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## **THE DETERMINANTS OF THE REGIONAL FOREIGN DIRECT INVESTMENT IN CHILE**

by

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## **Introduction**

Over the last 30 years, Foreign Direct Investment (FDI) has played an important role in the Chilean economy. In early 1970's there was a total control of capital movements, in addition with control of credit and the interest rate, capital inflows were close to zero and even negative, but in September of 1973, there was an attenuation of the restrictions affecting the amount of profits and dividends of external firms repatriated, in order to encourage and increase foreign investment. This was under a mechanism called Decree Law 600. In the late 1970s and early 1980's, Chile was facing a financial debt crisis, which was mostly solved through stabilization programs and the program of debt-equity swaps using foreign investors, although there were many privatizations, by 1990, these companies were not foreign-owned, during the first years of the 90's decade, FDI mostly

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concentrated in the mining sector, but it followed an evolutionary process towards investment in the services sector.

There have been many studies made concerning FDI in several ways, either as a determinant or as a dependant variable, but very few studies have considered the determinants of FDI at a regional level, then a question arises: Is it important to study the regional differences for attracting FDI?

The case of Chile is interesting, because, the patterns for FDI tend to be clearer as the years go by. One of these patterns can be seen on the distribution of FDI across regions, since Chile is considered a developing economy, the regions tend to specialize in their activities and in the ways in which they attract FDI. Then, it seems important to investigate what are the determinants for FDI across regions and if there are certain regions that attract more FDI than others.

This article is organized as follows, in the first section a theoretical framework is presented, followed by the introduction of the hypothesis regarding FDI and Chile; the third section presents the data and the methodology used specifically in this article, with the clear specification of the model used. Section five presents the main results, which are studied in section six. Finally section seven presents some concluding remarks regarding this study.

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## **Theoretical Framework**

There are many studies concerning the determinants of FDI, the traditional theory of FDI relates the profit maximization behavior of Multinational Enterprises, as indicated by Chen (2000) where the firm will decide whether it will enter the market of a host country or not, decision based on the profit maximization process. Smekal and Sausgruber (2000) and Kreinin (1995) on the other hand, explain FDI based on International trade theory where capital is considered a factor with an influence in comparative costs, moreover, when firms asked about their motivation to invest abroad, may not even mention increased profits, but there are two categories that they consider: cost considerations and market considerations (the second in order to increase revenues). In term of cost considerations, one that might be relevant is the need to obtain raw materials from abroad, in fact “vast American investment in the extractive industries are motivated by the fact that the capital must follow the resources” (Kreinin, 1995), this is also influenced by transportation cost of the primary product, if it is very high, the first stage of processing may have to take place at or near the extraction site. Another type of cost reducing investment is related with labor, but in this case it is important to consider if the activity is labor or capital intensive in order to be cost-advantage. In the case of market considerations, international trade leads to firms to increase their foreign investment, in other words, the opportunities to market products abroad also encourages to invest abroad in order to reach more easily the markets.

In their book, Armstrong and Taylor (2000), the study for potential determinants in FDI follows an hierarchical process, from the decision to locate abroad, where the question of which region of the world could be determined by trade barriers, market size, market growth and potential for import penetration. Once this question is solved, comes the next question: which country? And once the country is decided, comes the final question of which location *within* the country? There are a large set of the determinants that the authors propose, but there are related mostly with the access to markets, labor-market conditions, promotional activities of the state, state (or regional) taxes, access to land and the industrial structure at the new location.

Empirical studies usually link FDI with economic growth, either the GDP per capita or the growth of the GDP. For example Zhang, (2001) explores the link between FDI and economic growth. The main issue in his study is the bi-directional causality that could exist between these two variables, either FDI promotes growth or growth attracts FDI. His study considered 11 economies, in different parts of the world including East Asia and Latin America, although Chile was not considered in the group of Latin American countries. Other variable usually linked is the Exports level or international trade, as it was the case of Ruane and Górg (1996) and Lahiri and Ono (2003), in some cases because FDI is directly export oriented or because the international trade indicates the degree of openness of the country. FDI at the

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regional level became more appealing since the sole study of location factors showed that there are differences in the determinants, as is shown by Scott (1998) in his study of location factors of FDI in early 1930's.

One of the significant studies made was done by Wei *et al* (1999) where they study the determinants for pledged FDI and realized FDI for a panel data set of 27 provinces in China, the main variables include international trade, wage rates, growth of GDP, infrastructure and investment incentives, and agglomeration, among others. They used four specifications for each kind of FDI, with the result that the use of random effects models with autocorrelation being the most powerful explanatory models against ordinary least squares. The use of fixed effects specification was not considered due the presence of perfect multicollinearity. Their results showed that there is a spatial distribution of FDI and some regional characteristics in China and these determinants differ if the dependant variable is pledged FDI instead of realized FDI. In fact, whereas all the variables considered were significant for pledged FDI, only few variables were significant for realized FDI, specifically from the main equation:

*FDI = f (International trade, wage rates, R & D manpower, rate of GDP growth, infrastructure, agglomeration, a dummy for time (1 for 1992 onwards and 0 before 1992), and a cross-sectional dummy for low information costs and high investment incentives)*

Only international trade, wage rates and R&D manpower were significant for the case of realized FDI, indicating that the openness, labor costs and human capital are significant determinants, although they considered wage rates as a proxy for productivity levels, the results revealed that wages are considered part of the cost function rather than productivity and hence they got the opposite sign expected. Both dummies were also significant, one of the possible explanations for the difference between pledged FDI and realized FDI is that the first one is strongly market oriented, whereas realized FDI is mainly influenced by comparative advantages of the regions in terms of human capital, trade and labor costs.

Another study considering the case of China, Q. Sun *et al* (2002), realized a panel data study of the determinants of FDI considering a sample of 30 provinces over 1987 to 1998 period and a large set of proxies for variables such as Market demand and market Size (using GDP), Infrastructure (Railway per Km<sup>2</sup>), Degree of industrialization (domestic investment per worker), Level of Foreign Investment (ratio of Cumulative FDI over cumulative domestic investment), labor quality (ratio of number of engineers, scientist and technicians over total employees), Labor Cost (average wage) and country risk (risk ranking) Their regression considered a logarithm form estimating three models: Fixed effect model with a different intercept for each unit (province), a regression with common intercept and the third is first difference data (the latest considering the variables in term of growth), in all

three cases Both OLS and GLS were estimated. Their results showed that “the importance of FDI determinants moves through time” (Q. Sun *et al*, 2002). The average wage was significant, although its sign changed from positive to negative, labor quality and infrastructure showed a positive relationship, meaning that they attract FDI, other variables that were significant were the political stability and degree of openness, the level of foreign investment has a negative impact on new FDI, this was explained in the sense that multinational corporations may want to consider investing in provinces that are not flooded with FDI competitors.

Kozlowski & Weekly (1990) were concerned in the uneven distribution of FDI among U.S. states. They pointed out that regional differences in FDI could be grouped into three categories, market-related conditions, cost-based factors and public sector policies. In their research, they used a cross-section data analysis for the purpose of measuring the dependence of FDI and a set of variables, for example, population and the growth of domestic employment were used as market size and growth hypotheses, wage levels, union membership, tax burdens, right-to work laws and estimates of business climate were used as cost-related factors; and dollar allocation in the state budget was used as public sector policies. Using correlation between changes in affiliate shares and factor linked to FDI, their results revealed that aggregate economic growth could be considered as a proxy for higher profit potential, the size of the state (or the region) could reflect market-related factors, and a staff commitment appears to enhance FDI environment. Input costs seemed

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not to be related directly to change in the share of the affiliates, and most of the rank correlations are not significantly different from zero, it is also important to notice that previous findings about taxes do not influence location decisions was also confirmed in their study.

Few studies have considered the way in which developing countries attract FDI, Asiedu (2002), made a study taking into account the case of Africa, although in her study she considered variables such as the inverse of the real GDP per capita (as a proxy for return in investment), quality of infrastructure, openness of the host country (ratio of the trade to GDP), and political instability. She used a set of models such as ordinary least square model, cross-section regression and panel data for her estimation, the results that she obtained showed that a large share of the variation in FDI rate can be explained by openness to trade with a positive relationship, infrastructure and return on investment (also positive), for all of the specifications, but other variables such as a dummy for those countries located in the sub-Saharan Africa was not significant in the case of the ordinary least squares, but in the case of the other models the effect was negative, since this region tend to be non-market oriented FDI, and there is an importance in the regional effect. Other variables considered, such as growth of GDP, government consumption rate of inflation, ratio of liquid liabilities to GDP, and political instability, were not significant. She also pointed out that there are two types of FDI that should be considered: the market-seeking FDI and non-market seeking FDI, the latter, more

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related natural resource based investments and other export-oriented investment

(Asiedu, 2002). This remark was also made by Chen (2000), who pointed out that the reasons for multinational enterprises to invest abroad depend of necessities such as utilization of resources, attend to a foreign market, the internalization of intangible assets or the realization of locational advantages, each of them giving form a specific kind of FDI.

### **Proposition**

In the specific case of Chile, we can notice that the regions have attracted different kinds of FDI, it seems that there is a relation between regional characteristics and certain types of FDI.

As can be seen on Table 1, the first sector mentioned corresponds to the targeted FDI made; we can distinguish three different kinds of FDI. The first one is the investment made mainly in the mining sector and others such as fishing and forestry (primary sector), the second is the investment made in the industry sector and the third is the FDI on the services sector, along with electricity and transport. It is important to notice that the total population of Chile for the period of study is approximately 15 million people, and the metropolitan region concentrates approximately 30% of this population. Hence, the omission of the distinction for the FDI in services is not trivial.

Region	Sector
I	Mining
II	Mining, electricity and transport
III	Mining
IV	Mining, construction and services
V	Electricity and construction
VI	Industry, mining and agriculture
VII	Industry, construction and forestry
VIII	Industry, electricity and transport
IX	Industry and forestry
X	Industry, forestry and construction
XI	Mining, industry and fishing
XII	Industry
Metropolitan	Services, industry and electricity

Table 1. Main targeted sectors for FDI in Chile (1990 – 1999). Source: National Institute of Statistics, Chile and Vice-Presidency of Foreign Investments Committee.

Consider the following hypothesis:

1. The differences in regional economic structure play an important role in attracting FDI, i.e. the specific conditions of each region are a key to attracting a specific kind of FDI.
2. There are set of independent variables that act as a factors in attracting FDI at a regional level, such as:
  - a. The level of growth of each region (+)
  - b. The level of Exports in each region (+)
  - c. The unemployment level, i.e. the rate of the unoccupied force in each region (-)

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- d. The public incentives in each region (+)
  - e. The average wage rates of the occupied labor force in each region (- +)<sup>1</sup>
  - f. The size of the market (+).
  - g. Education levels, i.e the percentage of people that have finished high school and college in each region each year (+)
  - h. The infrastructure (+)
3. These main determinants act differently according to the targeted sector, i.e. these determinants differ if the FDI was oriented to the export sector, (non-market seeking FDI) which includes the primary sector; or if the FDI was made on the services sector (mainly electricity and telecommunications). Although the latter sector is related with market-seeking FDI, it is a little different from the traditional definition of market-seeking FDI, since the motives are more related with expansion with the rest of Latin America and lower costs for multinationals rather than the capturing large percentages of the Chilean market itself (ECLAC, 2000).

## Data And Methodology

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<sup>1</sup> In the case of this variable the expected sign is not clear, according to Chen (2000), wages are part of the cost function of the firm that wants to invest, in this case, it is expected a negative effect of the wages on FDI, specially when the activities are labor-intensive. On the other hand, wages can also be viewed as a measure of productivity levels, as it was pointed out by Wei *et al* (2001) and Q. Sun *et al* (2002), under this point of view, it is expected a positive relationship.

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Taking into account previous research and the availability of the data, the methodology chosen considers a panel data set for the 13 regions in Chile over a 10-year period.

The data provided information about two cases of FDI, Authorized level of FDI and Realized FDI, and also a detail of FDI for nine sectors in each region per year. The dependant variable in each case is the FDI and the set of independent variables are:

- Growth of regional GDP (lagged 1 year) (LogGdp)
- Level of regional Exports (LogExp)
- Unemployment rate per region (LogUne)
- Public regional expenditure (LogPexp)
- Level of Public Investment in each region (LogPinv)
- Average monthly Income of the workers per region (LogIng)
- Population in each region per year (LogPop)
- Percentage of population that have at least finished High School in each region (LogEdu)
- Approved and initiated buildings in m<sup>2</sup> (LogInft)

The variables are in log form, and then the general equation is

$$\text{LogFDI} = f(\text{LogGdp}, \text{LogExp}, \text{LogUne}, \text{LogPexp}, \text{LogPinv}, \\ \text{LogIng}, \text{LogPop}, \text{LogEdu}, \text{LogInft})$$

There are many reasons for the use of the Log form in this equation, as it was pointed by Wei *et al* (1999), this is a way to obtain directly the elasticities of FDI with respect to several explanatory variables and the relationship between the explanatory variables with the dependant variable seems to be non-linear.

The set of variables used are explained as follow:

#### *Rate of Growth (LogGdp)*

One of the key variables often used is the economic growth in the relationship with FDI, here it is considered as one of the determinants, and as noted earlier, it is expected to have a positive relationship with FDI, although it could be possible that it might not be significant for certain kinds of FDI, because since Chile is still a developing economy, the rate of growth of each region could not be powerful enough to act as an attractive factor opposing the overall rate of growth of the whole country. The data for GDP are lagged one year, because the possibility of a bi-directional causality is not discarded for the case of Chile.

#### *Level of Exports (LogExp)*

As it has seen in some studies, there could be a relationship between FDI and exports, although the causality is not clear. This variable acts also as a measure of

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openness to external trade and the “experience” of the region with exports, in the case of Chile. Some descriptive studies have shown that FDI has been oriented directly to export activities, especially in the northern regions of the country, and these exports are mostly aimed to developed countries such as Asia and the U.S. Hence it is expected a positive relationship because it might reflect also the accessibility to a needed resource in bigger markets.

#### *Unemployment Rate (LogUne)*

This is a variable considered in two ways, one as a measure of the availability of inputs, the other one as a part of the level of development in the region. According to Armstrong and Taylor (2000), the density of the manufacturing employment acts as a way to describe the industrial structure, and it has a positive relationship. Since in this case, we are using the unemployment rate, the expected result is the opposite; if this rate is high, it is expected that it deflects FDI to the regions rather than attracts it. However, it is also expected that it does not have an influence on investments made in the services sector, for example, because this variable used as availability of inputs does not reflect completely the quality of the human capital and it could not have influence in FDI in contrast with the same variable used in the primary and manufacturing sectors.

#### *Public Expenditure (LogPexp) and Public Investment (LogPinv)*

Although these variables are not often seen in studies of FDI, either one of them or both variables are considered as a proxy for incentives made by the central

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government in order to attract FDI. The variable often utilized is the expenditure for regional development alone; however, it seems reasonable to take a closer look at the public investment in order to narrow the scope of the government expenditures to something directly oriented to development. It is expected a positive relationship, although the opposite is also possible, for example, since the economic policy of Chile concerning FDI is the attraction of capital inflows towards development in general, when FDI concentrates in some of the regions, the central government tend to focus on those regions that do not receive these inflows in order to balance economic growth, under this point of view, it might be possible that FDI and public incentives compete each other.

*Average Income of the workers per region (LogIng)*

This variable is considered in two ways, the first one is for the case of market-seeking FDI, the total population of Chile is approximately 15 million, then the level of income could be a factor in the case of multinationals looking for profits in a small market. The second alternative, since it is specifically the income of the workers (on average) it could be used as a proxy for wages in the case of non-market (or export-oriented) FDI, either as a cost variable or a proxy for productivity levels, as it was indicated in Broadman and Sun (1997), Wei *et al* (1999), and Q. Sun *et al* (2002)

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*Population (LogPop)*

This variable is the common proxy used for agglomeration, as it was used the same way in Wei *et al* (1998); however, it is expected that this variable might be only significant for the case of a specific kind of FDI, such as the authorized FDI or the FDI in the services sector (in a certain way, considered market-seeking FDI), and not for the export-oriented FDI, since agglomeration and vertical integration for the case of Mining or Fishing, is not necessarily related to a large population, since it seems that these activities when bring capital inflows, they also obtain technology transfer and the quality of human capital would be more important than the size of population.

*Education (LogEdu)*

A variable often linked to the attraction of FDI is the quality of “human capital”. An important variable is the quality of education and training, as it was pointed out by Noorbakhsh *et al* (2001), because it often means lower costs, and better productivity. As an attractive factor for FDI, the use of educational levels provides an idea of the future quality of the workers and the ease with which employees could be trained.

*Infrastructure (LogInft)*

There are several studies that support the use of this variable on FDI, such as Broadman and Sun (1997), Wei *et al* (1999), Asiedu (2002) and Q. Sun *et al*

(2002). Although the relationship with the theory itself it is not clear in the sense to provide better comparative advantage in terms of costs or market accessibility, and the proxies utilized in each case were completely different, in this particular case, the proxy utilized was the approved and initiated buildings in m<sup>2</sup>, in terms of construction. Other variables, such as highways, railroads, or ports were not considered since they present less variation in the time frame considered (10 years).

## **Model**

We can consider, for the specific case of Chile, two kinds of FDI:

- a) Non-Market seeking FDI – Investments made primarily for Export activities, with special attention to availability of natural resources.
- b) “Market Capture” FDI, This is slightly different from the definition of market-seeking FDI, since these investments are mainly targeted to a market whose demand tends to be inelastic, for example water and electricity, or were the market is not limited to the country itself, but aims to capture bigger market in neighboring countries.

There are 4 dependent variables for which we will estimate the parameters:

1. The authorized FDI
2. The realized FDI
3. The FDI in the export sector
4. The FDI in the services sector

And also we have considered 4 econometric models to be compared:

- a) Fixed Effects Model (One Way Fixed effects- Model 1)
- b) Random effects model for the unobservable individual effect (One Way Random effects – Model 2)
- c) Two way fixed effect model (group and time effect) (Two Way Fixed effects – Model 3)
- d) Random effect model for both individual and time effect. (Two Way Random effects – Model 4)

Although all the regions of Chile are included in the model (13 regions), it is likely to find the random effect model more powerful than the fixed effects for some of the dependent variables, especially in the case when the FDI is divided in sectors such as exports and services, since the case of Chile presents a small degree of concentration of certain activities in specific regions, for example the mining sector is greatly concentrated on the northern regions of Chile, or the services sector is concentrated in the metropolitan region. The random effects model might be better in explaining the influence of the regions themselves assuming these as an error component rather than a fixed effect, especially when this influence is uneven among all 13 regions, which is the opposite of the presumption of fixed effects specification. Random effects model takes into account that this influence is only due to selected regions of the total, which it is assumed random, and hence, part of

the error term. The use of two-way fixed effect models was mainly in order to compare with the parsimonious one-way model and to obtain a more complete error-component model (random effect model for individual and period effect). The criteria for the decision of which model is more powerful to explain the dependant variable was based on the Likelihood ratio and F tests for the fixed effects and the Hausman Test in the case of random effects versus fixed effects, if the case was that the values were close to each other, the parsimonious principle was used to select the model.

## Results

We can see the main results in the following tables, the values in parenthesis associated with the parameters are standard deviations, whereas the percentages associated with the hypothesis tests indicate the probability to reject the correspondent model, the likelihood ratio and F test compares:

- Model 1 with a model without the effects, (a model considering the independent variables), and
- Model 3 with model 1

The Hausman Test compares the Random effect model with fixed effects i.e.:

- Model 1 vs. model 2
- Model 3 vs. model 4

Dependant Variable: Total Authorized FDI

	<b>Model 1</b> <b>One Way</b> <b>Fixed effects</b>	Model 2 One Way Random effects	Model 3 Two Way Fixed effects	Model 4 Two Way Random effects
LOGGDP	8.023 (6.726)	13.951** (6.402)	5.875 (7.482)	13.654** (6.860)
LOGEXP	-3.868*** (1.502)	0.461 (0.417)	-4.646*** (1.748)	0.328 (0.427)
LOGUNE	-0.709 (1.162)	1.158 (0.910)	2.346 (1.663)	2.463*** (1.039)
LOGPEXP	11.989*** (4.881)	2.174 (2.859)	8.851 (7.737)	2.666 (3.458)
LOGPINV	-1.153 (2.157)	-0.892 (1.909)	-2.353 (2.268)	-2.317 (2.024)
LOGING	6.886* (3.880)	1.214 (2.106)	6.763 (5.037)	1.719 (2.258)
LOGPOP	-45.271* (26.950)	0.609 (2.218)	11.316 (33.858)	2.518 (2.977)
LOGEDU	4.953* (3.015)	5.777** (2.726)	6.581** (3.074)	6.419*** (2.709)
LOGINFT	-3.386** (1.777)	-0.886 (1.457)	-4.152** (1.934)	-2.449 (1.566)
Constant		-7.144 (29.494)	-166.105 (443.490)	-6.910 (30.950)
R Squared	47.45%	30.75%	53.72%	25.64%
Log - Likelihood	-314.325		-306.060	
Likelihood	31.639		16.530	
Ratio Test ( $\chi^2$ )	(1.57%)		(5.66%)	
F Test	2.187 (1.70%)		1.492 (16.15%)	
Hausman (9)	20.02 (1.17%)		18.71 (2.77%)	

Table 2. Results for the first dependent variable, fixed and random effects model,  
\*: significant at 10%, \*\*: significant at 5%, \*\*\*: significant at 1%

Dependant Variable: Total Realized FDI

	<b>Model 1</b> <b>One Way</b> <b>Fixed effects</b>	Model 2 One Way Random effects	Model 3 Two Way Fixed effects	Model 4 Two Way Random effects
LOGGDP	3.941 (3.891)	6.219* (3.812)	2.628 (4.150)	5.260 3.915
LOGEXP	-0.932 (0.869)	0.521 (0.413)	-0.661 (0.969)	0.574 0.416
LOGUNE	-1.705*** (0.672)	-0.762 (0.593)	-3.151*** (0.923)	-1.041 0.675
LOGPEXP	9.396*** (2.824)	5.072*** (1.840)	22.894*** (4.291)	6.498*** 2.161
LOGPINV	-1.466 (1.248)	-1.818 (1.193)	-1.309 (1.258)	-2.008* 1.188
LOGING	-2.714 (2.244)	-0.846 (1.689)	-4.227 (2.794)	-0.851 1.828
LOGPOP	-16.117 (15.590)	-2.472** (1.486)	-7.049 (18.780)	-3.080* 1.822
LOGEDU	0.977 (1.744)	2.266 (1.637)	0.195 (1.705)	1.866 1.556
LOGINFT	-1.360 (1.028)	-0.306 (0.916)	-1.022 (1.073)	-0.799 0.941
Constant		18.205 (21.628)	-74.722 (245.988)	16.678 23.052
R Squared	62.33%	24.04%	69.50%	16.28%
Log - Likelihood	-243.166		-229.439	
Likelihood	59.572		27.452	
Ratio Test ( $\chi^2$ )	(0.00%)		(0.02%)	
F Test	5.232 (0.00%)		2.586 (1.01%)	
Hausman (9)	14.85 (9.50%)		29.65 (0.50%)	

Table 3. Results for the Second dependent variable, fixed and random effects model,  
\*: significant at 10%, \*\*: significant at 5%, \*\*\*: significant at 1%

Dependant Variable: FDI in the Primary Sector

	Model 1 One Way Fixed effects	Model 2 One Way Random effects	Model 3 Two Way Fixed effects	Model 4 Two Way Random effects
LOGGDP	12.164 *** (5.104)	15.894 *** (4.971)	12.307 ** (5.374)	14.055 *** (5.331)
LOGEXP	-2.327 ** (1.140)	0.255 (0.465)	-2.507 ** (1.255)	-2.595 ** (1.237)
LOGUNE	-1.674 * (0.882)	-0.891 (0.757)	-2.758 ** (1.195)	-3.390 *** (1.129)
LOGPEXP	3.099 (3.704)	1.952 (2.354)	23.005 *** (5.556)	17.906 *** (4.989)
LOGPINV	-3.533 ** (1.637)	-2.716 * (1.540)	-3.028 * (1.629)	-2.965 ** (1.626)
LOGING	7.310 *** (2.944)	4.174 ** (2.040)	3.227 (3.617)	3.489 (3.563)
LOGPOP	10.651 (20.451)	0.224 (1.866)	50.192 ** (24.315)	7.351 (15.338)
LOGEDU	2.016 (2.288)	1.265 (2.125)	1.937 (2.207)	0.935 (2.157)
LOGINFT	-0.014 (1.349)	0.742 (1.181)	2.008 (1.389)	0.903 (1.323)
Constant		-51.515 ** (26.513)	-926.483 *** (318.492)	-285.271 (193.275)
R Squared	71.93%	18.04%	77.87%	29.79%
Log - Likelihood	-278.451		-263.020	
Likelihood	111.577		30.861	
Ratio Test ( $\chi^2$ )	(0.00%)		(0.03%)	
F Test	12.232 (0.00%)		2.947 (0.38%)	
Hausman (9)	29.36 (0.07%)		9.17 (42.18%)	

Table 4. Results for the Third dependent variable, fixed and random effects model,  
\*: significant at 10%, \*\*: significant at 5%, \*\*\*: significant at 1%

Dependant Variable: FDI in the Services Sector

	Model 1 One Way Fixed effects	<b>Model 2</b> <b>One Way</b> <b>Random</b> <b>effects</b>	Model 3 Two Way Fixed effects	Model 4 Two Way Random effects
LOGGDP	-1.482 (8.109)	-2.229 (7.656)	0.639 (9.177)	0.217 (8.283)
LOGEXP	-2.517 (1.810)	-0.043 (0.458)	-4.766** (2.144)	0.009 (0.468)
LOGUNE	1.012 (1.401)	0.236 (1.065)	1.751 (2.040)	0.158 (1.210)
LOGPEXP	9.701* (5.884)	6.482** (3.359)	4.599 (9.490)	8.443** (3.943)
LOGPINV	-3.613 (2.600)	-3.983* (2.255)	-3.303 (2.782)	-4.039 (2.419)
LOGING	6.140 (4.677)	1.837 (2.382)	0.552 (6.178)	0.850 (2.543)
LOGPOP	-26.322 (32.489)	-1.481 (2.603)	10.967 (41.527)	-3.091 (3.355)
LOGEDU	-2.185 (3.635)	-1.159 (3.264)	-1.795 (3.770)	-1.096 (3.293)
LOGINFT	1.382 (2.143)	1.638 (1.719)	1.485 (2.372)	1.535 (1.860)
Constant		-62.627* (34.168)	-140.215 (543.953)	-51.483 (35.859)
R Squared	62.02%	56.08%	65.38%	55.92%
Log - Likelihood	-338.624		-332.604	
Likelihood	16.979		12.039	
Ratio Test ( $\chi^2$ )	(15.04%)		(22.11%)	
F Test	1.256 (25.57%)		1.067 (39.36%)	
Hausman (9)	8.69 (46.62%)		10.01 (34.94%)	

Table 5. Results for the Fourth dependent variable, fixed and random effects model,  
\*: significant at 10%, \*\*: significant at 5%, \*\*\*: significant at 1%

## Analysis

### *Fixed Effects Versus Random Effects (One Way and Two Way)*

As it was said before there are 4 models estimated for each dependent variable, model 1 estimates the parameters considering individual effects uncorrelated among each other and capture them as a fixed effect, whereas model 3 takes into account not only the individual effect but also the effect of each period inside the estimation, considering both of them as fixed effect, the comparison between these two models takes into account the values of the log-likelihood, the likelihood ratio and the F test, if the values are close to each other, the model selected is the one that uses less independent variables, due to the size of the sample (130 observations). For the case of the random effects, models 2 and 4 consider the individual<sup>2</sup> and period effects<sup>3</sup> correlated among each other and therefore the influence of these effects is random. This approach exploits the serial correlation in the composite error using a GLS framework, which was the estimation used here. The Hausman test compares its value with the critical  $\chi^2$  value, when this statistic exceeds the critical value it reveals that the fixed effects model is better than the random effects, for each case (one-way and two way respectively).

As we can see in the tables 2 and 3, the values for the Log-likelihood are close in the case of the one-way and two-way models, also, models 1 and 3 explain better the dependent variables, authorized FDI and realized FDI, that models 2 and 4 (random effects), this suggests that the influence of the regions and the years

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<sup>2</sup> For the case of Model 2

<sup>3</sup> For the case of Model 4

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themselves on FDI are uncorrelated and, therefore, can be captured as a fixed effect of the region and the year, although the values of R-squared and log-likelihood are smaller in the case of one-way fixed effects versus two-way, we applied the parsimonious principle and chose model 1 for the case of authorized FDI and realized FDI.

Table 4 indicates a different situation, in this case Model 3 is more powerful to explain the dependent variable, FDI in the export sector, when it is compared with one-way fixed effects, however, when the comparison is made with the random effects model (model 4) the Hausman value indicates that the latter is a better model, in other words, the influence of the regions and the years is random and cannot be captured as individual effect, hence it is considered in the error term. This result is not completely surprising, since the largest amount of FDI in the export sector is concentrated in few regions of the country, particularly those regions that have a large amount of natural resources such as mining and forestry, since the random effects model considers a large number of random draws from the cross-section, the treatment of these effects is as they were random draws of the population, which is appropriate when there is neglected heterogeneity in the regions concerning this sector, this heterogeneity of the FDI cannot be captured with fixed coefficients. A similar case happened for the fourth dependent variable, FDI in the services sector, table 5 shows in this case that both one-way and two-way random effects explain better the variable than models 1 and 3, but the R-squared

value shows that model 2 explains better the variable than model 4, and that means that the individual effects are correlated among each other but not the period effects, and that the effects of the regions are orthogonal with the rest of the explanatory variables, making necessary to treat them in the error term, which is correlated serially with the “natural” error term. The fact that the services sector is more concentrated in the regions with larger population (about one third of the total population in Chile), supports the idea of random effects, in the sense that the effect of the regions is not fixed for all regions, but rather concentrated in few regions of the population of study. The selected models for each variable are shown in Table 6, as a summary:

Dependent Variable	Model Chosen	Name of the Model
Authorized FDI	1	One-way Fixed Effects
Realized FDI	1	One-Way Fixed Effects
FDI in the Export Sector	4	Two-Way Random Effects
FDI in the Services Sector	2	One-Way Random Effects

Table 6: Summary of the models Chosen for each dependent variable

### *Authorized FDI*

From the results shown in Table 2, we can see that the level of exports, the public expenditure, the average income, the population, the education and the infrastructure are significant variables, this means that the “traditional” variables play a role in the decision of how much foreign investment is permitted in each region, the fixed effect of each region is also significant although only at a 10% level.

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The public expenditure, the income and the education have the sign expected, meaning that they are considered as attractive factors of FDI, and the magnitude of these parameters indicate that there is high sensitivity of the authorized FDI to these variables, since the results show directly the elasticities of the dependent variable to the explanatory variables; however, the exports, the population and the infrastructure present an opposite sign expected, they appear to deflect this kind of FDI rather than considered attractive, since this variable is more concerned with decision making rather than actual capital inflow, it is reasonable to think that variables such as population and infrastructure, when they are larger, they could be considered as a measure of agglomeration, which in the case of Chile, being a small country in terms of space might be considered a disadvantage, at least for the decision-makers. The exports level also shows a negative sign, which is a little surprising, since it was expected that openness or trade would be attractive to FDI. In this case, it seems that as exports increase, authorized FDI would decline, but this also could mean that exports and FDI are correlated each other rather than one explain the other, since this variable was not used in lagged form, there is possibility that the causality of these variables is the other way around, i.e. that the authorized FDI causes the export level to fall.

*Realized FDI* When we look at the results for the realized FDI on table 3, these differ completely from the previous case, the realized FDI estimation indicates that only the unemployment and the public expenditure are significant variables, with

99% of confidence, both variables have the sign expected, i.e. the public expenditure shows a positive sign, indicating that it is considered an attractive factor of FDI, since this variable is a proxy for public incentives, it shows that they are correlated, the other proxy used, public investment was not significant, although it was thought a better proxy, the unemployment rate shows a negative sign, which indicates that it deflects the actual FDI, since it may indicate instability of the country, the magnitude of them, measured as elasticities, indicate also a large sensitivity of the dependent variable, specially in the case of the public expenditure. Since it is also a fixed effects model, a closer look to these effects reveals that they are not significantly different from zero, indicating that the differences of the regions themselves do not play a role in the attraction of FDI. An interesting result is that the variables often linked with FDI, such as growth, income and infrastructure, do not play an important role in the attraction of FDI, at least not at regional level

### *FDI in the Primary Sector*

Looking the results on Table 4, we can see that the significant variables are the growth of GDP, the exports level, the unemployment rate, the public expenditure and the public investment. The values for the growth of GDP and public expenditure present the sign expected, with a large sensitivity of this kind of FDI to these variables. FDI on the primary sector is characterized mainly by investments on natural resources such as mining and fishing; in some cases they

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form a great part of regional GDP. The positive relationship of GDP with FDI indicates that the return of these investments are important for the multinationals and, in the case of public expenditure this variable acts as a measure of efforts for development and of the regions. The level of unemployment has a negative sign which it is expected if this variable is considered as an indicator of the quality of the labor force and development, considering that investment on natural resources may be a large source of profits for multinationals, every variable that indicates growth and development of the region acts as an attractive factor for investment. An interesting result is the role the level of exports, even though it is significant, it has a negative sign, which means that the elasticity of FDI is negatively related with the level of exports. Again, this could be explained in the sense that since this sector (primary), is mostly export-oriented, the country in general puts greater efforts in promoting exports in sectors. In this case, the level of exports acts as “competition” for the export-oriented FDI maybe because it leads to increase the foreign currency, making the exchange rate unfavorable to the export sector. For the case of public investment, is it reasonable to think that the FDI in the primary sector and this kind of investment might act as substitutes, i.e. the negative correlation between these two variables indicates that if there is public investment in one region then there will be foreign investment in the others, as a way to balance the capital in the regions. However, the causality in each case is not clear, specially for GDP, exports and public investment, these results only indicate that the FDI in the primary sector and the independent variables are correlated in a non-linear relationship.

*FDI in the services sector*

In the case of the FDI in the services sector, we can see from Table 5, that the public investment, the public expenditure and the constant significant variables, indicating that the proxies used for public incentives are correlated with the dependent variable, but the signs are different, in the case of public expenditure the sign is positive indicating that the larger the expenditure, the more the FDI will be attracted, with a high level of sensitivity, as it shows its magnitude of the coefficient, but for the public investment, the relationship is negative which could be explained in the same sense that these types of investments compete each other, the result of the influence of these variables is interesting, since there might be a positive linear correlation between each other, but the fact that they act in opposite ways in this non-linear model indicates that the variables have independent influence on the FDI in the services sector. The constant itself, although significant, shows that it has very little influence, since its magnitude is negative and only significant at 10% level. It is probably also that this FDI had flourished mainly through acquisitions and privatizations, the idea of market capturing can still be differentiated from pure market-seeking, since the gross of these investments are in activities related with almost inelastic demand and the attainment of a “secure” market. Market-seeking FDI is the searching for a large size market with downward slope demand. These mergers and acquisitions took place in sectors such as electricity and water (sanitation is also included in this category) as well as

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services such telecommunications and finances. Since very few variables explain the dependant variable, it should be considered the search for more specific determinants, such as costs, and demand-related variables, like consumption and prices, or time-related variables, the increase of these investments took place in the latter years of the period of study. The study of investment in sectors such as water and electricity also need the inclusion of “non-traditional” variables, since, for the specific case of Chile, many of these firms were government-owned, and these investments took place in a specific period of time of Chile, when the government authorized the privatization of such services.

## **Conclusions**

The story of FDI in Chile had tell us that direct policies made by Chile in order to attract FDI were slightly different from others applied in countries such as Argentina and Brazil, this difference is visible when comparing the authorized and realized FDI, the traditional variables were significant for the authorized FDI, indicating that the model of FDI that relates comparative advantages for multinationals is put into practice, although in Chile the objective for attracting FDI was not development *per se*, but the control of the debt crisis and inflation and to expand the export sector, this explains in part the reason why during the early 1990's most of the FDI were concentrated on the mining sector, a sector highly profitable for foreign companies, and appropriate as a tool for the export sector. However, when considering the realized FDI, the variables were not significant, with exception of two of them, indicating that the regional macroeconomic variables

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do not play an important role in FDI, but that there are other factors that do not imply regional location when attracting the total FDI.

The analysis of the determinants at a sector level tends to confirm that even though the usual variables used for explaining FDI might be significant in explaining the FDI, the causal relationships could be the other way around and that there is only correlation or even a bi-directional causality. In fact, for the case of the Mining sector, which was the leader in FDI until mid 1990's, some of the typical determinants were significant, whereas for the services sector, most of the determinants were shown to be not significant. Hence, as FDI evolved from the primary to the tertiary sector, the determinants also evolved, making necessary the search for other factors that could explain the attraction of FDI, examples could be the consideration of spatial effects or more specific factors such as trade arrangements, or the inclusion into bigger markets, which still have not been tested in other studies.

The use of panel data specifications showed an appealing performance, since for the main dependent variables (authorized and realized FDI) the fixed effects specification were significant, a most exhaustive analysis could be performed, it could be considered that an individual analysis of FDI in each region could provide more insight about the special characteristics that attract FDI that do not change in a short period of time or vice versa, characteristics that change over the time but

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are the same for all regions such as prices or taxes. It was specifically avoided the use of variables that did not vary either across regions or years, in order to avoid using dummies or combined dummies in this panel, which was almost a balanced-type panel (the number of individuals were 13 compared with a 10-year period). The fact that the random effects model were significant for the secondary dependent variables (FDI in the primary and services sector), indicate that there is some kind of concentration of the sector in few regions, i.e. the regions are heterogeneous in terms of FDI in certain sectors and that the fixed effects specification is not able to explain.

For the case of the services sector, we cannot assume that it was market-seeking FDI, since the typical factors considered for this kind of FDI were not significant, hence the denomination of market-capture FDI. So far, this concept has not been explored extensively, and the results presented here suggest that there are still some factors that need to be considered, from the quality of the data, the specification of the model and the use of other explanatory variables. Also, for the specific case of Chile we need to consider other aspects, for example the presence of double causality between FDI and some of its explanatory variables, it is not discarded the idea that also could exist the presence of an unit root for FDI itself. Either way, the study of FDI presents wide range of alternatives that are waiting to be explored.

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