industrial surveys carried out to 7.710 firms established in Chile in the period 2001 to 2006. The descriptive statistical analysis shows that increasing foreign ownership structure has a positive effect on labour productivity. Although the regression model does not yield conclusive results, the study suggests possible improvements for further empirical modelling.

## Keywords

Foreign Direct Investment, labour productivity, Chile.

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**Abstract** The objective of this paper is to test whether the degree of foreign ownership impacts on firm productivity levels and on the extent of spillovers into the domestic economy. Given that FDI is a key driver in Chile's economic growth and that it is a country with a relatively high absorptive capacity, the study focuses on testing whether the degree of foreign ownership structure in Chile's private productive sector has an impact on labour productivity. The methodology consists in two different levels of analyses; firstly the data is studied from a descriptive statistical perspective, to subsequently develop a regression model and finally compare both results to be able to provide a more consistent appraisal. The database refers to information from industrial surveys carried out to 7.710 firms established in Chile in the period 2001 to 2006. The descriptive statistical analysis shows that increasing foreign ownership structure has a positive effect on labour productivity. Although the regression model does not yield conclusive results, the study suggests possible improvements for further empirical modelling.

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## 1 – Introduction

Over the last decades firms have become internationalised to a greater extent through their integration into global value chains. Production fragmentation and multi-location of productive activities have increased over recent years leading to a higher importance of FDI in the global economy.

The studies relating the impact of FDI on host economies are very controversial, especially when analysing wages, working conditions or productivity. Developing and

transition economies received 45% and 6% of global FDI flows in 2011 respectively, and these figures are expected to remain stable in the following years (UNTAD, 2012). For these reasons, we consider relevant the study of the impact of FDI in these regions, and as productivity is considered a key issue for poverty reduction and development we will focus on this variable.

In particular, FDI inflows to Latin America and the Caribbean increased significantly in the last decades. In fact, in 2010 and 2011 the region's inward FDI amounted to more than 120.000 million dollars per year on average, equivalent to 10% of total world flows (ECLAC, 2012). The empirical part of this paper focuses on Chile, one of the most developed countries of the region, and one of the main players in attracting FDI. Chile has developed a model based on market economy, deregulation and predominance of the private sector with a favourable and appropriate legal framework for foreign investment. FDI has constituted a key driver for economic growth, contributing to the country's competitiveness and technological development. Currently, Chile stands among the twenty top economies of the world in terms of FDI inflow and the fourth in Latin America, after Brazil Mexico and British Virgin Islands<sup>1</sup> Together with some small economies of the Caribbean, Chile is the country of the region with higher FDI in relation to GDP (ECLAC, 2012)

For this purpose, the paper employs a database of Chilean's manufacturing firms established in Chile in the period 2001 to 2006 and is analysed in two different ways, firstly using descriptive statistical tools and secondly developing a regression model in order to try to arrive to a more consistent conclusion. In both cases, the key subject tested is whether the foreign ownership structure has a positive impact on labour productivity. The study of the manufacturing sector productivity constitutes an important analysis given the important role that it has on the productive structure in most of the countries of the region.

The structure of this paper is as follows. The first section presents a review of the existing literature relating to the impact of FDI on economic development and labour productivity. Section 3 provides a brief overview of the evolution of FDI in Chile since 1970 and the main political and economic factors surrounding it. The empirical approach and the firm-level data used for the regression analysis are described in Section 4. Section 4

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<sup>1</sup> UNCTAD (2012), World Investment Report

summarizes the results, and Section 5 presents some conclusions. Additional information on the data and estimation methods are included in an annex.

## 2 – FDI, labour productivity and economic development: the evidence and the controversy

Total factor productivity explains most of the cross-country differences in terms of growth and income (Easterly & Levine 2001) and, therefore, productivity growth can be seen as one of the main drivers of economic development. About half a century ago, most governments in developing countries aimed at enhancing productivity by promoting domestic firms and reducing foreign dependency through what is known as the import substitution industrialisation strategy (ISI). Although in many countries this policy contributed to inequality reduction and public investment increase, it also led to high levels of indebtedness which entailed a gradual abandonment of this economic strategy during the 80s and 90s. Since then, developing countries began to open their borders (export-oriented strategy) and foreign direct investment (FDI) became one of the most sought-after channels for increasing productivity.

One key feature of this liberalisation process was the openness to FDI as a means of acquiring technologies, skills and access to international markets, and of entering dynamic trade and production systems internal to multinational enterprises (Lall & Narula, 2004).

The role of FDI on development has been broadly studied, focusing mainly on the impact on wages and salaries, working conditions and host country competitiveness level. Foreign owned firms may produce externalities in local companies through production process relationships, technology transfer, training local employees that can afterwards be hired by local firms, among other factors. Ramirez (2006) summarizes and groups the impacts of FDI on host countries within nine topics; technological modernization, skilled labour force, capital accumulation, productive linkages, capital contribution (new funding resources to complement domestic savings), net job creation, market structure and competitive dynamics, risk of loss of sovereignty and control of local resources, change in the pattern of international trade integration.

Certain studies suggest that FDI has an impact on GDP via knowledge transfers and adoption of new technology (Hansen & Rand, 2006). Others arrive to different conclusions

depending on the region analysed and on the methodology used. For example, Chowdhury & Mavrotas (2006) concludes that it is GDP that causes FDI in the case of Chile and not vice versa, while for both Malaysia and Thailand, there is a strong evidence of a bi-directional causality between the two variables. While FDI and multinational enterprises (MNEs) lead to productivity and exports increase, it is not certain whether they contribute to competitiveness of the domestic sector and industrial capacity, which are actually the determinants of economic growth in the long run (Lall & Narula 2004).

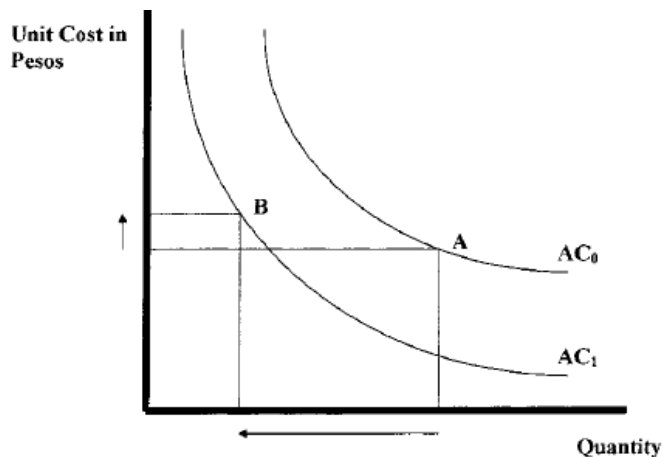
Therefore, no clear conclusion has been reached yet about the relationship among FDI, growth and development but it has become evident that **FDI needs a strong domestic industrial sector with the conditions to profit from externalities, in order to promote growth** (Lall & Narula, 2004).

The debate is equally polarised when considering the link between FDI and productivity, which is considered as a key factor for development. Harris, R. & Moffat, J. (2011) expose the importance of productivity for economic growth through the following two quotes; Paul Krugman (1997) noted "...Productivity isn't everything, but in the long run it is almost everything"; and William Baumol similarly states that "without exaggeration in the long run probably nothing is as important for economic welfare as the rate of productivity growth" (Baumol, 1984). However, it is not clear whether the increase in MNEs activity implies greater industrial development and the most controversial debate revolves around the impact on productivity growth in the recipient country (Narula & Drieffield 2011). Blomström & Sjöholm (1999) test whether the degree of foreign ownership impacts on firm productivity levels and on the degree of spillovers into the domestic market. They show that foreign corporations have higher levels of labour productivity compared to domestic firms. Nevertheless, their study also concludes that foreign ownership structure affects either labour productivity or the degree of spillovers.

To sum up, albeit with several caveats, the literature suggests that in general terms MNEs contribute to productivity growth and have positive effects on the host country's balance of payments, employment and externalities for the local industries such as organizational and managerial skills, new technology etc. However, these positive spillover effects on local firms can be offset especially in the short run due to rising competition what can lead to local firms' product demand decrease and hence a reduction in local productivity.

Aitken & Harrison (1998) explain this situation through the following graph where  $AC_0$  and  $AC_1$  relate to domestic firm average cost curve before and after spillover effects respectively.

**Figure 1 – FDI impact on domestic firms cost curves**



*Source: Aitken & Harrison (1998)*

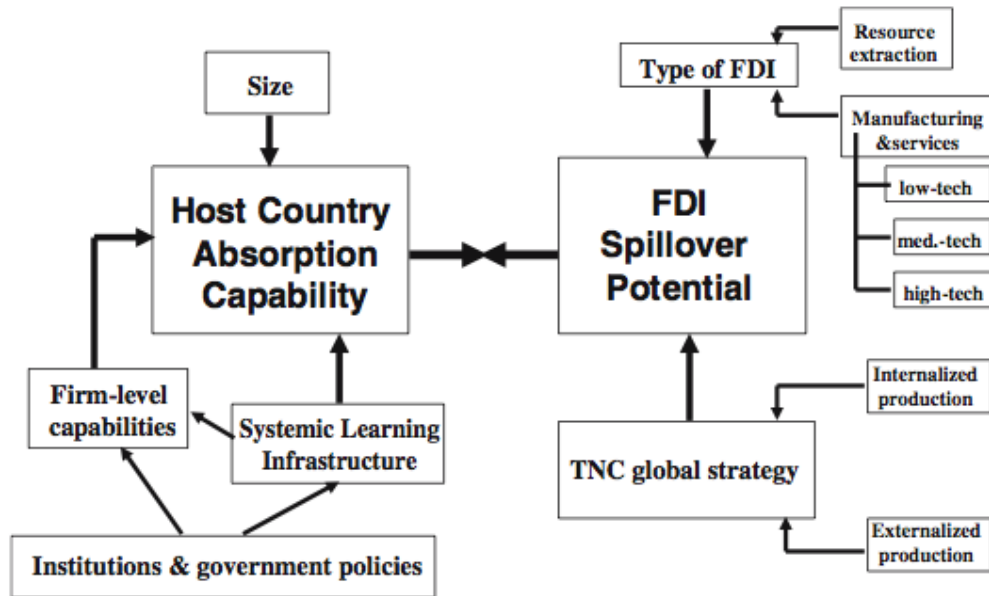
In this regard, one of the first studies relating productivity and internationalisation is the empirical work developed by Bernard and Jensen (1995) that analyses the differences in various indicators such as productivity among exporting and non-exporting companies. Ferrante & Freo (2012) provide a literature review about these linkages, setting out that Melitz (2003) developed a model to prove the relationship between differentials in productivity among firms in the same sector and the exporting costs. In addition, Helpman et al. (2004) completed this previous work and explained how the productivity level is associated with the degree of internationalisation, and therefore is profitable for firms with medium productivity to export while it is better for the least productive firms to focus on domestic market.

Another strand of the literature focuses on the relationship between productivity and international engagement focuses on testing whether productivity is the main driver for firms to internationalise or whether firms increase their productivity through internationalisation (including FDI). There are plenty of country level case studies supporting the theory that export oriented firms or those engaged with FDI are more productive than domestic. For example, in Thailand for the automobile Industry (Ito, 2002), Doms & Bradford (1998) and

Wolfgang & Yeaple (2008) for the United States, Criscuolo & Martin (2005) and Harris & Moffat,(2011) for United Kingdom, Hussinger & Matthias (2006) for Germany or Castellani & Zanfei (2007) for Italy.

Despite this imprecise scenario about the links between FDI and productivity and development, Narula supports the thesis that **the determinants of FDI are the determinants of development** (Narula, 1996). This is a key challenge for any empirical study attempting to analyze the causal relationship between FDI, labour productivity and economic development.

The impact of FDI on host country productivity depends on the particular type of FDI and on host country's absorptive capacity. The former relates, on one hand, to whether FDI is addressed to resource extraction or to the manufacturing sector and, on the other hand, to the average technology intensity of the product focus of the investment and on host country ability to progress within the production chain from standardized to value added and skill-intensive activities. The later factor relates to institutions and government policies, systemic learning infrastructure, and firm level capabilities, among other factors. Bloström & Kokko (1997) highlight that market size, local content regulations and the size and technological capability of local firms are the characteristics that determine the influence and the extent of linkages, which increase as local entrepreneurs improve their skill levels. The following chart schematically summarizes the FDI impacts previously explained.

**Figure 2 – FDI impacts on host country**


*Source: Paus & Gallagher (2007)*

Moreover, Narula & Dunning (2000) add two other reasons for significant spillovers; the subsidiary relationship with the parent firm and the motives for investment, principally seeking natural resources, new markets or new strategic assets and restructure existing foreign production.

Therefore, as Ramirez Cendrero (2006) argues, FDI is an instrument for business expansion and can only contribute to economic development under certain circumstances. Fostering appropriate domestic capabilities can create the conditions for benefits from knowledge flows within an economy and consequently industrial policies integrated with FDI strategies will lead to an optimal sustainable industrial growth. According to Narula and Dunning (2010), an important shortcoming of most studies linking FDI and development is that they do not take into account the role of policy orientation while the study of the impact of FDI on development, specially in the case of developing countries, it is important to highlight that FDI have experienced more effective results in countries with effective governments that get involved actively in FDI attraction (Rasiah 2000); this is the case of

Taiwan, Singapore or Ireland. Besides, nowadays governments are shifting their interest from quantity FDI to quality FDI given the increasing interest on innovation policies, which enhance productivity and long-term growth (Guimón and Filippov, 2012).

In this sense, Chudnovsky et al. (2001) and Chudnovsky & López (2007), set out Brazil as an example of an FDI successful case within Mercosur mainly due to a combination of structural factors (country size and larger industrial development) and public policies designed to centralize at a regional level key functions for the transnational corporation and to focus on high-tech FDI. The author suggests the following four fields of focus for FDI attraction public policies: train SME and local companies, promote local research and development, urge MNEs to focus their activities on technologically intense activities and encourage vertical spillovers between local and foreign companies.

Following a critical review of the existing literature several questions arise: Are foreign companies truly more productive than local ones or only in certain sectors? Are spillovers affected by the degree of foreign ownership? Is there a relationship between FDI and production structure change? Which are the necessary industrial policies that yield to the most successful FDI? Given the wide and varied spectrum of topics that can be subject of further study and building on the hypothesis that productivity increase is a key driver for production structure change as well as a sustainable path for poverty reduction in developing countries, the focus of the present work is the analysis of the impact of foreign ownership structure on productivity and spillovers.

Therefore, the objective of this paper is to test whether the thesis supported by Blomström and Sjöholm (1999) applies for the Chilean case or, on the contrary, whether the level foreign ownership structure affects labour productivity and the degree of spillovers as in the Greece case study analysed by Dimeli & Lourit (2002).

### 3 – Foreign Direct Investment in Chile

This chapter provides a brief overview of the political and economical situation of Chile since 1970 in order to better understand the evolution of inward FDI. It also presents the main FDI figures focusing on its distribution by sector and country of origin as well as on its main changes along the period under analysis.

### 3.1 – Chilean’s Political and economical overview (1970 – 2011)

In the late 1960s, Chile initiated a period characterised by deep economic reforms lead by the nationalisation of the big copper company and agricultural reform. This period was distinguished by the power increase of the public sector and a diminution of private agents’ presence, what resulted in a large fall of inward FDI.

After the military coup of 1973, Chile’s economic policy was reoriented towards a neo-liberal model leaving the import substitution industrialisation period behind, promoting the private sector as the engine of the economy and the exports based on comparative advantages as the key driver for economic growth and development. In this context, FDI was one of the main financing sources for the new trade liberalization economic model (ECLAC, 2010).

In 1982 the country entered into the worst economic downturn since the great depression. Interest rates increased mainly as a consequence of the contractive monetary policy undertaken in the United States what made difficult the investment on productive activities, the access to credit was restricted, Chilean’s terms of trade dropped and private indebtedness was high. This situation took place in an unfavourable economic environment in Latin America. The region was entering into a period subsequently called “the lost decade” characterised, among others, by a decrease in GDP per capita, high inflation rates, increasing unemployment, exit of capital flows, growing technological gap and natural resources overexploitation (Sánchez, 2002).

In this context, the government, in order to stimulate private investment, developed a mechanism<sup>2</sup> through which it was possible to change debt for capital, legislation that was in force from 1985 to 1990. As a consequence of this measure, FDI over GDP increased from 0,88% to 2,10%. This mechanism was no longer used after 1992 because the improvement of the economic situation made public debt more expensive and thereafter its change for capital less profitable (ECLAC, 2010).

In the 1990’s the region started to recover from the crisis and the macroeconomic situation began to improve. Along this decade, economic growth was closely linked with

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<sup>2</sup> Chapters XVIII and XIX of the “Compendio de Normas de Cambios Internacionales” del Banco Central de Chile (CNCI)

Chile's external sector enhancement and the country constituted a favourable environment for foreign investment, situation that was reinforced with the reestablishment of the democratic system. During this decade, FDI started to diversify towards activities and sectors not only related with the extraction of natural resources, such as agro-industry, paper and cellulose. According to ECLAC (2010) one of the main reasons explaining the international preference for Chile was related to the fact that FDI in Chile focused on the development of new projects contrary to other countries of the region where FDI was associated to privatization programs and in fact did not have a significant impact on the country's production capacity. The reason supporting this differentiation is that the majority of the privatization processes in Latin America were held during 1990's except for Chile where the privatizations took place within two previous stages; the first one from 1974 to 1979 to return expropriated firms to its predecessors owners and the second one from 1985 to 1989, phase related to the privatization of the big traditional public companies (Sánchez, 2002)

In the last thirteen years Chile has experienced an irregular economic growth mainly due to the fact that the country has suffered three external shocks, the Asian crisis in 1997-1998, commodities prices increase in 2004-2008 and the international financial crisis that started in 2008. As a consequence of the first shock, average GDP growth decreased from an average 7% from 1990 to 1997 to 3,2% from 1997 to 2003 leading to a productivity gap increase, measured as the difference between actual and potential GDP<sup>3</sup> (*See Annex I for a chart that summarizes the more relevant issues that affected inward FDI since 1970 in Chile as a percentage over GDP compared also with that of Latin America and the Caribbean*)

### **3.2 – Foreign Direct Investment in Chile - Comparative advantage and entry modes.**

Chile constitutes a small market in Latin America comparing to neighbouring countries such as Brazil or Argentina, but according to the report “Democracy, Market and Transparency” published annually by CADAL (Centro para la Apertura y el Desarrollo de América Latina), Chile is the freest economy in the region ranking 16th in the World in 2010 , which makes it one of the most attractive destinations for FDI. Besides, Chile is the country with more trade agreements in the world with more than 56, what allows it to have better access to more than 3.800 million consumers and to products and services at competitive

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<sup>3</sup> Source: Chile's Central Bank

prices. As a result of these large quantities of trade agreements, the average custom duty amounts to 1,2% in comparison with the 6% official general duty, and circa 94% of all products imported in 2010 were subject to special treatment (ICEX, 2010).

According to ECLAC (2010), FDI arrives to the country to look for either natural resources such as copper, salmon, fruits, wine and forestry products, or new regions and markets for the services industry concretely in financial services, telecommunication, water or energy. In fact Chile is seen as a privileged gateway to Latin America, thanks to its political stability and attractive investment climate.

Following Paus and Gallaguer (2007), it can be argued that Chile is characterized by high absorption capability but low FDI spillover potential. Regarding the first point, on one hand it has solid institutions with long and recognized experience on FDI as well as government policies aligned with national development and long term growth strategy and, on the other hand, domestic firms have been exposed to foreign investments for long time which gives them the capability to better absorb potential spillovers. However, Chile has a long way to improve in terms of FDI spillover potential. The country should swift to FDI with higher-tech component trying also to progress within the production chain from standardized to value added and skill-intensive activities.

### 3.3 – Foreign direct investment in Chile by sector and country of origin

The United States and Spain have been the main investors in the country. The former focuses on copper industry while the second country's investments are much more diversified focusing mainly on services such as telecommunications, financial services, energy or infrastructures (see Annex II).

In the 1990's the origin of most of the FDI moved from Canada and the United States, to Europe, especially to Spain which increased its participation on total inward FDI from 2% in the first half of the decade, to 30% in the second half. According to Foreign Investment Committee, the change in this tendency is associated with the high degree of competitiveness privatization of the telecommunication, water, gas and energy companies.

FDI analysed by sector shows on one side the change of trend in the 1990's from a predominance of investments focused on natural resources to increasing foreign funds addressed to the services sector, concretely in the telecommunication and financial sectors. As an example, during the period 1990 to 1995, the mining sector received 58% of total FDI in the period, the electricity, water and gas industry received 1% and contrary, in the second half of the decade from 1996 to 2000, the former decreased its percentage over total inward FDI to 24% while the second industry increased its participation up to 27%. (See Annex II)

In the 2000's this tendency has been consolidated and services foreign investments overlap more than half of all inward FDI every year except for 2002. This represents a shift from resource seeking to market seeking motivations. FDI in services is still under-researched and more efforts are needed to better understand the implications of this trend for Chile from a development and growth perspective.

## 4 –Methodology and data

As explained earlier, the main objective is to test whether foreign ownership structure affects labour productivity in the case of Chile. Moreover, in section two we analyzed the relationship between exports and inward FDI concluding that both variables are correlated in the case of Chile but that their causality is under controversy.

The firm-level data we use for the labour productivity analysis is disaggregated by sector and includes the percentage of exports over sales by firm. This information enables us to study from a microeconomic perspective whether FDI is addressed to already exporting sectors or whether it acts as a catalyst to boost domestic firms to enter the international market.

In order to study the impact of foreign ownership structure on labour productivity, this section includes two different analyses of the variables; first we rely on the analysis of descriptive statistics and then we develop a regression model.

### 4.1. – Description of the database

The database refers to information from industrial surveys carried out to 7.710 firms

established in Chile in the period 2001 to 20064. The main variables extracted from the surveys are shown in Table 1.

**Table 1: Variables description**

Variable	Description
Industrial sector	4 digit code according to ISIC classification
National	Percentage of national ownership
Foreign	Percentage of foreign ownership
Output	Total revenues (sales + other revenues)
Costs	Costs of goods sold + OPEX + Personnel expenses
Va	EBITDA
Gross value of production	Gross Margin
Investment widely defined	(Investment + improvements + others) / fixed assets
Investment defined	(Investment + improvements + others) / fixed assets
Investment narrowly defined	(Investment + improvements + others) / fixed assets
Lw	Skilled workers
Lb	Non skilled workers
L	Total workers
Exports	Exports over sales

*Source Author*

From the 7.710 initial firms included in the database only 2.684 (35% of the original sample) are going to be used in this research, which are the ones that present homogeneous information for the whole period.

All firms are classified according to the ISIC code (International Standard Industrial Classification) that is the international reference classification for productive activities. The version included in this database is the ISIC 4, revised in 2006. The sectors included relates to divisions C – “Manufacture”, D – “Electricity, gas, steam and air conditioning supply” and E – “Water supply; sewerage, waste management and remediation activities”. The following table provides a detail of the sectors included and the average number of firms included in each.

<sup>4</sup> Information provided by Division of Production, Productivity and Management (DPPM) on the ECLAC, Santiago, Chile

**Table 2: Total number of firms analysed by sector**

Total number of firms analysed by sector	
<b>Manufacturing</b>	
Manufacture of coke and refined petroleum products	68
Manufacture of electrical equipment	79
Manufacture of machinery and equipment n.e.c.	179
Manufacture of basic metals	180
Manufacture of furniture	40
Manufacture of other transport equipment	2
Manufacture of paper and paper products	148
Manufacture of rubber and plastics products	116
Manufacture of leather and related products	895
Manufacture of computer, electronic and optical products	152
Manufacture of fabricated metal products, except machinery and equipment	170
Manufacture of basic pharmaceutical products and pharmaceutical preparations	84
Manufacture of chemicals and chemical products	178
Manufacture of motor vehicles, trailers and semi-trailers	107
Printing and reproduction of recorded media	127
Other manufacturing	4
Repair and installation of machinery and equipment	15
Motor vehicles	22
	<b>2.566</b>
<b>Water supply; sewerage, waste management and remediation activities</b>	
Water collection, treatment and supply	<b>110</b>
<b>Electricity, gas, steam and air conditioning supply</b>	
Electricity, gas, steam and air conditioning supply	<b>8</b>
	<b>2.684</b>

Source Author's elaboration with data provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

Below we summarize the main characteristics of the database employed:

- *Ownership structure*: 93% of all firms analysed are 100% national and from the 7% with mix capital, 64% on average have majority foreign capital. The following table shows a sectorial detail of the number of firms by ownership structure in 2006, identifying the average foreign capital and the number of firms with majority foreign capital.

**Table 3: Ownership structure by sector - 2006**

Ownership structure by sector - 2006	Natio l k	Mix k	%	#
			foreign k (av.)	foreign k >50%
<b>Manufacturing</b>				
Manufacture of coke and refined petroleum products	68	0	0%	0
Manufacture of electrical equipment	69	10	76%	6
Manufacture of machinery and equipment n.e.c.	175	4	67%	3
Manufacture of basic metals	130	50	85%	39
Manufacture of furniture	38	2	93%	2
Manufacture of other transport equipment	2	0	0%	0
Manufacture of paper and paper products	142	6	69%	4
Manufacture of rubber and plastics products	115	1	100%	1
Manufacture of leather and related products	833	62	62%	34
Manufacture of computer, electronic and optical products	139	13	52%	4
Manufacture of fabricated metal products, except machinery and equip	160	10	79%	7
Manufacture of basic pharmaceutical products and pharmaceutical pr	78	6	100%	6
Manufacture of chemicals and chemical products	165	13	55%	5
Manufacture of motor vehicles, trailers and semi-trailers	104	3	67%	1
Printing and reproduction of recorded media	125	2	70%	1
Other manufacturing	4	0	0%	0
Repair and installation of machinery and equipment	12	3	100%	3
Motor vehicles	21	1	0,1%	0
	<b>2380</b>	<b>186</b>	<b>60%</b>	<b>116</b>
<b>Water supply; sewerage, waste management and remediation activities</b>				
Water collection, treatment and supply	<b>109</b>	<b>1</b>	<b>50%</b>	<b>0</b>
<b>Electricity, gas, steam and air conditioning supply</b>				
Electricity, gas, steam and air conditioning supply	<b>8</b>	<b>0</b>	<b>0%</b>	<b>0</b>
	<b>2497</b>	<b>187</b>	<b>55%</b>	<b>116</b>

Source Authors elaboration with data provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

As it can be seen, the average foreign capital is above 50% in most of the cases. According to Dimelis & Lourit (2002) higher degree of foreign ownership is associated with more efficiency production but with less degree of spillovers to domestic firms specially in developed countries. (See Annex I for further detail)

- Labour productivity: as expected, the most productive firms measured this as total output per worker, are the water and services firms and the less productive are the manufacture ones. Considering a deeper breakdown within the manufacture sector, it can be appreciated that the more productive firms are those that produce electric equipment and vehicles while the less productive by far are firms producing “other transport equipment”.

- *Employment:* On average, manufacture firms tend to have higher number of employees than services firms but less skilled ones, given that the sector with the higher percentage of skilled workers over total employees is the electricity, gas, steam and air conditioning.

The following table summarizes the top 5 sectors in terms of labour productivity and how they rank in terms of percentage of skilled workers over total number of employees.

**Table 4: Productivity and % of skilled workers**

	% skilled (*)
<i>Top 5 labour productivity</i>	
Electricity, gas, steam and air conditioning supply	40%
Manufacture of electrical equipment	16%
Motor vehicles	38%
Manufacture of basic metals	40%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	19%
<i>Top 5 - %skilled workers</i>	
Printing and reproduction of recorded media	41%
Repair and installation of machinery and equipment	40%
<b>Electricity, gas, steam and air conditioning supply</b>	<b>40%</b>
<b>Manufacture of basic metals</b>	<b>40%</b>
<b>Motor vehicles</b>	<b>38%</b>
<i>Inferior 5 - %skilled workers</i>	
Manufacture of chemicals and chemical products	10%
<b>Manufacture of electrical equipment</b>	<b>16%</b>
Manufacture of motor vehicles, trailers and semi-trailers	18%
Manufacture of other transport equipment	18%
<b>Manufacture of basic pharmaceutical products and pharmaceutical preparations</b>	<b>19%</b>

(\*) Average figures for the period 2001 - 2006

Source Authors elaboration with data provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

As it can be observed, from the five more productive sectors in terms of labour productivity, three of them are among the ones that require more skilled workers while two are among the ones that require the less.

Therefore, no clear general conclusion can be inferred about the relationship between labour productivity and the degree of skillness because it depends on a deeper degree on the type of sector and activity. (See Annex II for sub-sector detail).

- *Exports*: On average, the higher export ratio, measured as the volume of exports over sales is registered in the manufacture of electric equipment sector, followed by that of the group of other manufacture industries. The following table includes the top 5 sectors in terms of labour productivity as well as the top 5 and inferior 5 sectors in terms of the exports over sales ratio.

**Table 5: Productivity and exports over sales (%)**

	Exports over sales (*)
<i>Top 5 labour productivity</i>	
Electricity, gas, steam and air conditioning supply	0%
Manufacture of electrical equipment	23%
Motor vehicles	4%
Manufacture of basic metals	8%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	12%
<i>Top 5 - exports/sales</i>	
Manufacture of electrical equipment	23%
<b>Other manufacturing</b>	<b>23%</b>
Manufacture of chemicals and chemical products	21%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	12%
Manufacture of leather and related products	12%
<i>Inferior 5 - exports/sales</i>	
Manufacture of machinery and equipment n.e.c.	3%
Printing and reproduction of recorded media	2%
Manufacture of rubber and plastics products	1%
<b>Electricity, gas, steam and air conditioning supply</b>	<b>0%</b>
Manufacture of other transport equipment	0%

(\*) Average figures for the period 2001 - 2006

1

*provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile*

As expected, services sectors have lower export ratio and it is even 0% most of the years under analysis, in the electricity, gas, steam and air conditioning sector. (See Annex III for further detail)

Besides, there is no observable relationship between the degree of internationalisation of a sector and its labour productivity ratio, therefore as in the case of labour structure, from the sample analysed, no clear conclusion can be inferred.

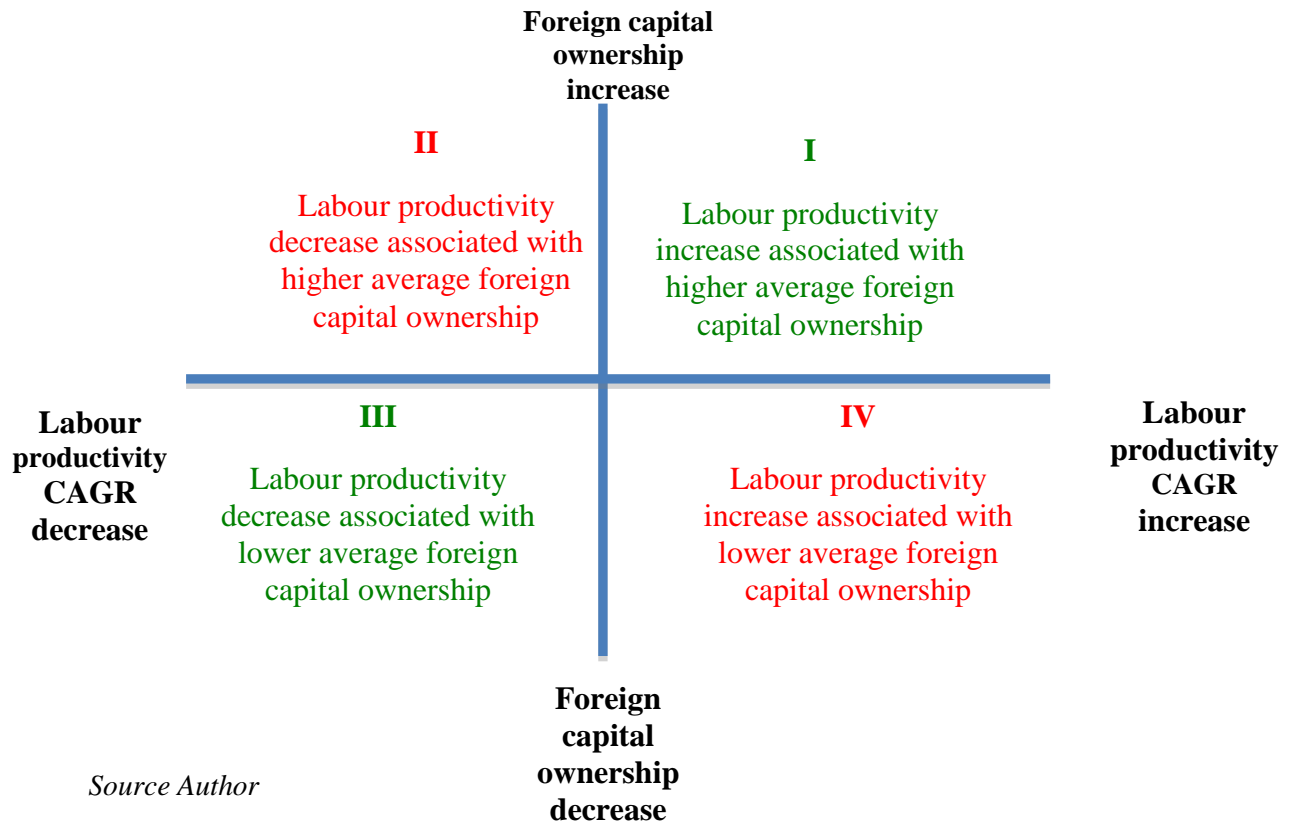
As explained in the previous section, Chile has moved from resource-seeking FDI into market-seeking FDI. The former is expected to foster exports while the later might have a neutral effect. The results exhibited above confirm that the role of FDI in export promotion depends on the motive for investment.

20

#### 4.2. – Preliminary analysis

Graph 1 presents a sectorial analysis that relates for each sector and for the period under analysis (2001 – 2006) the Compound Annual Growth Rate (CAGR) with the change in the percentage of foreign capital labour productivity.

**Figure 3: Labour productivity CAGR vs change in foreign capital percentage over total**

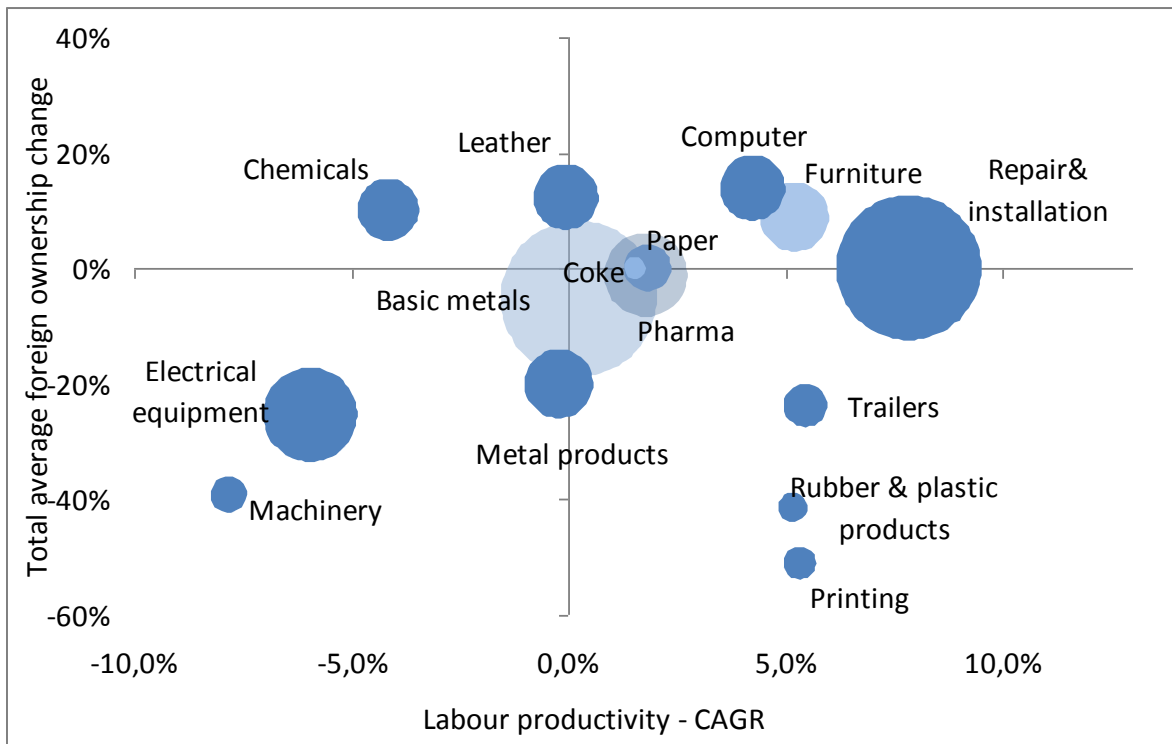


The right-upper quadrant (I) and left- lower quadrant (III) relates to situations in which the change in the percentage of foreign ownership and in labour productivity has the same sign. That is, an increase in the percentage of foreign capital as a whole in a sector associated with a certain degree of labour productivity increase or vice-versa.

Contrary, the left-upper quadrant (II) and right-lower quadrant (IV) relates to situations in which the change in the percentage of foreign ownership and in labour productivity has opposite sign. That is, an increase in the percentage of foreign capital as a whole in a sector associated with a certain degree of labour productivity decrease or vice-versa.

Graph 1 shows the sectors included in our sample classified through the previously explained taxonomy. In addition, a third variable has been included in the graphical representation; the average percentage of foreign capital at the beginning of the period, which relates to the size of the bubble.

**Figure 4: Labour productivity CAGR vs change in foreign capital percentage over total – Chile 2001 – 2006**



*Source: Author*

As it can be seen in the graph, the majority of the sectors lay on quadrants I and III, or in the coordinate axes, except for “manufacture of chemicals and chemical products”, “manufacture of motor vehicles, trailers and semi-trailers”, “manufacture of rubber and plastic products” and “printing and reproduction of recorded media”. Nonetheless, these sectors are mainly composed of domestic firms, given that the size of the bubbles is small.

Therefore for the majority of sectors, and with the necessary caution, it can be concluded that an increase in foreign capital ownership leads to higher labour productivity while a nationalization or decrease of foreign capital leads to lower labour productivity. The

cases, in which the relationship between the two variables is the opposite, are related to already very small-internationalized sectors with low degree of foreign presence.

To complement these preliminary results, the next section presents the methodology employed for further empirical modelling.

#### 4.3. – The regression model

The methodology employed is a panel data regression model in which the dependent variable is labour productivity defined as output per worker (Y/L). To consider foreign ownership structure, three dummy variables are included in the model given the hypothesis that different levels of ownership cause differences in labour productivity:

- “*Labour productivity*”: Total output measured as firm’s benefits sales divided by the total number of workers. This is a broadly criticised variable for measurement of productivity but it can be used as a proxy in the absent of more specific data. Dimeli, S. & Lourit, H. (2002).
- “*National*”: Dummy variable taking value 1 if the firm is fully national and value 0 if the firm under analysis has certain foreign ownership regardless of the percentage that it represents on total capital structure.
- “*Min*”: Dummy variable that takes value 1 if the percentage of foreign ownership is less or equal to 50% and 0 if it is more than 50%.

In order to include in the model other factors to reflect the heterogeneity among firms, the literature suggests introducing a set of variables such as size, leverage or liquidity. The ones we can include given the information provided by the surveys are the following:

- “*Exports*”: relates to the percentage of exports over sales
- “*Sector*”: We indentify three main big sectors; manufacture, water services and electricity, gas, steam and air conditioning services.

In order to include the three cases into the model we create a quantitative value and assign a number to each sector and then we calculate two dummy variables:

- “*Manuf*”
  - 1: Manufactures
  - 0: Services
  
- “*Water*”: given “*Manuf*” variable equal to 0;
  - 1: Water services sector
  - 0: Electricity sector

In conclusion the model set out comprises three quantitative variables (“*labour*”, “*productivity*”, “*size*” and “*exports*”) and four dummy variables (“*foreign*”, “*maj*”, “*manuf*” and “*water*”) and is defined as follows:

$$\ln(Y_i/L_i) = \beta_0 + \beta_1 \cdot \text{natinalni} + \beta_2 \cdot \text{mini} + \beta_3 \cdot \text{manufi} + \beta_4 \cdot \text{wateri} + \beta_5 \cdot \ln \text{ exportsi} + e_i \quad (1)$$

$$i = 1, \dots, N$$

The error term relates to other factors not observed that affect productivity such as management strategy and technological change, among others.

Once the regression equation is defined, the quantitative variables, that its labour productivity and exports are changed into logarithm form to thereby obtain elasticities there between. Subsequently, an estimate was made by panel data<sup>5</sup> using a model of Ordinary Least Squares (OLS). As a result we found that at 5% all variables were significant except for “*manuf*” with a p-value equal to 0,227 and with a very low R<sup>2</sup>, amounting to 0,1027. (See Annex IV – graph IV .1)

The sign of the parameters ( $\beta_0$  to  $\beta_5$ ) provides the following information:

- $\beta_1 = -0,56$  The negative relationship shows us that a firm 100% national have 56% less labour productivity than a firm with mix capital, independently of the degree of foreign ownership, variable analyse with  $\beta_2$ .
- $\beta_2 = 0,4$  This parameter tries to explain whether the degree of foreign ownership matters in terms of labour productivity. The positive sign explains

<sup>5</sup> Panel data refers to a series of different observations over certain period of time

us that when the percentage of foreign capital is lower or equal to 50%, labour productivity increase by 40%.

Conclusions obtained from  $\beta_1$  and  $\beta_2$  match partially with the information obtained by descriptive statistic previously exposed. On one hand both analyses argue that the increase in foreign capital ownership leads to higher labour productivity but on the other hand while the regression model shows that this relationship is stronger with a foreign capital ownership the descriptive statistics analysis argues that the relationship is opposite in sectors with a relative low degree of foreign capital presence.

- $\beta_3 = -0,73$  This parameter shows that manufacturing firms have lower level of labour productivity than services firms, concretely 73% less.
- $\beta_4 = -1,554$  Given that services firms have higher labour productivity, this parameter explains the difference in productivity between the two services sectors included in the sample. The parameter indicates that water collection; treatment and supply sector is 154% less productive than electricity, gas and air conditioning supply sector.

Therefore both methodologies of analysis (descriptive statistics and regression OLS model) get to the same conclusion regarding the differences in productivity by sector.

- $\beta_5 = -0,07$  As in the previous analysis, the impact of de internationalisation degree, measured as the percentage of exports over sales, is not significative and can be associated to the Chilean's inward FDI transition from resource-seeking FDI into market-seeking FDI being the first one associated with a higher degree of internationalisation while the second one have more neutral effect.

However, even if the variables are significant and explain the sign of the relationships in relation to the dependent variable, they are insufficient to explain all the variability in the dependent variable (labour productivity). According to theory, a change to a Generalized Least Squares (GLS) method has to be made in order to better explain the estimation. (See

Annex IV – graph IV .2 and 3). Finally in order to find what kind of model is better for our estimation (fixed or random effects), it is necessary to estimate both models and then perform a Hausman test which will determine which is the best one.

In the following section the results are analysed and possible options for improving the regression model are provided.

## 5 –Results

On one hand, the exploratory analysis of the data shows that an increase in foreign capital ownership leads to higher labour productivity while a decrease of foreign capital leads to lower labour productivity. There are however some cases in which the relationship between the Compound Annual Growth Rate (CAGR) of the sector and the change in the percentage of foreign capital labour productivity is the opposite, although this relates to already very small-internationalized sectors with low degree of foreign presence.

On the other hand, the regression model analysis does not show conclusive results. As explained previously, the panel data regression model is not significant neither under OLS nor under GLS, suggesting that even if the variables employed explain certain variability of the dependent variable, they do not constitute a strong reason for labour productivity differences.

Up to this point and on the basis of the results obtained, it can be concluded, on the one hand, that neither foreign structure nor the degree of foreign ownership has a significant influence over the level of labour productivity or, on the other hand, that the sample must be modified and the model revised in order to obtain a proper conclusion regarding the relationship between ownership structure and labour productivity.

In order to understand the reason for the model not to be significant we rely on the literature review presented at the beginning of the present study, identifying the following three main reasons:

Firstly, the impact of FDI on host countries is a mix of a battery of variables, some of them quantitative such as capital contribution or the level of skilled labour force and some of them more qualitative such as technological transfer and modernization or market structure

and competitive dynamics. Some of the impact mechanisms are intangible and remain hidden in traditional economic measurement systems.

At a firm level other non-quantitative issues may impact labour productivity such as management strategy or the level of risk that the managers are able to handle. Moreover, as Paus & Gallaguer (2007) diagram shows, host country productivity highly depends on the particular type of FDI and on host country's absorptive capacity. This kind of non-quantitative variables may influence productivity at a great extent and cannot be realistically included in the regression model.

Secondly, the effects of inward FDI on local firms differ over time. Aitken & Harrison (1998) explained how positive spillovers from inward FDI can partially be offset in the short-run by rising competition, what would lead to a decrease in firms' product demand and hence to a reduction in labour productivity. Besides, it could be useful to include a time lag in the regression model given that the effects of inward FDI on labour productivity are not immediate and therefore positive spillovers can arrive in the medium or long term.

Thirdly, Chowdhury & Mavrotas (2006) concludes that it is GDP that causes FDI in the case of Chile and not vice versa, meaning that at micro level it may be inferred that the comparative high level of labour productivity can induce foreign investment to get into the country instead of being foreign investment the reason for labour productivity increase.

Therefore, to sum up, the following considerations and modifications could be included both in the model and in the sample:

*Improve the sample:*

- The sample should be enlarged including more sectors, taking also into consideration on one hand a wider variety of services that is the most dynamic sector internationally and the one that generates the higher quantity of outward FDI, and on the other hand, the mining industry given that is the most important sector in Chilean's economy and the one that have historically received higher levels of inward FDI. In this regard,
- On average, up to 93% of the companies included in the sample have 100% domestic capital. Given that the main objective of the regression is to analyse how

the ownership structure impacts on labour productivity, it seems reasonable to consider more capital mixed companies in order to reach a more consistent conclusion.

*Modify the regression equation:*

- Include more variables in the regression equation; size, financial variables such as the leverage ratio measured as short and long term debt over equity or the liquidity ratio measured as working capital by total assets, in order to test which are the variables that better explain the differences in labour productivity in the Chilean's case.
- Improve the measure of labour productivity using instead of total number of workers, full time equivalent variable that relates to the total number of units of work associated to an 8 hours working day.

*Change the methodology:*

- Use of the quantile methodology. This relates to an estimation developed by quantiles instead of by the mean regression line employed in the OLS technique. This methodology is used in cases in which the dependent variable is not normal and further non-Gaussian residuals (Dimelis & Lourit, 2002).
- Introduction of a temporary or spatial component in the regression analysis, what can be done through a spatial-temporal modeling technique.

## 6 –Conclusions

Chile's economic growth has been closely related to external sector enhancement and therefore FDI has constituted a key driver for economic growth along the last decades. FDI arrived to the country to look for either natural resources such as copper, salmon, fruits, wine and forestry products, or new regions and markets for the services industry concretely in financial services, telecommunication, water or energy. Chile is seen as a privileged gateway to Latin America, thanks to its political stability and attractive investment climate.

The main investors in Chile are the United States, Canada and Spain. The first two countries tend to focus on copper industry while the second country's investments are much more diversified focusing mainly on services such as telecommunications, financial services, energy or infrastructures. Historically the majority of FDI used to come from the United States and Canada, situation that changed in the 1990's what seems to represent a shift from resource seeking to market seeking motivations.

Chile is characterised by high absorption capability because it has solid institutions with long and recognized experience on FDI, government policies aligned with national development and long term growth strategy, as well as domestic firms which have been exposed to foreign investments for long time what gives them the capability to better absorb potential spillovers. However, our study suggests that Chile has low FDI spillover potential. The country should shift to high-tech inward FDI and simultaneously progress within global value chains from standardized to value added and skill-intensive activities.

Given that FDI is a key driver in Chilean economic growth and that it is a country with high absorption capability, the present study has focused on testing whether the degree of foreign ownership structure in Chile's private productive sector has an impact on labour productivity. The results from an analysis of descriptive statistics and through the regression model suggest that the increase in foreign capital ownership leads to higher labour productivity, although this relationship needs further investigation and the results are far from conclusive. Even if the statistical descriptive analysis shows us that increasing foreign ownership structure has a positive effect on labour productivity contrary to the thesis supported by Blomström and Sjöholm (1999), the regression model employed in the study shows that the significance of the ownership structure as an explanatory variable for labour productivity differences is low.

In light of these preliminary results, and with the objective of comparing descriptive statistical analyses with regression model results and be able to provide a more consistent appraisal, we suggest modifying the model for further research focusing on improving the sample, improving the regression formula with more variables, and the change to a quantile methodology.

In broader terms, FDI inflows to Latin America and the Caribbean have increased considerable during the last decades and transnational corporations have become key agents

in diversifying and upgrading the productive structure of the region. In this context, as Chile is one of the most important countries of the regions in terms of FDI flows in relation to the size of its economy, the results of the present study are relevant for other countries in Latin America and the Caribbean as well as for other small and open economies. Moreover, the adoption of a set of policies combining FDI attraction and structural change measures could promote the establishment of *quality* transnational corporations and the increase of spillovers, fostering economic development in the long run.

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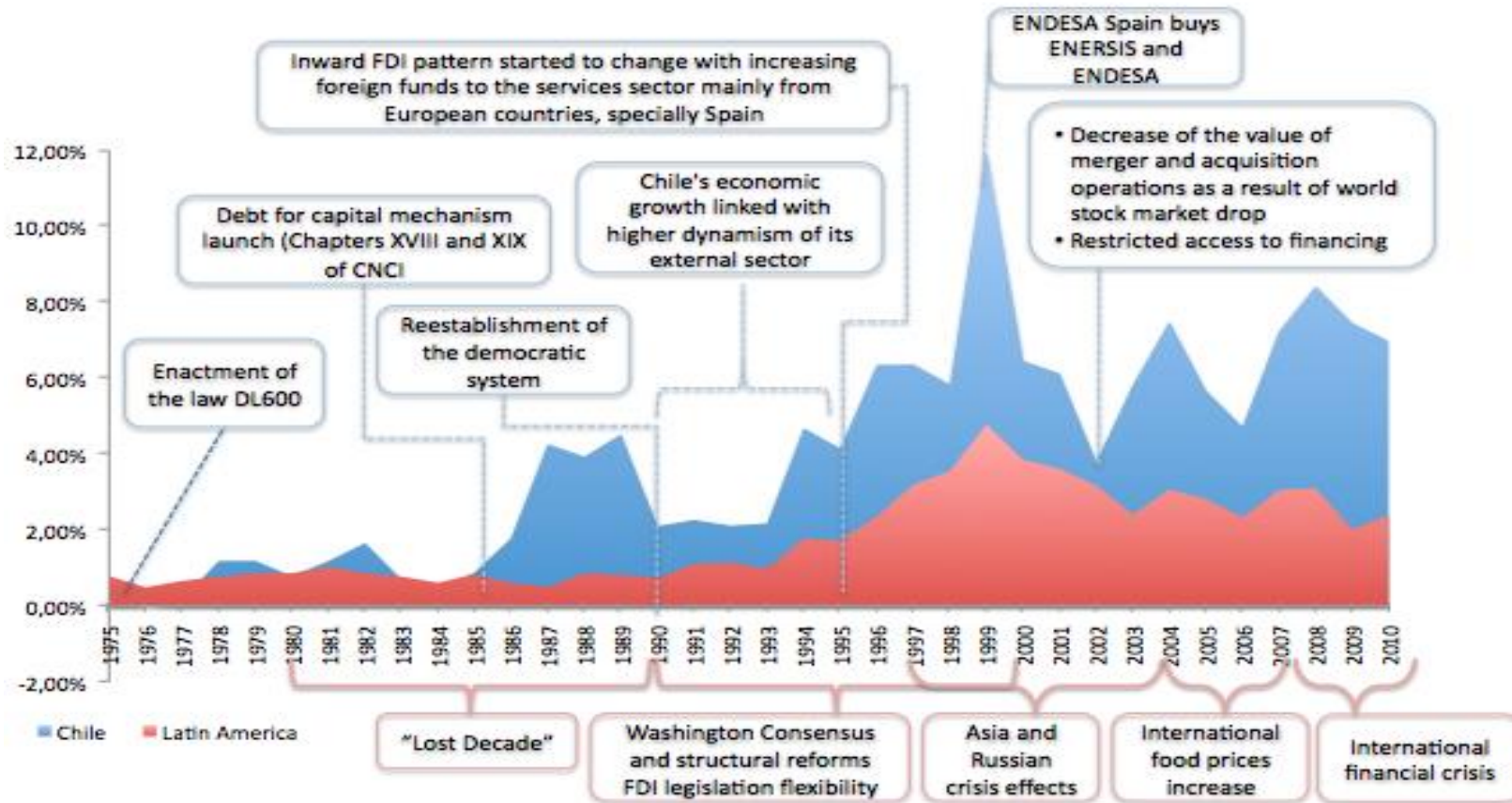
Foreign Investment Committee - Chile <http://www.foreigninvestment.cl/>

ECLAC - CEPALSTAT <http://websie.eclac.cl/sisgen/ConsultaIntegrada.asp>

World Bank <http://data.worldbank.org/>

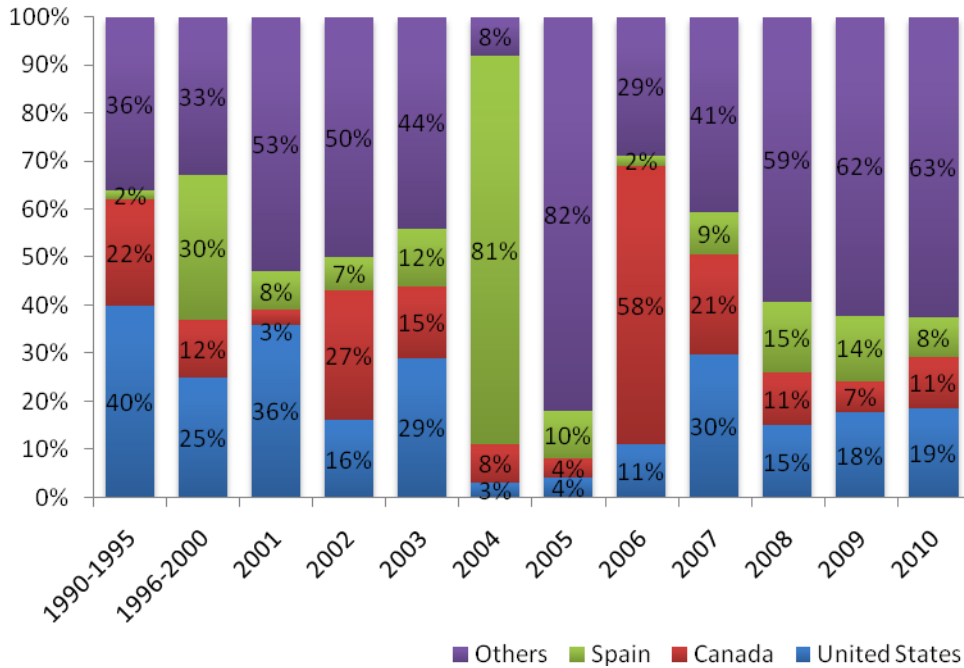
## Annex

### Annex I – Relevant issues relating FDI (% GDP) historical trends – Chile and Latin America

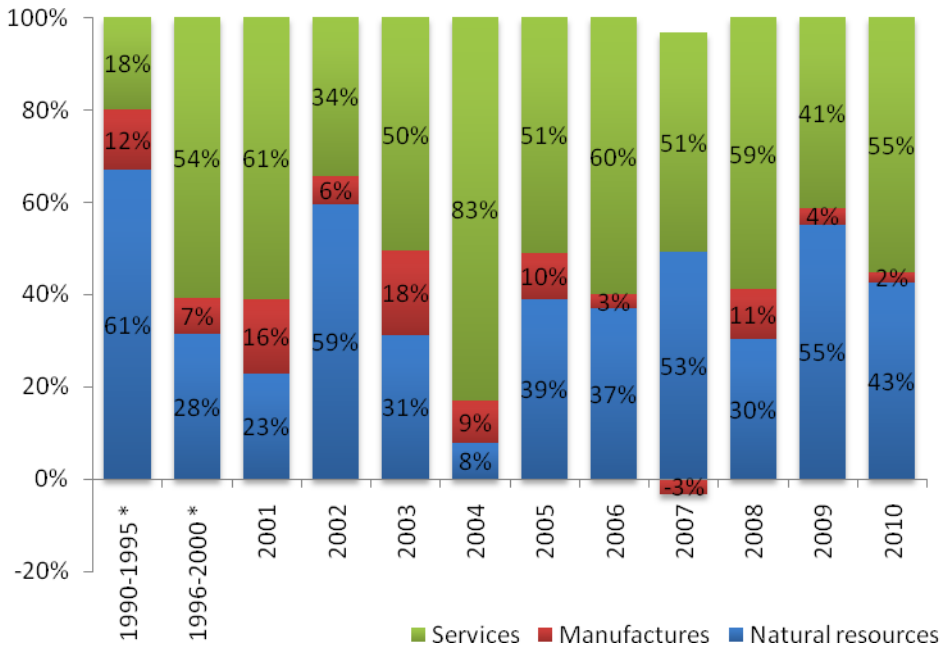


## Annex II – Foreign Direct Investment by country of origin and sector

### FDI by country of origin



### FDI by sector



### Annex III – Firms analysed by sector according to ISIC classification and ownership structure

Majority foreign capital	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	0	0	0	0	0	0
Manufacture of electrical equipment	9	9	6	4	3	6
Manufacture of machinery and equipment n.e.c.	4	3	3	3	3	3
Manufacture of basic metals	41	37	41	39	38	39
Manufacture of furniture	2	3	2	2	2	2
Manufacture of other transport equipment	0	0	0	0	0	0
Manufacture of paper and paper products	4	2	2	3	4	4
Manufacture of rubber and plastics products	2	4	3	3	2	1
Manufacture of leather and related products	31	32	28	27	35	34
Manufacture of computer, electronic and optical products	5	5	5	4	4	4
Manufacture of fabricated metal products, except machinery and equipment	9	10	9	9	7	7
Manufacture of basic pharmaceutical products and pharmaceutical preparations	6	6	6	5	6	6
Manufacture of chemicals and chemical products	5	5	5	5	5	5
Manufacture of motor vehicles, trailers and semi-trailers	2	2	2	1	1	1
Printing and reproduction of recorded media	2	1	3	4	1	1
Other manufacturing	0	0	0	0	0	0
Repair and installation of machinery and equipment	3	3	3	3	3	3
Motor vehicles	0	0	0	1	0	0
	<b>125</b>	<b>122</b>	<b>118</b>	<b>113</b>	<b>114</b>	<b>116</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	0	0	0	0	0	0
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	0	0	0	0	0	0
	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>TOTAL</b>	<b>125</b>	<b>122</b>	<b>118</b>	<b>113</b>	<b>114</b>	<b>116</b>
<b>% of majority/foreign</b>	<b>67%</b>	<b>65%</b>	<b>65%</b>	<b>62%</b>	<b>65%</b>	<b>62%</b>

Source: Compilasion based on information provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

<i>100% national</i>	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	68	68	68	68	68	68
Manufacture of electrical equipment	67	68	70	72	72	69
Manufacture of machinery and equipment n.e.c.	173	173	174	173	174	175
Manufacture of basic metals	127	130	128	130	131	130
Other manufacturing	38	37	38	38	38	38
Manufacture of other transport equipment	2	2	2	2	2	2
Manufacture of paper and paper products	142	144	144	143	143	142
Manufacture of rubber and plastics products	114	112	113	113	114	115
Manufacture of leather and related products	842	838	843	840	838	833
Manufacture of computer, electronic and optical products	140	140	141	142	141	139
Manufacture of fabricated metal products, except machinery and equipment	157	156	156	157	159	160
Manufacture of basic pharmaceutical products and pharmaceutical preparations	77	77	78	78	78	78
Manufacture of chemicals and chemical products	168	167	166	166	166	165
Manufacture of motor vehicles, trailers and semi-trailers	103	103	103	104	104	104
Printing and reproduction of recorded media	123	125	123	122	125	125
Other manufacturing	4	4	4	4	4	4
Repair and installation of machinery and equipment	12	12	12	12	12	12
Motor vehicles	22	22	22	21	21	21
	<b>2.379</b>	<b>2.378</b>	<b>2.385</b>	<b>2.385</b>	<b>2.390</b>	<b>2.380</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	<b>110</b>	<b>110</b>	<b>110</b>	<b>110</b>	<b>110</b>	<b>109</b>
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>	<b>8</b>
<b>TOTAL</b>	<b>2.497</b>	<b>2.496</b>	<b>2.503</b>	<b>2.503</b>	<b>2.508</b>	<b>2.497</b>
<b>% national/total</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>	<b>93%</b>

Source: Compilasion based on information provided by Division of Production, Productivity and Management (DPPM) on the ECLAC, Santiago, Chile

<i>Minority foreign capital</i>	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	0	0	0	0	0	0
Manufacture of electrical equipment	3	2	3	3	4	4
Manufacture of machinery and equipment n.e.c.	2	3	2	3	2	1
Manufacture of basic metals	12	13	11	11	11	11
Manufacture of furniture	0	0	0	0	0	0
Manufacture of other transport equipment	0	0	0	0	0	0
Manufacture of paper and paper products	2	2	2	2	1	2
Manufacture of rubber and plastics products	0	0	0	0	0	0
Manufacture of leather and related products	22	25	24	28	22	28
Manufacture of computer, electronic and optical products	7	7	6	6	7	9
Manufacture of fabricated metal products, except machinery and equipment	4	4	5	4	4	3
Manufacture of basic pharmaceutical products and pharmaceutical preparations	1	1	0	1	0	0
Manufacture of chemicals and chemical products	5	6	7	7	7	8
Manufacture of motor vehicles, trailers and semi-trailers	2	2	2	2	2	2
Printing and reproduction of recorded media	2	1	1	1	1	1
Other manufacturing	0	0	0	0	0	0
Repair and installation of machinery and equipment	0	0	0	0	0	0
Motor vehicles	0	0	0	0	1	1
	<b>62</b>	<b>66</b>	<b>63</b>	<b>68</b>	<b>62</b>	<b>70</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	0	0	0	0	0	1
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	0	0	0	0	0	0
<b>TOTAL</b>	<b>62</b>	<b>66</b>	<b>63</b>	<b>68</b>	<b>62</b>	<b>71</b>
<b>% of majority/foreign</b>	<b>33%</b>	<b>35%</b>	<b>35%</b>	<b>38%</b>	<b>35%</b>	<b>38%</b>

Source: Compilation based on information provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

## Annex IV – Employment

<i>Labour</i>	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	4.581	4.708	4.878	5.133	5.619	5.551
Manufacture of electrical equipment	18.197	17.149	17.205	17.830	17.632	18.072
Manufacture of machinery and equipment n.e.c.	9.411	9.290	9.739	10.624	12.075	12.730
Manufacture of basic metals	19.256	19.582	19.520	20.144	22.256	21.864
Manufacture of furniture	2.733	2.639	2.713	2.815	2.782	2.845
Manufacture of other transport equipment	17	17	18	17	15	13
Manufacture of paper and paper products	10.164	9.617	9.473	9.636	10.008	10.115
Manufacture of rubber and plastics products	5.814	5.400	5.267	5.628	5.954	6.101
Manufacture of leather and related products	79.844	81.922	83.103	84.438	91.326	89.653
Manufacture of computer, electronic and optical products	11.140	10.530	10.014	10.256	11.090	11.261
Manufacture of fabricated metal products, except machinery and equipment	11.701	12.271	12.651	13.149	14.657	14.722
Manufacture of basic pharmaceutical products and pharmaceutical preparations	9.339	9.637	9.989	10.224	11.004	11.511
Manufacture of chemicals and chemical products	20.128	22.476	23.478	23.764	27.500	26.743
Manufacture of motor vehicles, trailers and semi-trailers	7.486	6.986	7.144	7.187	7.722	8.141
Printing and reproduction of recorded media	11.218	10.919	11.392	11.727	12.234	12.380
Other manufacturing	85	91	86	93	93	88
Repair and installation of machinery and equipment	951	877	884	910	947	973
Motor vehicles	1.252	1.425	1.407	1.172	1.143	1.096
	<b>223.317</b>	<b>225.536</b>	<b>228.961</b>	<b>234.747</b>	<b>254.057</b>	<b>253.859</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	5.742	6.043	6.282	6.575	7.940	7.180
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	320	356	375	318	412	415
<b>TOTAL</b>	<b>229.379</b>	<b>231.935</b>	<b>235.618</b>	<b>241.640</b>	<b>262.409</b>	<b>261.454</b>

Source: Compilation based on information provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

<i>Skilled labour/labour</i>	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	21%	19%	22%	23%	22%	23%
Manufacture of electrical equipment	17%	16%	15%	16%	16%	16%
Manufacture of machinery and equipment n.e.c.	21%	21%	21%	18%	18%	17%
Manufacture of basic metals	41%	40%	40%	38%	40%	41%
Manufacture of furniture	28%	29%	31%	30%	30%	30%
Manufacture of other transport equipment	18%	18%	17%	24%	13%	15%
Manufacture of paper and paper products	20%	22%	22%	22%	22%	25%
Manufacture of rubber and plastics products	27%	31%	31%	30%	32%	28%
Manufacture of leather and related products	24%	24%	24%	24%	22%	22%
Manufacture of computer, electronic and optical products	23%	20%	20%	20%	19%	18%
Manufacture of fabricated metal products, except machinery and equipment	21%	20%	20%	19%	19%	19%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	22%	20%	19%	19%	18%	19%
Manufacture of chemicals and chemical products	11%	11%	11%	9%	9%	9%
Manufacture of motor vehicles, trailers and semi-trailers	15%	18%	19%	19%	18%	18%
Printing and reproduction of recorded media	42%	41%	39%	40%	42%	43%
Other manufacturing	33%	32%	29%	33%	26%	25%
Repair and installation of machinery and equipment	38%	41%	42%	40%	38%	39%
Motor vehicles	31%	61%	37%	31%	32%	34%
	<b>24%</b>	<b>24%</b>	<b>23%</b>	<b>23%</b>	<b>23%</b>	<b>23%</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	<b>20%</b>	<b>19%</b>	<b>22%</b>	<b>20%</b>	<b>19%</b>	<b>19%</b>
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	<b>37%</b>	<b>34%</b>	<b>34%</b>	<b>36%</b>	<b>49%</b>	<b>46%</b>
<b>TOTAL</b>	<b>81%</b>	<b>77%</b>	<b>79%</b>	<b>79%</b>	<b>91%</b>	<b>88%</b>

Source: Compilation based on information provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

## Annex V – Export ratio ( exports / sales)

Average - Exports over sales	2001	2002	2003	2004	2005	2006
<b>Manufacturing</b>						
Manufacture of coke and refined petroleum products	5%	5%	5%	5%	5%	5%
Manufacture of electrical equipment	24%	20%	24%	25%	23%	24%
Manufacture of machinery and equipment n.e.c.	3%	3%	2%	3%	3%	3%
Manufacture of basic metals	9%	8%	8%	8%	8%	8%
Manufacture of furniture	3%	3%	4%	3%	3%	2%
Manufacture of other transport equipment	0%	0%	0%	0%	0%	0%
Manufacture of paper and paper products	4%	3%	5%	4%	5%	5%
Manufacture of rubber and plastics products	2%	1%	1%	1%	1%	1%
Manufacture of leather and related products	12%	12%	12%	12%	12%	12%
Manufacture of computer, electronic and optical products	3%	3%	4%	4%	3%	3%
Manufacture of fabricated metal products, except machinery and equipment	5%	5%	5%	5%	5%	6%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	8%	10%	13%	14%	14%	14%
Manufacture of chemicals and chemical products	20%	21%	23%	22%	22%	19%
Manufacture of motor vehicles, trailers and semi-trailers	3%	3%	4%	4%	4%	5%
Printing and reproduction of recorded media	1%	2%	1%	2%	2%	2%
Other manufacturing	23%	23%	24%	22%	23%	22%
Repair and installation of machinery and equipment	9%	9%	8%	7%	7%	7%
Motor vehicles	3%	3%	4%	5%	3%	3%
	<b>8%</b>	<b>7%</b>	<b>8%</b>	<b>8%</b>	<b>8%</b>	<b>8%</b>
<b>Water supply; sewerage, waste management and remediation activities</b>						
Water collection, treatment and supply	4%	4%	5%	5%	5%	4%
<b>Electricity, gas, steam and air conditioning supply</b>						
Electricity, gas, steam and air conditioning supply	0%	0%	1%	0%	0%	0%
<b>TOTAL</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>	<b>4%</b>

Source: Compilation based on information provided by the Division of Production, Productivity and Management (DPPM) of the ECLAC, Santiago, Chile

## Annex VI – Regression model

Graph 1 – OLS regression model

```

. xtset nui year
    panel variable: nui (strongly balanced)
    time variable: year, 2001 to 2006
                delta: 1 unit

. reg logprod knational water mag manufactura water logexpor
    
```

Source	SS	df	MS			
Model	<b>484.161738</b>	<b>5</b>	<b>96.8323477</b>	Number of obs =	<b>3779</b>	
Residual	<b>4228.01186</b>	<b>3773</b>	<b>1.12059683</b>	F( 5, 3773) =	<b>86.41</b>	
Total	<b>4712.17359</b>	<b>3778</b>	<b>1.2472667</b>	Prob > F =	<b>0.0000</b>	
				R-squared =	<b>0.1027</b>	
				Adj R-squared =	<b>0.1016</b>	
				Root MSE =	<b>1.0586</b>	

logprod	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
knational	<b>-.9721386</b>	<b>.0741532</b>	<b>-13.11</b>	<b>0.000</b>	<b>-1.117523</b>	<b>-.8267544</b>
water	<b>-1.554801</b>	<b>.6208618</b>	<b>-2.50</b>	<b>0.012</b>	<b>-2.772059</b>	<b>-.3375442</b>
mag	<b>-.4066588</b>	<b>.0858682</b>	<b>-4.74</b>	<b>0.000</b>	<b>-.5750114</b>	<b>-.2383063</b>
manufactura	<b>-.7390471</b>	<b>.6119575</b>	<b>-1.21</b>	<b>0.227</b>	<b>-1.938847</b>	<b>.4607523</b>
water	<b>(dropped)</b>					
logexpor	<b>.0709062</b>	<b>.0089697</b>	<b>7.91</b>	<b>0.000</b>	<b>.0533203</b>	<b>.0884922</b>
_cons	<b>12.62377</b>	<b>.6167793</b>	<b>20.47</b>	<b>0.000</b>	<b>11.41452</b>	<b>13.83303</b>

Graph 2 – GLS random effects regression model

```
. xtreg logprod knational water mag manufactura water logexpor, re
note: water dropped because of collinearity
```

```
Random-effects GLS regression                Number of obs   =   3779
Group variable: nui                          Number of groups =   830

R-sq:  within = 0.0000                      Obs per group:  min =    1
        between = 0.0308                      avg =           4.6
        overall = 0.0367                      max =           6

Random effects u_i ~ Gaussian                Wald chi2(5)     =   22.22
corr(u_i, X) = 0 (assumed)                  Prob > chi2      =   0.0005
```

logprod	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
knational	-.0898604	.0496423	-1.81	0.070	-.1871575	.0074366
water	-1.19424	.7820537	-1.53	0.127	-2.727037	.3385573
mag	.0158694	.063924	0.25	0.804	-.1094193	.1411582
manufactura	-.378815	.7533436	-0.50	0.615	-1.855341	1.097711
logexpor	-.0050331	.0067529	-0.75	0.456	-.0182685	.0082023
_cons	11.28974	.7546612	14.96	0.000	9.810631	12.76885
sigma_u	1.0152848					
sigma_e	.31523033					
rho	.91207529	(fraction of variance due to u_i)				

Graph 3 – GLS fixed effects regression model

```

. xtreg logprod knational water mag manufactura water logexpor, fe

Fixed-effects (within) regression              Number of obs   =   3779
Group variable: nui                          Number of groups =   830

R-sq:  within = 0.0030                      Obs per group:  min =    1
        between = 0.0489                      avg             =   4.6
        overall = 0.0368                      max             =    6

corr(u_i, Xb) = -0.2348                      F(3, 2946)      =    2.96
                                                Prob > F        =   0.0311
    
```

logprod	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
knational	.0293472	.0514188	0.57	0.568	-.0714733	.1301677
water	<b>(dropped)</b>					
mag	.0153359	.0672482	0.23	0.820	-.1165222	.1471941
manufactura	<b>(dropped)</b>					
water	<b>(dropped)</b>					
logexpor	-.0210406	.0071751	-2.93	0.003	-.0351093	-.0069718
_cons	10.81107	.0503433	214.75	0.000	10.71236	10.90978
sigma_u	1.104001					
sigma_e	.31523033					
rho	.92461611	(fraction of variance due to u_i)				

F test that all u\_i=0: F(829, 2946) = 47.77 Prob > F = 0.0000