CHILE[1]

Investment Climate Assessment (ICA) on Productivity and on Allocative Efficiency: Effects on Exports, Foreign Direct Investment, Wages and Employment

Analysis Based on Firm Level Data from 2001-2003

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1. Introduction

As developing countries face the pressures and impacts of globalization, they are seeking ways to stimulate growth and employment within this context of increased openness. With most of these countries having secured a reasonable level of macroeconomic stability, they are now focusing on issues of competitiveness and productivity through microeconomic reform programs. From South East Asia to Latin America, countries are reformulating their strategies and making increased competitiveness a key priority of government programs

Chile´s economic performance continues to surpass the rest of Latin America. Figure 1, panel a, shows that the per capita income of Chile from the period 1960 to 1980 was more or less stable around 70% of the aggregate per capita income in Latin America. However, during the last 25 convergence due to persistent positive rates of growth in GDP allowed Chile´s per capita income to reach 140% of Latin America in 2005. A different convergence result in per capita income is obtained if we use as a point of reference more developed countries. In 1960, the per capita income of Chile was around 30% of the per capita income of the Unites States (US) and 42% of the European Union (EU). Slow divergence in per capita income occurred until the end the 80´s, relative to the US and the EU, and since then steady rates of convergence allowed Chile to recover in 2005 the relative per capita income levels of 1960.

Is convergence in per capita income of Chile relative to Latin America and the lack of convergence relative to the US and the EU, due to labor productivity differences or to other demographic factors (ratio of labor force to total population)? Figure 1, panels b and c, show that labor productivity is the important factor explaining the evolution of the relative per capita income. Relative labor productivity follows a pattern similar to relative per capita income while the demographic factor evolution is more stable. Total factor productivity together with the inputs of the production function is the key element explaining the evolution of labor productivity.

A significant component of country competitiveness is having a good investment climate or business environment. The investment climate, as defined in the WDR (2005), is "the set of location-specific factors shaping the opportunities and incentives for firms to invest productively, create jobs and expand." It is now well accepted and documented, conceptually and empirically, that the scope and nature of regulations on economic activity and factor markets - the so-called investment climate and business environment - can significantly and adversely impact productivity, growth and economic activity (see Bosworth and Collins, 2003; Dollar et al., 2004; Rodrik and Subramanian, 2004; Loayza, Oviedo and Serven, 2004; McMillan, 1998 and 2004; OECD, 2001; Wilkinson, 2001; Alexander et al., 2004; Djankov et al., 2002; Haltiwanger, 2002; He et al., 2003; World Bank, 2003; and World Bank, 2004 a,b). Prescott (1998) argues that to understand large international income differences, it is necessary to explain differences in productivity (TFP). His main candidate to explain those gaps is the resistance to the adoption of new technologies and to the efficient use of current operating technologies, which in turn are conditioned by the institutional and policy arrangements a society employs (investment climate variables). Recently, Cole et al. (2004) also have argued that Latin America has not replicated Western economic success due to the productivity (TFP) gap. They point to competitive barriers (investment climate constraints) as the promising channels for understanding the low productivity observed in Latin American countries.

Government policies and behavior exert a strong influence on the investment climate through their impact on costs, risks and barriers to competition. Key factors affecting the investment climate through their impact on costs are: corruption, taxes, the regulatory burden and extent of red tape in general, factor markets (labor, intermediate materials and capital), the quality of infrastructure, technological and innovation support, and the availability and cost of finance.

For example, Kasper (2002) shows that poorly understood "state paternalism" has usually created unjustified barriers to entrepreneurial activity, resulting in poor growth and a stifling environment. Kerr (2002) shows that a quagmire of regulation, which is all too common, is a massive deterrent to investment and economic growth. As a case in point, McMillan (1988) argues that obtrusive government regulation before 1984 was the key issue in New Zealand's slide in the world per-capita income rankings. Hernando de Soto (2002) describes one key adverse effect of significant business regulation and weak property rights: with costly firm regulations, fewer firms choose to register and more become informal. Also, if there are high transaction costs involved in registering property, assets are less likely to be officially recorded, and therefore cannot be used as collateral to obtain loans, thereby becoming "dead" capital.

Likewise, poor infrastructure and limited transport and trade services increase logistics costs, rendering otherwise competitive products uncompetitive, as well as limiting rural production and people's access to markets, which adversely affects poverty and economic activity (Guasch 2004).

The pursuit of greater competitiveness and a better investment climate is leading countries - often assisted by multilaterals such as the World Bank - to undertake their own studies to identify the principal bottlenecks in terms of competitiveness and the investment climate, and evaluate the impact these have, to set priorities for intervention and reform. The most common instrument used has been firm-level surveys, known as Investment Climate Assessments (ICAs), from which both subjective evaluations of obstacles and objective hard-data numbers with direct links to costs and productivity are elicited and imputed. Such surveys collect data at firm level on the following themes: a) infrastructure, b) red tape, corruption and crime, c) finance and corporate governance, d) quality, innovation and labor skills and d) other control variables like capacity utilization, age and size of the firm, etc.

While the Investment Climate Assessments are quite useful in identifying major issues and bottlenecks as perceived by firms, the data collected is also meant to provide the basic information for an econometric assessment of the impact or contribution of the investment climate (IC) variables on productivity. In turn, that quantified impact is used in the advocacy for, and design of, investment-climate reform. Yet providing reliable and robust estimates of productivity estimates of the IC variables from the surveys is not a straightforward task since; first, the surveys do not provide panel-type data on IC variables; second, neither the production function parameters nor the functional form are observed; and third, there is an identification issue separating total factor productivity (TFP) component from the inputs of the production function.

When any of the production function inputs is influenced by common causes affecting productivity, like IC variables or other plant characteristics, there is a simultaneous equation problem. In general, one should expect the productivity to be correlated with the production function inputs (technological progress is not Hicks neutral) and, therefore, inputs should be treated as endogenous regressors when estimating production functions. This property has demanded special care with the econometric specification when estimating those productivity effects and in the choice of the most appropriate way of measuring productivity. There is an extensive literature discussing the advantages and disadvantages of using different statistical estimation techniques and/or growth accounting (index number) techniques to estimate productivity or Total Factor Productivity (TFP). For overviews of different productivity concepts and aggregation alternatives see, for example, Solow (1957), Hall (1990), Foster, Haltiwanger and Krizan (1998), Batelsman and Doms (2000), Hulten (2001), Diewert and Nakamura (2002), Jorgenson (2003), Jorgenson, Gollop and Fraumeni (1987), Olley and Pakes (1996) and Barro and Sala-i-Martin (2004). In this paper we discuss the applicability of some of these techniques to the problem at hand and present adaptations and adjustments that provide a best fit for the described objective: estimating the productivity impact of IC variables collected through a firm-level survey (international longitudinal micro-level data sets).

We believe that improving the investment climate (IC) is a key policy instrument to promote economic growth and to mitigate the institutional, legal, economic and social factors that are constraining the convergence of per capita income and labor productivity of Chile relative to more developed countries. For that, we need to identify the main investment climate variables that affect economic performance measures like total factor productivity, employment, wages, exports and foreign direct investment and this is the main goal of this paper.

The recent trade literature has emphasized the importance of firm heterogeneity in understanding export behaviour. Traditional trade theory either has all firms or none of the firms in a given sector export. However, micro-level evidence shows this picture to be seriously flawed. Even within so-called export sectors, a substantial fraction of firms exclusively sell in the domestic market. Bernard and Jensen (1995, 1999), Clerides, Lach and Tybout (1998), and Aw, Chung and Roberts (2000) all find that larger and more productive firms are more likely to export. This heterogeneity shows up both across and within sectors. Moreover, these stylized facts seem to be common to both developed and developing countries. The work of Bernard and Jensen (1995, 1999), for instance, focuses on the U.S., whereas Clerides, Lach and Tybout (1998) analyze

Colombia, Mexico and Morocco. The results presented in this paper on Chile confirm many of these stylized facts. In particular, productivity is shown to have an important impact on a firm's probability to export. However, larger firms are not more productive. This result holds up after controlling for a large variety of investment climate variables.

These stylized facts have given rise to a number of important theoretical contributions. Melitz (2003) proposes a monopolistic competition model with heterogeneous firms. Each firm draws its productivity from a distribution. To enter the export market, firms need to pay a fixed cost. As a result, only the larger or more productive firms will choose to export, while the smaller or less productive firms will decide to only serve the domestic market. Yeaple (2005) is able to obtain the same qualitative results, without assuming that firms are randomly assigned their productivity levels. Instead, ex ante homogeneous firms get to choose between competing technologies, and can hire workers of heterogeneous skill. Different workers have comparative advantage in different technologies. As in Melitz (2003), there is a fixed cost in accessing export markets. The model generates ex post heterogeneous firms, with the low productivity firms serving the domestic markets, and the high productivity firms exporting.

What keeps low productivity firms from exporting in both Melitz (2003) and Yeaple (2005) is the existence of a fixed cost to enter export markets. There is empirical evidence supporting this view. Das, Roberts and Tybout (2006), for instance, estimate that Colombian chemical plants need to pay a fixed cost of around $1 million to enter export markets. Other papers, such as Bernard and Jensen (2004) for the U.S. and Bernard and Wagner (2001) for Germany further substantiate the existence of fixed costs involved with exporting.

In our study on Chile we find, for instance, that having *fixed costs* like e-mail, R&D activities, belonging to a trade association, having the annual statements engaged in external auditories, etc., increase the probability to export. In contrast to Melitz (2003), the theoretical work by Bernard, Eaton, Jensen and Kortum (2003) suggests that fixed export costs are not needed to match the heterogeneity in export performance. They propose a model with Bertrand competition, where the price a firm can charge is bound by potential rivals. In this setup it is easier for a firm to sell at home than abroad. To export, a firm needs to overcome the hurdle of transportation costs, whereas to sell in the domestic market, transportation costs reduce the threat of foreign rivals. Therefore, firms that export will be more productive, as occurs in Chile.

Although much of the empirical evidence points to more productive firms becoming exporters and not the other way around (see, e.g., by Bernard and Jensen, 1999, and Clerides et al., 1998), the theory on the relation between productivity and exports is not exempt from reverse causality or the simultaneity found in Chile. Whereas Melitz (2003) and Bernard et al. (2003) argue that high productivity firms self select to become exporters, it is also true that access to export markets may make firms more productive. In the work by Grossman and Helpman (1991), for instance, an increase in the market size allows for more varieties being produced, thus improving the productivity of final good producers. Holmes and Schmitz (2001) propose a quality ladder model, in which entrepreneurs can use their time to either block the innovation of their rivals or to innovate and move up the ladder. They show how trade shifts the relative returns from unproductive blocking towards productive innovation. Desmet and Parente (2006) emphasize yet another mechanism: they argue that access to larger markets increases the elasticity of demand, thus increasing the incentive for firms to adopt more productive technologies.

The conventional wisdom associates foreign direct investment with higher productivity. According to Markusen (1995), one important stylized fact is that multinationals are prevalent in firms and industries with high levels of R&D, a large share of professional and technical workers, and products that are new and/or technically complex. This is in line with Dunning (1993) who argues that to overcome local barriers, multinationals must have some intangible assets, such as superior technologies or more advanced management techniques and those arguments support our empiricasl findings in Chile. Markusen (1995) refers to this as knowledge-based assets.

However, the statistical contemporaneous correlation (simultaneity) between foreign ownership and productivity does not settle the question of causality. Do foreign firms, through technology transfers, improve the productivity of the firms they acquire? Or do foreign investors select more productive firms to acquire? To use the words of Evenett and Voicu (2002), are foreign investors picking winners or creating them? In order to answer this causality questions we need to have either a control group of firms or a dynamic panel of IC variables and therefore are out of the scope of this paper.

In the case of developing countries, inward FDI may increase productivity, simply because foreign investors, often based in more advanced economies, dispose of more productive technologies. In this case, domestically owned and foreign owned firms get their productivity from different exogenous distributions. However, the positive contemporaneous correlation between foreign ownership and productivity also holds up when one focuses on FDI between developed countries. The recent theoretical work of Helpman, Melitz and Yeaple (2004) proposes a mechanism, similar to the one in Melitz (2003), that rationalizes this fact. Because of the fixed costs involved in setting up an affiliate plant abroad, only the most productive firm are able to become multinationals. Even if home firms and foreign firms get their productivity assigned from the same exogenous distribution, only the more productive foreign firms will choose to set up affiliates in the home country. This self selection issue gives rise to an endogenous difference in the productivity distribution of domestically owned and foreign owned firms.

Although these theories suggest that foreign investors would tend to improve the productivity of the firms they acquire, recent work on FDI in developed countries suggests that selection bias may be a problem. This supports the view that foreign investors may be "picking winners". For instance, Harris and Robinson (2003) find that in the case of the UK foreign firms acquire better performing local firms, without further improving productivity after acquisition. Benfratello and Sembenelli (2006) come to a similar conclusion in the case of Italy. Other studies continue to find a positive effect from foreign ownership though. Conyon et al. (2002), for example, estimate that UK firms get a 14% productivity boost after being acquired by foreign firms.

Studies of foreign acquisitions in developing countries suggest self selection bias is less of an issue. In the case of the Czech Republic, Djankov and Hoekman (2000) and Evenett and Voicu (2002) both find evidence of technology transfers by foreign owners. Moreover, the positive impact is larger in foreign owned firms than in joint ventures. In a recent study of Indonesian manufacturing plants, Jens and Smarzynska (2005) use propensity score matching to determine what would have happened to a domestic firm had it not been acquired? They find a strong positive effect of foreign ownership. The increase in plant productivity is estimated to reach 34% three years after acquisition.

In this work on Chile we find that productivity is one of the main variables affecting foreign investors acquiring local firms but as in the work by Jens et al. (2005), other characteristics, such as innovation (R&D on new products in Chile) and labor skills (internal training and University staff in Chile) also matter. Furthermore, those firms that receive foreign direct investment are more productive (even after controlling fro R&D activities and human capital) and therefore we find evidence of simultaneity between FDI and TFP at the firm level.

Finally, productivity has also a positive and important effect on wages and a negative but small elasticity (-0.1) measuring the direct effect on employment (technical change is labour saving in Chile).

The structure of this paper is the following: In section 2 of this report, we study the investment climate (IC) determinants of productivity, wages, employment, probability of exports and probability of receiving foreign direct investment, using panel data coming from the investment climate assessment (ICA) survey done at the plant level in Chile. In particular, we estimate the impact of investment climate (IC) variables and other firm control (C) characteristics on these dependent variables. (See Table A.1 of the appendix). The properties and quality of the observations are analyzed in Tables B.1 to B.6. The IC variables are groped in five broad categories: a) infrastructure, b) red tape, corruption and crime, c) quality, innovation and labor skills, d) finance and corporate governance and e) other firm control characteristics. (See Table A2 of the appendix). Once we have obtained several productivity measures (Solow residuals, Cobb-Douglas and Translog production functions) at several aggregation levels (aggregate and by industry) we estimate the IC-elasticities and we show that the estimated results are robust. Therefore, for simplicity, we only evaluate whether the productivity measure based on the Solow residuals has significant impacts on wages, on labor demand, on the probability of becoming an exporting firm and the probability of receiving foreign direct investment (FDI), after controlling for ICA variables and other firm control (C) characteristics.

In section 3, we compute the Olley and Pakes (1996) decomposition of aggregate productivity in two terms: average productivity and the efficiency term. We also apply a similar decomposition of aggregate wages and aggregate employment using as weights for the productivity shares of each firm. All those decompositions are performed at several levels: aggregate level, by industry, by region, by size of the firm and by year.

Section 4 evaluates the impact of IC variables on: average (log) productivity, average (log) wages, average (log) employment, on the probability of exporting and on the probability of receiving foreign direct investment. This IC evaluation is performed at the previous seven levels of aggregation (aggregate, by industry, by size, etc.).

In section 5, the impact of IC variables on the efficiency component of the Olley and Pakes (1996) decomposition is analyzed. A new decomposition of aggregate (log) productivity is proposed in terms of the contribution of the inputs (labor, intermediate materials and capital stock) and the productivity term to the efficiency term.

Section 6 discusses the robustness of the previous ICA results to the PROBIT, instead of the linear probability model (LPM), and to other productivity measures based on simple extensions of the Levinsohn and Petrin (2003) and Ackerberg and Caves (2003) procedures to account for the presence of IC variables and other control variables that affect the endogeneity of the inputs in the presence of observable fixed effects. A summary Table with the significant ICA effects and comments on the main empirical results are included in section 7. Most of the Tables and Figures are included in a large appendix at the end of the paper.

2. Econometric Methodology for ICA-Elasticity Estimation on: Productivity, Wages, Employment, the Probability of Exporting and the Probability of Receiving Foreign Direct Investment

The productivity approach that we follow here is based on the robust econometric methodology of Escribano and Guasch (2005). Productivity (P), or multifactor productivity, refers to the effects of any variable different from the inputs --labor (L), intermediate materials (M) and capital services (K)--, affecting the production (sales) process. In general, we expect productivity to be correlated with the inputs L, M and K, and therefore the inputs must be treated as endogenous regressors when estimating production functions. The list of industries and regions, the list of input variables of the production function and the list of other dependent variables (exports, foreign direct investment, wages and employment) with the indication on how there are measured are included in Table A.1 of the appendix.

2.1 Description of the ICA Data Base of Chile

From Chile´s ICA survey we are able to form a balanced panel data base, see Table B.2. The panel is short in the time dimension with 3 years of observations but, long in the cross section dimension with almost 847 plants. About the input variables of the production function we have temporal observations for the years 2001, 2002 and 2003. However, for the long list IC variables included in Table A2 (I-III) of the appendix, we only have observations for the year 2003. In the empirical application we assume that the investment climate characteristics for this short period of time (say three years) are constant at the plant level and therefore we treat them as observable fixed effects. This assumption has important econometric advantages, as will become clear later on.

We do not estimate the productivity equations in first differences since we will loose all the information on ICA variables, since that information is fixed (constant). In particular, we estimate the elasticities and semi-elasticities of the ICA and other control variables based on productivity measures in levels (logs), adding always dummy variables to control for the three years and the eight sectors including industries, services, farm-fishing. Table B.1 shows the total number of observations available for Chile in each of the eight sectors and in each of the five regions. It is clear that the information from La Araucania region should be carefully interpreted since we only have information one firm that produce wood and cork products. Table B.2 lists the number of observations per year in each industry and indicates that we have a balanced panel, after cleaning for outliers and controlling for missing data. Table B.3 list the number of missing observations of the production function variables which are needed to obtain productivity measures. Without outliers and missing observations we could have used 948 observations per year. After appropriate handling of outliers and missing observations we end up loosing around 100 observations keeping 847 for each of the three years. Tables B.4 (I) and B.4 (II) list the number of missing observations that we found in the ICA survey of Chile for each IC variable. However, we are able to save many IC variables by using region-industry averages instead of individual observations. For more details see the last section on data transformations of the Appendix. As will become clear later on, this region-industry transformation helps us also reducing the degree of endogeneity of IC variables.

2.2 Econometric Methodology for Productivity Analysis

In previous robust ICA analysis done at the World Bank, for other Latin American countries, Escribano and Guasch (2005) proposed to pool observations across several countries when estimating productivity in levels (logs). In the case of Chile, to estimate the ICA elasticities and semi-elasticities on productivity, we pooled the observations from manufacturing industries to estimate common IC coefficients. For the sector by sector evaluation we compute the impacts of IC variables on: the mean (log) productivity, on the mean (log) employment, the mean (log) wages, the probability of exporting and the probability of receiving foreign direct investment, as will be explained in the next sections.

In all the panel data regressions we use several sector-industry (D_j, j = 1, 2... q_D) annual dummy variables (D_t, t = 1, 2 ...T) and a constant term (intercept). In particular, in the regressions of Tables C.1-C.2 we include seven dummy variables for the eight sectors, two year dummies for the three years of data and a constant term.

To address the endogeneity problem of the inputs we follow the approach proposed by Escribano and Guasch (2005). That is, we proxy the usually unobserved firm specific fixed effects (which are the main cause of the endogeneity of the inputs) by a long list of firm specific observed fixed effects coming from the investment climate information, see the list of investment climate variables (IC) and control variables (C) included in Tables A.2 (I-III).

In particular the *extended Cobb-Douglas production function* estimated in 1-step becomes,

$$\log Y_{jit} = a_L \log L_{jit} + a_M \log M_{jit} + a_K \log K_{jit} + a'_{IC} IC_i + a'_C C_i + a'_{Ds} D_j + a'_{DT} D_t + a_P + u_{jit} \qquad (1)$$

where the variables IC_i, C_i, D_j and D_t are (q_{IC}x1), (q_Cx1), (q_{Ds}x1) and (Tx1) column vectors, respectively. With this specification we will test whether we have (at the aggregate and at the industry level) technologies with constant returns to scale ($a_L + a_M + a_K = 1$). Based on equation (1) log productivity is given by, $\log P_{jit} = a'_{IC} IC_i + a'_C C_i + a'_{Ds} D_j + a'_{DT} D_t + a_P + u_{jit}$.

If the production function is *Translog*, using similar arguments, we can consistently estimate by least squares, the following extended production function in 1-step,

$$\begin{aligned} \log Y_{jit} = {} & a_L \log L_{jit} + a_M \log M_{jit} + a_K \log K_{jit} + \frac{1}{2} a_{LL} (\log L_{jit})^2 + \frac{1}{2} a_{MM} (\log M_{jit})^2 + \frac{1}{2} a_{KK} (\log K_{jit})^2 \\ & + a_{LM} (\log L_{jit})(\log M_{jit}) + a_{LK} (\log L_{jit})(\log K_{jit}) + a_{MK} (\log M_{jit})(\log K_{jit}) \qquad (2) \\ & +_{jit} a'_{IC} IC_i + a'_C C_i + a'_{Ds} D_j + a'_{DT} D_t + a_P + u_{jit} \end{aligned}$$

Based on equation (2), log productivity is given by

$$\log P_{jit} = a'_{IC} IC_i + a'_C C_i + a'_{Ds} D_j + a'_{DT} D_t + a_P + u_{jit}.$$

With both parametric specifications of the production function F(L,M,K), we can also test the constant returns to scale[3] condition behind Solow´s residuals in levels ($\log \hat{P}_{it}$), see equation (3), under the condition that the shares are constant in time at the aggregate and at the industry level. Therefore, the third alternative methodology considered in this paper is to use a nonparametric or index number approach based on cost-shares from Hall (1990) to obtain the Solow´s residual in levels (logs),

$$\log Y_{jit} = \bar{s}_L \log L_{jit} + \bar{s}_M \log M_{jit} + \bar{s}_K \log K_{jit} + \log P_{jit} \qquad (3)$$

where $\bar{s}_r$ is the aggregate *average cost shares* from the last two years[4] given by $\bar{s}_r = \frac{1}{2}(s_{r,t} + s_{r,t-1})$ for r = L, M and K.

The advantage of the Solow residuals, Solow (1957), is that it does not require the inputs (L, M, K) to be exogenous or the input-output elasticities to be constant or homogeneous, see Escribano and Guasch (2005). The drawback is that it requires having constant returns to scale (CRS) and at least competitive input markets.

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3 Remember, that CRS are satisfied if the coefficients of the inputs (L, M and K) in the Cobb-Douglas specification of the production function add up to one. Similar but more complicated coefficient restrictions apply for a CRS Translog production functions.

4 When there is only firm information about a single year we take the average cost share of the firms of that year.

Two-step estimator: Once we have estimated productivity (1st-step) in equation (3) we can estimate from equation (4) the IC elasticities and semi-elasticities in the 2nd-step,

$$\log P_{jit} = \alpha'_{IC} IC_i + \alpha'_C C_i \ + \alpha'_{Ds} D_j + \alpha'_{DT} D_t + \alpha_P + u_{jit} \,. \tag{4}$$

Since there is no single salient measure of productivity (or $\log P_{j,it}$), any empirical evaluation on the productivity impact of IC variables might critically depend on the particular way productivity is measured. Therefore, to get reliable empirical elasticities for policy analysis, Escribano and Guasch (2005) suggest searching for robust empirical results using several productivity measures. This is the approach we follow in this ICA report of Chile.

Controlling for the largest set of investment climate (IC) variables and plant control (C) characteristics in equations (1) to (4) we can get, under standard regularity conditions, *consistent and unbiased* least squares estimators of the parameters of the production function and of the productivity equation. For example, we can run OLS from a one-step regression[5] based on the extended production function (1). To estimate the IC-elasticities, we will do pooling OLS with robust standard errors and also random effects (RE) estimators, or generalized least squares (GLS) estimators, to control for the heterogeneity (heteroskedasticity) present in the regression errors. The results are in Tables C.1 to C.5 of the appendix.

Endogeneity of the Explanatory Variables

Another econometric problem that we have to face when estimating (1), (2) and (4) is the possible *endogeneity* of IC variables and some C variables. In the productivity equations, the traditional instrumental variable (IV) approach is difficult to implement, given that we only have IC variables for one year and therefore we cannot use the natural instruments for the inputs, like those provided by their own lags, etc. As an alternative correction for the endogeneity of the IC variables, we use the *region-industry average* of the plant level investment climate variables ($\overline{IC}$) instead of the crude IC variables, which is a common

[5] Alternatively, we could have used an equivalent two-step control function approach procedure where we first estimate by OLS a regression of each of the inputs on all the IC and C variables (partialling out) and then running simple regressions including one by one the residuals of each estimated input equation, instead of the observed explanatory variables, in the equation.

solution in panel data studies at the firm level[6]. Furthermore, taking industry averages, and not the individual IC variables, is also useful to mitigate the effect of missing individual IC observations at the plant level. This is an important issue in most of the ICA surveys done in developing countries. However, to evaluate the productivity impact on wages, on labor demand, on the probability of becoming an exporting firm and the probability of receiving foreign direct investment (FDI), we instrument the productivity variable by using a selection of IC and C variables, as will be explained later on.

Strategy for IC Variables' Selection

The econometric methodology applied for the selection of the variables (IC and C) goes from the *general to the specific*. The otherwise *omitted variables* problem that we encounter, starting from a too simple model, generates biased and inconsistent parameter estimates. We include in tables C.1 to C.2 the set of IC variables from Table A.2 (I-III) that were significant in at least one of the 10 productivity specifications estimated by using pooling OLS or random effects (RE). The list of significant IC variables from all the estimated equations in Chile is listed in Tables B.5. These regression results of Tables C.1 and C.2 are consistent (robust) across the 10 productivity measures used, with equal signs and a reasonable range of parameter values. The detailed empirical results are explained in the next sections.

2.3 Robustness of the Estimated Productivity-IC Elasticities and Semi-elasticities

For policy recommendations we want the *elasticities, or semi-elasticities* of IC variables on productivity to be *robust* (equal signs and of similar magnitudes) to the 10 productivity measures used.

The alternative productivity measures considered in this paper come from considering:

1) different functional forms of the production functions (Cobb-Douglas and Translog),

2) different set of assumptions (technology and market conditions) to get consistent estimators based on Solow´s residuals, or OLS, RE, etc. and,

3) different levels of aggregation in measuring input-output elasticities (at the industry level or at the aggregate country level).

[6] This two step estimation approach has an instrumental variables (2SLS) interpretation.

Table 1. Summary of Productivity Measures and Estimated Investment Climate (IC) Elasticities

1. Solow´s Residual	Two Step Estimation	1.1 Restricted Coef.	1.1.a OLS 1.1.b RE	2 (P_{it}) measures 4 (IC) elasticities
		1.2 Unrestricted Coef.	1.2.a OLS 1.2.b RE	
2. Cobb-Douglas	Single Step Estimation	2.1 Restricted Coef.	2.1.a OLS 2.1.b RE	4 (P_{it}) measures 4 (IC) elasticities
		2.2 Unrestricted Coef.	2.2.a OLS 2.2.b RE	
3. Translog	Single Step Estimation	3.1 Restricted Coef.	3.1.a OLS 3.1.b RE	4 (P_{it}) measures 4 (IC) elasticities
		3.2 Unrestricted Coef.	3.2.a OLS 3.2.b RE	
			Total	10 (P_{it}) measures 12 (IC) elasticities

Restricted Coef.= Equal input-output elasticities in all industries
Unrestricted Coef.= Different input output elasticities by industry
OLS = Pooling Ordinary Least Squares estimation (with robust standard errors)
RE = Random Effects estimation.

As mentioned in section 2.1, to reduce the simultaneous equation bias and the risk of getting reverse causality problems for those IC_i variables that are endogenous, we use their region-industry average ($\overline{IC}_j$). The productivity coefficients of investment climate ($\overline{IC}_i$) variables and other plant-specific control (C_{it}) variables are maintained constant but we allow the production function elasticities, and therefore the productivity measures, to change for each functional form (Cobb-Douglas and Translog), and for each aggregation levels (industry and countries). *Restricted estimation* (equal input-output elasticities among industries) and *unrestricted estimation* (different input-output elasticities for each industry), are the two levels of aggregation considered in the input-output elasticities of the production functions.

Moreover, we consider two different estimators (pooling OLS and random effects) for each productivity measure. Table 1, summarizes the list of productivity measures considered. Thus we obtain 10 different productivity measures (P_{it}) and we evaluate the impact of IC variables on each of them based on two estimation procedures, pooling OLS and RE. Table B.6 of the appendix reports the *correlations* for each of the (log) productivity measures obtained from the eight production functions estimated in 1-step and from the two Solow´s residuals respectively, whereas Tables B.7 and B.8 report the main descriptive statistics on the original sample and after correction for outliers of the productivity measures in logs and in levels respectively. Figures 35 and 36 plot the histograms of the restricted Solow residual and the productivity measure obtained from Cobb-Douglas single step estimation with unrestricted by industry coefficients, comparing in both cases the original sample and the sample without outliers.

The results for Chile are as follows: when we consider the correlations between the Solow residuals and the productivity measures that comes from estimating restricted production functions (see the second box of column one of Table B.6), the correlations are very similar in all the cases, ranging from 0.98 to 0.90. However, the unrestricted by industry production functions differ and therefore the correlations are much lower between those productivity measures (see the third box of column one of Table B.6), ranging from 0.76 in the unrestricted Cobb-Douglas case to a correlation of 0.09 in the unrestricted Translog OLS. With Solow´s unrestricted (by industry) productivity measures the correlations are much smaller. Therefore, the challenge is to get similar (robust) productivity elasticities for ICA variables even for those very different productivity profiles. The correlations between the Cobb-Douglas productivities and the Translog productivities are very high for the restricted aggregate case (the correlation is around 0.92) and lower for the unrestricted case, see the second column of Table B.6.

2.3.1 Restricted Coefficient Estimates (equal input-output elasticities across sectors)

i) Solow´s Residual (Two-step restricted estimation)

We can estimate the elasticity parameters of the IC variables once we have a measure of productivity (P_{it}). For that we obtain the Solow residuals ($\log P_{it}$) as in equation (3) and then estimate the impact of IC variables on $\log P_{it}$ through regression techniques. This two-step approach overcomes the endogeneity problem for the inputs.

From Table C.3 of the appendix we have the cost share of labor at 0.31, the cost share of intermediate materials at 0.59 and that of capital at 0.1. Notice, that the input-output elasticities add up to one since we are imposing the constant returns to scale (CRS) condition.

The empirical results of estimating equation (4) by OLS and random effects (RE) are in Table C.1 of the appendix and will be discussed later on.

ii) *Cobb-Douglas and Translog Productivities (Single-step restricted estimation)*

Consider now that the coefficients of the three inputs (L, M and K) of the Cobb-Douglas (1) and Translog (2) production functions are constant for the sectors and subsectors of Table A1. Each of the two equations is estimated in a single step, meaning that the parameters of the production function are estimated jointly with the parameters of the IC, C and D variables. However, to make the empirical results more readable we present them in separate tables in the appendix, see Tables C.1 and C.3.

In particular, for the Cobb-Douglas production function the empirical results from pooling OLS and random effects (RE) estimators are included in Tables C.3. The input-output elasticities of the Cobb-Douglas production function are: for labor between 0.29 (OLS) and 0.28 (RE), for intermediate materials is between 0.51 (OLS) and 0.49 (RE) and for capital is 0.20 (OLS) and 0.13 (RE). The constant returns to scale (CRS) condition is rejected for RE but not for OLS.

For the Translog production function, the empirical results obtained from the estimation by OLS and random effects (RE) are also presented in Table C.3 of appendix, even though the parameters were estimated in one step (jointly estimated) from (2). With the Translog functional form, the hypothesis that the production function is Cobb-Douglas specification is rejected by the data with a p-value of 0, as shown in Table C.3.

We then tested for CRS in the Translog specification and it was also rejected with the same p-value.

2.3.2 Unrestricted Production Function Coefficients (by sector and sub sector)

In the unrestricted case we allow the coefficients of the inputs (L, M and K) of the production function to vary by sector and sub sector. The definitions of the eight j sub sectors are included in Table A1 of the appendix.

i) Solow´s Residuals (Two-step unrestricted estimation)

First, the costs shares of each industry are reported in Table C.4. We can see that there is certain homogeneity among the eight sub sectors. Intermediate materials (M) always has the highest share, around 0.60 for all the sectors but for the information and technology (IT) services where the cost share of labor is higher than cost share of intermediate materials. For the rest of sectors the cost share of labor is t near 0.30 and the cost share of capital is around 0.10.

ii) Cobb-Douglas and Translog Productivities (Single-step unrestricted estimation by sector)

In this unrestricted case, the production functions specifications derived in equations (1) and (2) become the production functions for each sub sector j, j=1,2 ,...,8. Each equation is estimated by OLS and by random effects (RE) and the parameter estimates are reported in Table C.4 of the appendix. Once again, we separate the information on the production function elasticities from the information on the IC elasticities to make the tables more readable although all the parameters were jointly estimated.

For the Cobb-Douglas specification, OLS and random effects (RE) input-output elasticities tend to give similar results, except for in Metal products, IT-services and Farms and Fishing. The decision on constant returns to scale (CRS) is mixed.

Similar single-step procedures are used to estimate the Translog specification (2) at the industry level. The results are included in Table C.5. We tested the null hypothesis of constant returns to scale (CRS) in each sector and the decision is mixed. Furthermore, we tested the Cobb-Douglas specification using equation (2) and was rejected in all sectors.

Two explanatory variables, exports and foreign direct investment, of the productivity equations are endogenous (as will become clear later on) and could create important simultaneous equation biases and inconsistencies. To evaluate the magnitude and the implications in terms of the IC elasticity estimates we estimated those equations using instrumental variables. We use as instruments region industry averages of IC variables and other control variables. The estimation results in terms of two stage least squares (2SLS) are included in Table C.2b. The selected instruments are correlated with the two endogenous variables since the null hypothesis of uncorrelation is rejected (F-test) with p-value equal to 0. At the same time the over identification restrictions are not rejected indicating that those instruments are not correlated with the regression errors. Notice that the significance, the signs and the magnitudes of the IC elasticities of Tables C.1 and C.2 estimated by least squares (pooling OLS and GLS) are very similar to those of Table C.2b, estimated by 2SLS.

In the next subsections, we present the individual estimates of the elasticities or semi-elasticities of IC variables on productivity for Chile.

2.4 Estimated IC-Productivity Elasticities and Semi-Elasticities

The econometric analysis based on the 10 different productivity (P) measures is explained in the rest of this section. The units of measurement of each explanatory variable are included in Tables B.5 (I) and B.5 (II) of the appendix. But, before discussing the effects of different IC variables on productivity, it is important to take into account that the economic interpretation of each investment climate coefficient is contingent on the units of measurement of each IC variable and on the transformations performed on them (logs, fractions, percentages, qualitative constructions, etc.). Since productivity measures are always in logs, when the IC variable is expressed in log terms, the estimated coefficient is the constant *productivity-IC elasticity*; and when the IC variable is not expressed in log form, the estimated coefficient is generally described as a *productivity-IC semi-elasticity*[7]. While the constant productivity-IC

[7] While it is sometimes natural to express an IC variable in log form, for some types of IC variables it is more appropriate not to do so. For example, if IC variables are fractions or percentage numbers with some data equal to 0. However, expressing IC variables in fractions allow us to approximate their coefficients as constant elasticities and not as semi-elasticities.

elasticity measures the percentage change in productivity induced by a percentage change in the IC variable, the semi-elasticity coefficient multiplied by 100, measures the percentage change in productivity induced by a unitary change in the IC variable. Notice that within each group, most of the IC variables of Tables C.1 and C.2 have the expected signs and the estimated elasticities or semi-elasticities are within a reasonable range of values for the 10 productivity measures considered, as will be explained in subsection 2.4. The empirical results are robust since the signs of all of the ICA variables are equal and the range of values of the elasticities are reasonable.

Here we briefly discus the interpretation of the estimated elasticities or semi-elasticities of IC variables on productivity. A summary of the estimated values of the elasticities and semi-elasticities of productivity with respect to investment climate variables is provided in Figure 2. For each significant IC variable, we represent the average values of the pooling OLS elasticity estimates given in Tables C.1 and C.2. For each group of IC variables we could have given the range of values of the productivity impacts obtained for the elasticities (minimum and maximum values) coming from the different productivity measures used. But instead, for simplicity of the interpretation, we give in Figure 2 the average levels of the OLS elasticities or semi-elasticities of each IC variable, listed under the four thematic categories of IC variables. Additional grouping of other control variables is also included.

Figure 2 shows that the largest marginal effect comes from *Experience of the manager,* which elasticity is 0.26 meaning that if the experience of the manager increases by 1% productivity will increase by 0.26%. *Foreign direct investment* has also considerable marginal effect, being in this case the value of the semi-elasticity 0.23; therefore the productivity is 23% higher in firms that received foreign direct investment.

In the next subsection we evaluate, at different levels of aggregation, the impact of IC variables on several measures of economic performance.

2.5 Further Robustness: 2SLS Estimation and Recent Productivity Estimation Procedures based on Levinsohn and Petrin´s (L&P) and on Ackerberg and Caves´s (A&C).

In this section we comment the results obtained from estimating IC elasticities and semi-elasticities with respect to productivity by using 2SLS included in Table C.2b. By applying the Hausman test for endogeneity on the explanatory variables we found that the test does not reject the null hypotheses of exogenous regressor for *Export* and *FDI* variables. To control for the endogeneity of these variables several IC variables that do not enter the equation are considered as instruments for the 2SLS estimation. The correlation between productivity and those IV is supported through the F-test with a p-value equal to 0. The over identification restrictions (Hansen´s test) fail to reject the null hypothesis that all the instruments but one are uncorrelated with the regression errors. The whole list of instruments used is included in Table C.2b. Results shows that previous results on IC effects are robust to 2SLS estimation.

We also want to show that the previous results are robust to recent productivity estimation procedures proposed by Levinsohn and Petrin (2003) and Ackerberg and Caves (2003). We introduce a modification on both approaches, L&P and A&C, to control for the IC effects on the two steps.

The empirical results are in Table C.2c of the appendix. The input-output elasticities on labor (L), intermediate materials (M) and capital (K) are reported, together with the cost shares from Solow´s residuals and the OLS based on the Cobb-Douglas production function. The values of the estimated input-output elasticities vary but their impact is not affecting the IC elasticities reported in Table C.2c. Therefore, we conclude that for policy recommendations, this econometric methodology reports robust empirical IC elasticities and semi-elasticities for several measures of economic performance.

2.6 Econometric Methodology for Investment Climate and Productivity Analysis on: Wages, Employment, the Probability of Exporting and the Probability of Receiving Foreign Direct Investment

As was mentioned before, we are interested in having productivity measures that are robust for the evaluation investment climate. We found robust results for all the productivity measures used (10 in total). Therefore, we can concentrate on the analysis of two of the productivity measures; the Solow´s residuals (TFP) from the restricted case and from the unrestricted by industry case. The two-step estimation procedure is the following: First, we obtain the Solow´s residuals with constant input-output elasticities, at the aggregate level and second we estimate the equation to evaluate the impact of IC variables on those total factor productivity measures (TFP_{it}).

First-step, generate Solow´s residuals (see Solow (1967)) as residuals from equation,

$$\log Y_{j,i\,t} = \bar{s}_L \log L_{j\,i\,t} + \bar{s}_M \log M_{j\,i\,t} + \bar{s}_K \log K_{j,i\,t} + \log TFP_{j,i\,t} \qquad (5)$$

where $\bar{s}_r$ is the average cost share of each input r = L, M and K, over the last two years given by $\bar{s}_r = \frac{1}{2}(\underline{s}_{\,r,t} + \underline{s}_{\,r,t-1})$, and $\underline{s}_{\,r,t}$ is the average cost share of each input taken across the entire sample of plants from the seven countries (restricted case) in year t.

In the unrestricted TFP case, we allow the coefficients of the inputs (L, M and K) of the production function to vary industry by industry. For this (unrestricted) case we obtain the cost share ($\bar{s}_{rj}$) of each input r = L, M and K, for each of the eight sectors, j=1, 2… 8.

In order to model the relationship between infrastructure and other IC and control (C) variables on several measures of economic performance we use the following simultaneous equations system.

Second-step, estimate the following structural simultaneous equations system for panel data:

The productivity equation,

$$\log P_{j\,i\,t} = a_P + a_{P,i} + a'_{Ds} D_j + a'_{DT} D_t + e_{P,j\,i,t} \qquad (6.1a)$$

$$a_{P,i} = a'_{IC} IC_i + a'_C C_i + v_{P,i}\,. \qquad (6.1b)$$

Labor demand equation,

$$LogL_{j,it} = g_L + a_{L,i} + g_P\ LogP_{j,it} + g_w\ LogW_{j,it} + g'_{Ds} D_j + g'_{DT} D_t + e_{L,j,it} \qquad (6.2a)$$

$$a_{L,i} = g'_L IC_i + g'_C C_i + v_{L,i}\,. \qquad (6.2b)$$

The wage (earnings) equation,

$$\text{LogW}_{j,it} = b_W + a_{W,i} + b_P \text{ LogP}_{j,it} + b'_{Ds} D_j + b'_{DT} D_t + e_{W,j,it} \quad (6.3a)$$

$$a_{W,i} = b'_{IC}\text{IC}_i + b'_C \text{C}_i + \text{v}_{W,i}\,. \quad (6.3b)$$

Probability of exporting equation,

$$y^{Exp}_{jit} = d_{Exp} + a_{Exp,i} + d_P \log P_{jit} + d'_{Ds} D_j + d'_{DT} D_t + e_{Exp,j\,i,t} \quad (6.4a)$$

$$a_{Exp,i} = d'_{IC}\text{IC}_i + d'_C C_i + \text{v}_{Exp,i}\,. \quad (6.4b)$$

Probability of receiving foreign direct investment equation,

$$y^{FDI}_{jit} = r_{FDI} + a_{FDI,i} + r_P \log P_{jit} + r'_{Ds} D_j + r'_{DT} D_t + e_{FDI,j,it} \quad (6.5a)$$

$$a_{FDI,i} = r'_{IC}\ \text{IC}_i + r'_C C_i + \text{v}_{FDI,i}\,. \quad (6.5b)$$

By substituting the usually unobserved fixed effects components by their corresponding equation we can simplify the system of equations to:

The productivity equation is,

$$\log P_{jit} = a_P + a'_{IC}\text{IC}_i + a'_C C_i + a'_{Ds} D_j + a'_{DT} D_t + (\text{v}_{P,i} + e_{P,j,it}) \quad (7.1)$$

Labor demand equation is,

$$\text{LogL}_{j,it} = g_L + g_P \log\text{P}_{j,it} + g_w \log\text{W}_{j,it} + g'_L \text{IC}_i + g'_C \text{C}_i + g'_{Ds} D_j + g'_{DT} D_t + (\text{v}_{L,i} + e_{L,j,it}) \quad (7.2)$$

The wage (earnings) equation is,

$$\text{LogW}_{j,it} = b_W + b_P \log\text{P}_{j,it} + b'_{IC}\text{IC}_i + b'_C \text{C}_i + b'_{Ds} D_j + b'_{DT} D_t + (\text{v}_{W,i} + e_{W,j,it}) \quad (7.3)$$

The probability of exporting equation is,

$$y^{Exp}_{jit} = d_{Exp} + d_P \log P_{jit} + d'_{IC}\text{IC}_i + d'_C C_i + d'_{Ds} D_j + d'_{DT} D_t + (\text{v}_{Exp,i} + e_{Exp,j\,i,t}) \quad (7.4)$$

The probability of receiving foreign direct investment equation is,

$$y^{FDI}_{jit} = r_{FDI} + r_P \log P_{jit} + r'_{IC}\ \text{IC}_i + r'_C C_i + r'_{Ds} D_j + r'_{DT} D_t + (\text{v}_{FDI,i} + e_{FDI\,j\,i,t}) \quad (7.5)$$

Notice that since the variable $y^r_{j,it}$, with r = Exp or FDI, is a *binary random variable* taking only 0 and 1 values, then $P(y^r_{jit} = 1/x) = E(y^r_{jit}/x)$, the conditional probability is equal to the conditional expectation which is usually assumed to follow a PROBIT or a LOGIT model, and the conditional variance (heteroskedasticity) is equal to the product of the conditional probabilities of the two events. In general, the linear probability models (LPM) approximate well the PROBIT and LOGIT nonlinear models when the variables are evaluated at their sample mean. Since we are interested in the mean IC contribution relative to the mean values of the dependent variables of (7.1) to (7.5), we will concentrate on linear probability specifications, like (7.4) and (7.5). The main advantage of the LPM is in its simplicity since the parameters of the explanatory variables of (7.4) and (7.5) measure the change in probability when one of the explanatory variables changes, holding the rest of the explanatory variables constant. This is important for the economic interpretation of the coefficients obtained in the empirical section.

We assume that the error terms of each equation ($v_{r,i}+e_{r,j,it}$) are uncorrelated with all the explanatory variables of each equation r, where r=P, Exp, FDI, W and L. However, for certain explanatory variables this exogeneity condition is not satisfied. The endogeneity of certain IC variables induces a correlation between those IC variables and the errors ($v_{r,i}+e_{r,j,it}$) of the system of equations (7.1) to (7.5) and creates simultaneous equation biases and inconsistencies in least squares estimators, like pooling OLS or in random effects (RE) estimators. This correlation is in general mitigated by replacing those plant-level IC variables by their region-industry averages ($\overline{IC}_j$), as we have seen before. However, for some other explanatory variables like productivity, wages, exports and FDI, the endogeneity is intrinsic due to the simultaneous structure of the system of equations. Therefore, we will estimate each equation by instrumental variables (IV) techniques based on two stages least squares (2SLS) procedures using heteroskedasticity-robust standard errors. We could have used 3SLS, which is more efficient than 2SLS under correct specification. However, since with system of equations estimation techniques the misspecification of one equation affects the whole system, we believe that the results from 2SLS are more robust.

2.6.1 Identification Issues

To discuss the identification issues underlying the system of equations proposed it is useful to apply matrix notation in this sub-section. The structural form of the system of (7.1) to (7.5) is given by

$$\mathbf{?\,y_t} + \mathbf{?\,x_t} = \mathbf{u_t} \qquad (8)$$

where $\mathbf{y_t}$ is the 5×1 vector of observations of the *endogenous* variables (log-productivity, log-employment, log-wage, y_{it}^{Exp} and y_{it}^{FDI}); $\mathbf{x_t}$ is the 92×1 vector of observations on the *exogenous* variables (IC_i, C_i, D_j and D_t); $\mathbf{u_t}$ is the 5×1 vector of errors; **?** is a 5×5 matrix of coefficients of the *endogenous* variables; **?** is a 5×92 matrix of coefficients of the exogenous variables.

We can rewrite (8) as

$$\mathbf{?\,y_t} = \begin{pmatrix} 1 & a_{P,L} & a_{P,W} & a_{P,Exp} & a_{P,FDI} \\ a_{L,P} & 1 & a_{L,W} & a_{L,Exp} & a_{L,FDI} \\ a_{W,P} & a_{W,L} & 1 & a_{W,Exp} & a_{W,FDI} \\ a_{Exp,P} & a_{Exp,L} & a_{Exp,W} & 1 & a_{Exp,FDI} \\ a_{FDI,P} & a_{FDI,L} & a_{FDI,W} & a_{FDI,Exp} & 1 \end{pmatrix} \begin{pmatrix} \log P_{it} \\ \log L_{it} \\ \log W_{it} \\ y_{it}^{Exp} \\ y_{it}^{FDI} \end{pmatrix} = -\mathbf{?\,x} + \mathbf{u_t}$$

Since we are impossing that employment has not affect in any other equation of the system and real wages only appears in employment demand as explanatory variable, matrix A is reduced to

$$\mathbf{?\,y_t} = \begin{pmatrix} 1 & 0 & 0 & a_{P,Exp} & a_{P,FDI} \\ a_{L,P} & 1 & a_{L,W} & a_{L,Exp} & a_{L,FDI} \\ a_{W,P} & 0 & 1 & a_{W,Exp} & a_{W,FDI} \\ a_{Exp,P} & 0 & 0 & 1 & a_{Exp,FDI} \\ a_{FDI,P} & 0 & 0 & a_{FDI,Exp} & 1 \end{pmatrix} \begin{pmatrix} \log P_{it} \\ \log L_{it} \\ \log W_{it} \\ y_{it}^{Exp} \\ y_{it}^{FDI} \end{pmatrix}$$

and therefore

$$\begin{pmatrix} \log P_{it} - a_{P,Exp} y_{it}^{Exp} - a_{P,FDI} y_{it}^{FDI} \\ \log L_{it} - a_{L,P} \log P_{it} - a_{L,W} \log W_{it} - a_{L,Exp} y_{it}^{Exp} - a_{L,FDI} y_{it}^{FDI} \\ \log W_{it} - a_{W,P} \log P_{it} - a_{W,Exp} y_{it}^{Exp} - a_{W,FDI} y_{it}^{FDI} \\ y_{it}^{Exp} - a_{Exp,P} \log P_{it} - a_{Exp,FDI} y_{it}^{FDI} \\ y_{it}^{FDI} - a_{FDI,P} \log P_{it} - a_{FDI,Exp} y_{it}^{Exp} \end{pmatrix} = \mathbf{-BX_t} + \mathbf{u_t}$$

The rank condition is a necessary and sufficient condition for the system (8) to be identified. To discuss whether the rank condition is satisfied in the first equation, says productivity equation, let $\mathbf{a}'$ be the first row of **?** and $\mathbf{ß}'$ the first row of **?** . We may now partition these vectors into two components corresponding to the included ($\mathbf{a}_1'$ and $\mathbf{ß}_1'$) variables and excluded ($\mathbf{a}_2'$ and $\mathbf{ß}_2'$) variables in productivity equation such that

$$\mathbf{A} = \begin{bmatrix} \mathbf{a}_1' & \mathbf{0} \\ \mathbf{A}_1 & \mathbf{A}_2 \end{bmatrix} \quad \text{and} \quad \mathbf{?} = \begin{bmatrix} \mathbf{ß}_1' & \mathbf{0} \\ \mathbf{B}_1 & \mathbf{B}_2 \end{bmatrix},$$

which allow us to construct the next matrix

$$\mathbf{D} = \begin{bmatrix} \mathbf{0} & \mathbf{0} \\ \mathbf{A}_2 & \mathbf{B}_2 \end{bmatrix}$$

By the rank condition, productivity equation is identified if $rank(\mathbf{D}) = 5 - 1$. The same holds for the other equations of the system.

Thus, we have several exclusion restrictions in matrix **?** , nevertheles these restrictions are not enough to ensure the rank condition to be satisfied. Therefore, we also must restrict the coefficient of several variables in matrix **?** to be 0 prior to start estimating the system. The list of variables restricted and the proof that rank condition is satisfied for each equation are in appendix C.

2.7 IC-Elasticities on Employment. Is Productivity Affecting the Employment Demand?

The objective is to estimate the impact of IC variables on employment demand, based on equation (7.5) under alternative productivity measures. To control for the endogeneity of productivity several instruments using region-industry averages of the IC variables are considered for the 2SLS estimation. The correlation between productivity and those IV is supported through the F-test with a p-value equal to 0. The over identification restrictions (Hansen´s test) fail to reject the null hypothesis that all the instruments but one are uncorrelated with the regression errors. See the last two rows at the end of Table D.1. The average of the estimated employment demand elasticities are plotted in Figure 3 of the appendix.

The average of the estimated employment demand elasticities are plotted in Figure 3 of the appendix. The largest marginal effects come from *Small* and *Medium*, which semi-elasticities are -1.89 and -1. The effect of productivity is negative, being the elasticity -0.09, therefore if productivity increases by 1% employment will decrease by 0.09% on average.

2.8 IC-Elasticities on Wages: Are Productivity Gains Translated to Wages?

In order to evaluate the impact that productivity and IC variables have on wages we estimate the wage equation (7.4). The selection of the significant IC variables in equation (8) goes from the general to the specific, as was done with equations (7.1) - (7.3), in order to avoid the biases and inconsistencies generated by omitted variables.

Equation (8) is estimated by instrumental variables (IV) to control for the endogeneity of productivity. In particular we use two stage least squares (2SLS) estimation procedures. As instruments we use some of the region-industry averages of IC variables since they are correlated with productivity. The F-test of joint insignificance is rejected with a p-value of 0. On the other hand, Hansen´s test on the over identification restrictions cannot reject the null hypothesis that all the instruments minus one are uncorrelated with the regression errors. See the last rows of Table D.2.

The IC elasticities given in Table D.2, show similar numbers and equal signs for all the elasticity estimates. Therefore, the ICA wage estimation results are robust across productivity measures, even when the correlation between those productivity measures is small. See Table B.6 of the appendix. Figure 4 plots the average values of the wage elasticities and semi-elasticities of each IC and C variable. Productivity elasticity is 0.48, meaning that an increase of productivity by 1% will cause an increase in real wage by 0.48%.

2.9 IC-Elasticities on the Probability of Exporting

The results of the 2SLS estimation of the linear probability model of equation (7.2), with heteroskedasticity-robust standard errors, are included in Table D.1 of the appendix. The results on the investment climate (IC) effects on the probability of exporting are as expected and the results are robust for both productivity (TFP) measures. Productivity is the endogenous variable and it instrumented by several IC variables where most of them are region-industry averages. The F-tests presented at the end of Table D.1 reject the null hypothesis of uncorrelation between productivity and the list of instruments with a p-value of 0. The over identification restrictions (Hansen test) are not rejected indicating that there is no evidence of correlation between all the instruments minus one and the regression errors.

Figure 5 of the appendix reports the average values of the estimated IC coefficients that are reported in Table D.1 from the estimation of equation (7.2) with two different TFP measures. The elasticity of productivity is 0.03 meaning that if productivity increases by 1% the probability of becoming exporter increases by 0.03%.

2.10 IC-Elasticities on the Probability of Receiving Foreign Direct Investment

The results of the 2SLS estimation of the linear probability model of equation (7.3), with heteroskedasticity-robust standard errors, are included in Table D.2 of the appendix. The results on the investment climate (IC) effects on the probability of receiving foreign direct invstment are as expected and are robust for both productivity (TFP) measures. Productivity is endogenous and it is therefore instrumented by several IC variables where most of them are region-industry averages. The F-tests presented at the end of Table D.1 reject the null hypothesis of uncorrelation between productivity and the list of instruments with a p-value of 0. The over identification restrictions (Hansen test) are not rejected indicating that there is no evidence of correlation between all the instruments minus one and the regression errors. Figure 6 of the appendix reports the average values of the two estimated IC coefficients that are reported in Table D.2 from the estimation of equation (7.3) with two different TFP measures. Productivity elasticity is 0.03, thus if productivity increases by 1% the probability of receiving FDI increases by 0.03%.

2.11 More on Marginal Effects: Parameters of the System of Equations in Reduced Form

We come back to the matrix notation to express the system in *structural form* of equation (8) in its *reduced form*

$$\mathbf{y_t = -A^{-1}?\ x_t + A^{-1}u_t = ?\ x_t + v_t} . \qquad (9)$$

Matix **?** contains the reduced form parameters, and give us the *net effects* of the system between *endogenous* and *exogenous* variables.

Notice that since productivity and employment are affected by IC and C variables we also can include the production function to the system of equations and thus compute the net effects of IC and C variables have on the output (sales) through productivity and employment. The net effect of variable IC_{it}^{m} on log sales is given by $\frac{\partial \log Y}{\partial IC_{it}^{m}} = \hat{a}_L(\hat{g}_L^{IC^m}) + \hat{a}_{IC^m}$, where $\hat{a}_L$ is the input-output elasticity of employment (approximated by the corresponding cost-share of the restricted Solow residual case), $\hat{g}_L^{IC^m}$ is the marginal effect of IC_{it}^{m} on employment, and $\hat{a}_{IC^m}$ is the marginal effect of IC_{it}^{m} on productivity.

Table H.2 reports the results of equation (9). As coefficients of the structural form we used those provided in Figures 1 to 5. A zero indicates that although the net effect of that variable on the corresponding endogenous variable exists, it is lower than 0.001 and therefore almost insignificant. It must be pointed out that now most IC and C variables have a net effect on the endogenous variables. It is important to note that no variables change the sign of the effect.

3. The Olley and Pakes Decomposition: IC Productivity Contribution to the Mean component and to the Allocative Efficiency component.

To complement the productivity analysis based on regression techniques we perform the allocation efficiency decomposition of Olley and Pakes (1996). This analysis is especially interesting when the number of firms in some sectors have small number of observations on IC variables. In those cases, we cannot give much credibility to the sector-by-sector regression estimates of the impact of IC variables on productivity since they are based on very small samples. This decomposition provides additional information which is useful for the sector or industry efficiency allocation analysis is within each country.

The Olley and Pakes (1996) decomposition of productivity, (O&P), has two elements; the average productivity and the efficiency or covariance term. As will become clear later on, the O&P decompositions would allows us to do a sector by sector, region by region, etc., evaluation of the impact of IC variables on average productivity and on efficiency without requiring further parameter estimation with fewer observation.

Let $P_{jt} = \sum_{i=1}^{N_{jt}} s^{Y}_{j,it} P_{j,it}$ be the aggregate productivity of industry j at time t obtained as the weighted average of i-plant-level productivity ($P_{j,it} = \exp(\log P_{j,it})$) in sector j at year t, where N_{jt} is the number of firms in sector j where j = 1, ... ,8 at time t. The weights ($s^{Y}_{j,it}$) indicate the share of sales of firm i in year t over the total sales (Y) of sector j of that year ($s^{Y}_{j,it} = \frac{Y_{jit}}{\sum_{i=1}^{N_{j,t}} Y_{jit}}$).

Let $\overline{P}_{jt} = \frac{1}{T}\sum_{i=1}^{N_{jt}} P_{jit}$ be the sample average productivity of the firms of sector j in year t. Then the annual aggregate productivity of industry j can be decomposed as in (10) where $\tilde{s}^{Y}_{j,it} = (s^{Y}_{jit} - \overline{s}^{Y}_{j,t})$ and $\tilde{P}_{j,it} = (P_{j,it} - \overline{P}_{j,t})$ are in deviations to the mean. Notice that $\overline{s}^{Y}_{j,t} = \frac{1}{N_{jt}}$ the Olley and Pakes (1996) decomposition (O&P) in levels is:

$$P_{jt} = \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}^{Y}_{jit} \tilde{P}_{jit} \,. \qquad (10)$$

The first term ($\overline{P}_{jt}$) is the *average productivity* of industry j in year t and the second term ($\sum_{i=1}^{N_{jt}} \tilde{s}^{Y}_{jit} \tilde{P}_{jit}$) = N_{jt} $\mathrm{cov}(s^{Y}_{j,it}, P_{jit})$, measures the *allocative efficiency* or covariance between the share of sales and productivity, $\mathrm{cov}(s^{Y}_{j,it}, P_{jit})$, multiplied by the number of firms, N_{jt}, that belong to sector j in year t. If the covariance is positive, then the larger it is, the higher will be the share of sales that goes to more productive firms, allocation efficiency is increased and sector j productivity is enhanced. If the covariance is negative, there are allocation inefficiencies since the more negative the covariance is, the higher will be the share of output that goes to less productive firms, reducing sector j productivity.

Similarly we can compute the aggregate productivity of sector j but in logs. Let $\log P_{jt} = \sum_{i=1}^{N_{jt}} s_{jit}^{\log Y} \log P_{jit}$ be the aggregate log productivity of industry j at time t obtained as the weighted average of ~~i~~plant log productivity in sector j at year t, where N_{jt} is the number of firms in sector j where j = 1, ... ,8. The weights ($s_{jit}^{\log Y}$) indicate the share of firm i log sales (logY) in year t over the total log sales of sector j of that year ($s_{jit}^{\log Y} = \frac{\log Y_{jit}}{\sum_{i=1}^{N_{j,t}} \log Y_{jit}}$). Let

$\log \overline{P}_{jt} = \frac{1}{T}\sum_{i=1}^{N_{jt}} \log P_{jit}$ be the sample average log productivity of the firms of sector j in year t. Then the annual aggregate log productivity of industry j can be decomposed as in (9) where $\tilde{s}_{jit}^{\log Y} = (s_{jit}^{\log Y} - \overline{s}_{j,t}^{\log Y})$ and $\log \tilde{P}_{jit} = (\log P_{jit} - \log \overline{P}_{j,t})$ are in deviations to the mean. Notice that since $\overline{s}_{j,t}^{\log Y} = \frac{1}{N_{jt}}$ then the O&P decomposition in logs becomes,

$$\log P_{jt} = \log \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}_{jit}^{\log Y} \log \tilde{P}_{jit} \ . \qquad (11)$$

The first term ($\log \overline{P}_{jt}$) is the *average log productivity* of industry j in year t and the second term ($\sum_{i=1}^{N_{jt}} \tilde{s}_{\log Y, j, it} \log \tilde{P}_{jit}$) $= N_{jt} \operatorname{cov}(s_{\log Y, jit}, \log P_{jit})$, measures the *allocative efficiency* between variables in logs. As will become clear later on, the decomposition (11) has several advantages over (10) in terms of explanatory power of the investment climate (IC) variables on each of the two terms of aggregate productivity.

For each aggregation level, we construct a measure of aggregate productivity and we apply the alternative Olley and Pakes (O&P) decompositions. The particular productivity measure that we select is not important if the empirical results are robust for all the measures. In particular, we apply the Olley and Pakes productivity decompositions (10)-(11) to the Solow residuals, see equation (3), at five different levels of aggregation; aggregate level, by sector, by region, by size of the firms, by age of the firms, etc.

Empirical Results

Figures 7.1 to 7.4 report the results of the O&P decomposition in levels at industry, region, size and age and year aggregation levels. By industry *IT services* has the largest aggregate productivity followed by *Chemicals*. Efficiency term becomes more relevant in *IT services*, whereas in *Machinery and Equipment* and *Paper Products* its role is marginal. By regions *Santiago* is the more productive region, having the efficiency term a key role. By size and age, Large and Young firms are the most productive. By year, the productivity decreases in 2003.

Figures 8.1 to 8.4 show the results of the O&P decomposition in logs at different aggregation levels. It must be pointed out that the efficiency term measured in logs becomes almost insignificant, being almost equivalent measuring average productivity to measuring aggregate productivity in logs. Thus the interest of such decomposition is in the average productivity and not in the efficiency term. The question now is whether average productivity in logs approximate well average productivity in levels. Figures 7.5 to 7.8 compare average productivity both in levels and in logs; in spite of the different magnitudes average productivity in logs is proportional to its counterpart in levels, maintaining this proportions at different aggregation levels. This interesting result is very useful when we want to perform decompositions of productivity in terms of IC and C variables, as will become clear in sections 4 and 5.

4. ICA-Evaluation on the O&P Decomposition

In section 3 by following Olley and Pakes (1996) we have decomposed aggregate productivity both in levels and in logs into two terms, average productivity and *allocative* efficiency (or covariance) term. In this section our aim is to deal in depth with these decompositions and go one step beyond so that we are able to evaluate the impact of each IC and control (C, D) variables on average productivity, on the efficiency (covariance) term and as a result on aggregate productivity. To do that, we propose a decomposition of productivity in logs and another approximate decomposition of productivity in levels. In addition, in sub-section 4.3 for comparison purposes we also evaluate the effect of IC and C variables on productivity by simulating changes in those variables. Finally, sub-section 4.4 resumes and compares all results obtained.

4.1 Aggregate Productivity Decomposition in Logs in Terms of IC variables and an Alternative Input Decomposition

Consider the O&P decomposition of aggregate productivity of sector j based on variables in logs, see equation (9),

$$P_{jt} = \sum_{i=1}^{N_{jt}} s_{j,i\,t}^{\log Y} \log P_{j,i\,t} = \log \bar{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}_{j,i\,t}^{\log Y} \log \tilde{P}_{j,i\,t} \tag{12}$$

where $s_{j\,i\,t}^{\log Y} = \log Y_{j,i\,t} \left(\sum_{i=1}^{N_{jt}} \log Y_{jit} \right)^{-1}$. Writing the Solow´s residuals from equation (3), or the productivity term of the Cobb-Douglas production function (1), with variables in deviation to their means we have,

$$\begin{aligned}(\log Y_{j\,i\,t} - \log \bar{Y}_{jt}) = a_L(\log L_{j\,i\,t} - \log \bar{L}_{jt}) + a_M(\log M_{j\,i\,t} - \log \bar{M}_{jt}) + a_K(\log K_{j\,i\,t} - \log \bar{K}_{jt}) \\ + (\log P_{j\,i\,t} - \log \bar{P}_{jt}).\end{aligned} \tag{13}$$

Multiplying by $(\log P_{j,i\,t} - \log \bar{P}_{jt})$ and dividing by $\sum_{i=1}^{N_{jt}} \log Y_{it}$ on sides, forming their corresponding sample averages and assuming that the inputs are *endogenous* we get, [8]

[8] If the inputs $\log L_{j,it}$, $\log M_{j,it}$ and $\log K_{j,it}$ are *exogenous* so that their covariances with $\log P_{j,it}$ are equal to zero, then

$$\hat{c}ov(s_{j,i\,t}^{\log Y}, \log P_{it}) = \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{it}} \hat{c}ov(\log Y_{it}, \log P_{it}) = \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{it}} \hat{v}ar(\log P_{it})$$

and the O&P decomposition (9) in logs is reduced to,

$$\log P_{jt} = \sum_{i=1}^{N_{jt}} s_{j\,i\,t}^{\log Y} \log P_{it} = \log \bar{P}_{jt} + \sum_{i=1}^{N_{jt}} (\log P_{j,i\,t} - \log \bar{P}_{jt})^2$$

That is, the aggregate log productivity of the sector-industry j, is given by the sum of two components; average log productivity and N_{jt} times the sample variance of log productivity of the firms of sector j.

$$\hat{cov}(s_{jit}^{\log Y}, \log P_{jit}) = a^*_L \hat{cov}(\log L_{jit}, \log P_{jit}) + a^*_M \hat{cov}(\log M_{jit}, \log P_{jit}) + a^*_K \hat{cov}(\log K_{jit}, \log P_{jit}) + \\ + \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{jit}} \hat{var}(\log P_{jit}). \qquad (14)$$

where $a^*_L = a_L \left(\sum_{i=1}^{N_{jt}} \log Y_{jit} \right)^{-1}$, $a^*_M = a_M \left(\sum_{i=1}^{N_{jt}} \log Y_{jit} \right)^{-1}$ and $a^*_K = a_K \left(\sum_{i=1}^{N_{jt}} \log Y_{jit} \right)^{-1}$.[9]

So far we have derived an expression of the covariance term of the O&P decomposition in logs as a weighted sum of the covariances of each input (logL, logM and logK), with log-productivity plus a constant proportion term of the sample variance of log-productivity. However, we are interested on reaching an expression of the covariance term in terms of IC and control (C, D) variables. To do that we express the estimated productivity equation (4) in deviations to the mean, this leads to

$$(\log P_{jit} - \log \overline{P}_{jt}) = \hat{a}'_{IC}(IC_{j,i} - \overline{IC}_j) + \hat{a}'_C(C_{j,i} - \overline{C}_j) + \hat{a}'_{Ds}(D_j - \overline{D}_j) + \hat{a}'_{DT}(D_t - \overline{D}_t) + \hat{u}_{jit} \qquad (15)$$

For simplicity in the notation we now replace that IC_i, C_i D_j and D_t by IC_i, C_i, D_j and D_t representing scalars instead of vectors; hence we would be handling only one IC, C, D_j and D_t variables. Substituting (15) in the O&P efficiency term of equation (11) we get a decomposition of the allocative efficiency component in terms of IC variables, control (C) variables, sector dummies (D_j), year dummies (D_t) and the productivity residuals ($\hat{u}_{it}$),

$$\sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y} \log \tilde{P}_{jit} = \hat{a}_{IC} \sum_{i=1}^{N_{jt}} \tilde{s}_{jit}^{\log Y} (IC_{j,i} - \overline{IC}_j) + \hat{a}_C \sum_{i=1}^{N_{jt}} \tilde{s}_{jit}^{\log Y} (C_{j,i} - \overline{C}_j) + \\ + \hat{a}_{Ds} \sum_{i=1}^{N_{jt}} \tilde{s}_{jit}^{\log Y} (D_j - \overline{D}_j) + \hat{a}_{DT} \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y} (D_t - \overline{D}_t) + \sum_{i=1}^{N_{jt}} \tilde{s}_{jit}^{\log Y} \hat{u}_{jit} \qquad (16)$$

Substituting (16) in (12) and taking into account that

$$\log P_{jit} = \hat{a}_{IC} IC_{j,i} + \hat{a}_C C_{j,i} + \hat{a}_{Ds} D_j + \hat{a}_{DT} D_t + \hat{a}_P + \hat{u}_{jit} \qquad (17)$$

---

[9] The estimation of the input-output elasticities, a_L, a_M and a_K can be obtained from equation (1) or from their corresponding cost shares, see equation (3).

and therefore

$$\log \overline{P}_{jt} = \hat{a}_{IC}\overline{IC}_j + \hat{a}_C\overline{C}_j + \hat{a}_{Ds}\overline{D}_j + \hat{a}_{DT}\overline{D}_t + \hat{a}_P + \overline{\hat{u}}_{jit} \tag{18}$$

and being $\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, J_{jit}) \equiv \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y}(J_{jit} - \overline{J}_{j,t})$ with $J_{j,it} = IC_{j,i},\ C_{j,i},\ D_j,\ D_t$ and u_{jit},

we have

$$\begin{aligned} P_{j,t} &= \hat{a}_{IC}\overline{IC}_j + \hat{a}_C\overline{C}_j + \hat{a}_{Ds}\overline{D}_j + \hat{a}_{DT}\overline{D}_t + \hat{a}_P + \overline{u}_{jit} + \hat{a}_{IC}\,\hat{\text{c}}\text{ov}(s_{jit}^{\log Y}, IC_{j,i}) + \hat{a}_C\,\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, C_{j,i}) \\ &+ \hat{a}_{Ds}\,\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, D_j) + \hat{a}_{DT}\,\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, D_T) + \hat{\text{c}}\text{ov}(s_{jit}^{\log Y}, \hat{u}_{jit}) \end{aligned} \tag{19}$$

Equation (19) relative to aggregate productivity becomes

$$\begin{aligned} 100 &= \frac{\hat{a}_{IC}\overline{IC}_j}{P_{jt}}100 + \frac{\hat{a}_C\overline{C}_j}{P_{jt}}100 + \frac{\hat{a}_{Ds}\overline{D}_j}{P_{jt}}100 + \frac{\hat{a}_{DT}\overline{D}_t}{P_{jt}}100 + \frac{\hat{a}_P}{P_{jt}}100 + \frac{\overline{u}_{jit}}{P_{jt}}100 + \frac{\hat{a}_{IC}\,\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, IC_{j,t})}{P_{jt}}100 \\ &+ \frac{\hat{a}_C\,\hat{\text{c}}\text{ov}(s_{jit}^{\log Y}, C_{j,i})}{P_{jt}}100 + \frac{\hat{a}_{Ds}\,\hat{\text{c}}\text{ov}(s_{jit}^{\log Y}, D_j)}{P_{jt}}100 + \frac{\hat{a}_{DT}\,\hat{\text{c}}\text{ov}(s_{jit}^{\log Y}, D_T)}{P_{jt}}100 + \frac{\hat{\text{c}}\text{ov}(s_{j,it}^{\log Y}, \hat{u}_{jit})}{P_{jt}}100 \end{aligned} \tag{20}$$

The same is of application if we are willing to replace equation (17) in (14).[10] Let R be a input where $R=L,\ M,\ K$, substituting the expression for log-productivity of equation (17) in (14) we have the next general decomposition for each input R in terms of IC, C and D variables and the residual term $\hat{u}_{jit}$

[10] Notice that it is interesting to express (12) as

$$100 = \frac{a^*_L\,\hat{c}ov(\log L_{jit}, \log P_{jit})}{\hat{c}ov(s_{jit}^{\log Y}, \log P_{jit})}100 + \frac{a^*_M\,\hat{c}ov(\log M_{jit}, \log P_{jit})}{\hat{c}ov(s_{jit}^{\log Y}, \log P_{jit})}100 + \frac{a^*_K\,\hat{c}ov(\log K_{jit}, \log P_{jit})}{\hat{c}ov(s_{jit}^{\log Y}, \log P_{jit})}100 + \frac{\hat{v}ar(\log P_{jit})}{\hat{c}ov(s_{jit}^{\log Y}, \log P_{j,it})\sum_{i=1}^{N_{jt}}\log Y_{jit}}100$$

where the ratio of the sample covariance of each input and log productivity to the efficiency term can easily be estimated as the slope coefficient of three simple instrumental variable (IV) regressions using log productivity as the instrument; a) the $\log Y_{j,it}$ on a constant and $\log L_{j,it}$, b) the $\log Y_{j,it}$ on a constant and $\log M_{j,it}$ and the $\log Y_{j,it}$ on a constant and $\log K_{j,it}$. Finally, the last term of equation (17) is similarly obtained as the slope coefficient of the IV estimation of the simple regression of $\log Y_{j,it}$ on a constant and $\log P_{j,it}$ using again $\log P_{j,it}$ as instrument.

$$a^{*}{}_{R}\hat{c}ov(\log R_{jit},\log P_{jit}) = a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{IC}IC_{j,i}) + a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{C}C_{j,i}) +$$
$$+ a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{Ds}D_{j}) + a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{DT}D_{t}) + a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{u}_{jit}) \qquad (21)$$
$$+ \left(\sum_{i=1}^{N_{jt}} \log Y_{jit}\right)^{-1} \hat{v}\mathrm{ar}\left(\hat{a}_{IC,r}IC_{j,i} + \hat{a}_{C}C_{j,i} + \hat{a}_{Ds}D_{j} + \hat{a}_{DT}D_{t} + \hat{u}_{jit}\right)$$

Substituting (16) by (21), equation (19) becomes

$$P_{jt} = \hat{a}_{IC}\overline{IC}_{j} + \hat{a}_{C}\overline{C}_{j} + \hat{a}_{Ds}\overline{D}_{j} + \hat{a}_{DT}\overline{D}_{t} + \hat{a}_{P} + \overline{u}_{j,t} + \sum_{R=L,M,K} \{a^{*}{}_{R}\hat{c}ov(\log R_{j,it},\hat{a}_{IC}IC_{j,i})$$
$$+ a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{C}C_{j,i}) + a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{Ds}D_{j}) + a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{a}_{DT}D_{t}) \qquad (22)$$
$$+ a^{*}{}_{R}\hat{c}ov(\log R_{jit},\hat{u}_{jit})\} + \left(\sum_{i=1}^{N_{jt}} \log Y_{jit}\right)^{-1} \hat{v}\mathrm{ar}\left(\hat{a}_{IC,r}IC_{j,i} + \hat{a}_{C}C_{j,i} + \hat{a}_{Ds}D_{j} + \hat{a}_{DT}D_{rt} + \hat{u}_{jit}\right)$$

Results of equation (20) are in Table F and Figure 11.1 and will be commented in sub-section 4.4.

4.2 Approximate Aggregate Productivity Decomposition in Levels in Terms of IC Variables

Consider the O&P decomposition of aggregate productivity of sector j based on variables in levels, see equation (8),

$$P_{jt} = \sum_{i=1}^{N_{jt}} s^{Y}_{j,it} P_{j,it} = \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}^{Y}_{jit} \tilde{P}_{jit} \qquad (23)$$

In order to obtain a decomposition for the aggregate productivity in levels in term of IC and control (C, D) we start from the next algebraic equality $\Delta \log P_{jit} = \dfrac{\Delta P_{jit}}{P_{jit-1}}$. When the changes in P from t-1 to t are small the next empirical regularity $P_{jit} \simeq P_{jit-1} \log P_{jit}$ can be observed, and consequently we can get rid of the increments in the first expression. However, when such changes in productivity are not small we may obtain a better approximation by using $P_{jit} = \hat{a}_0 + \hat{a}_1 P_{j,it-1} \log P_{jit}$; being $\hat{a}_1$ the slope of the regression between P_{jit} and $P_{jit-1} \log P_{jit}$ and $\hat{a}_0$ the constant of the regression. Hence by substituting in (23) we have

$$\sum_{i=1}^{N_{jt}} s^Y_{jit}(\hat{a}_0 + \hat{a}_1 P_{j,it-1} \log P_{j,it}) = \frac{1}{N_{jt}} \sum_{i=1}^{N_{jt}} (\hat{a}_0 + \hat{a}_1 P_{j,it-1} \log P_{jit}) \\ + \sum_{i=1}^{N_{jt}} (s^Y_{j,it} - \overline{s}^Y_{jit})[(\hat{a}_0 + \hat{a}_1 P_{j,it-1} \log P_{jit}) - (\hat{a}_0 + \hat{a}_1 \overline{P}_{j,it-1} \log \overline{P}_{jit})] \quad (24)$$

We can go back to equations (16) and (17) and replace them in (24), after rearranging terms we get

$$\sum_{i=1}^{N_{jt}} s^Y_{jit}(\hat{a}_0 + \hat{a}_1 P_{jit-1}(\hat{a}_{IC} IC_{j,i} + \hat{a}_C C_{j,i} + \hat{a}_{Ds} D_j + \hat{a}_{DT} D_t + \hat{a}_P + u_{j,it})) \\ = \frac{1}{N_{jt}} \sum_{i=1}^{N_{jt}} (\hat{a}_0 + \hat{a}_1 P_{jit-1}(\hat{a}_{IC} IC_{j,i} + \hat{a}_C C_{j,i} + \hat{a}_{Ds} D_j + \hat{a}_{DT} D_t + \hat{a}_P + u_{jit})) \\ + \sum_{i=1}^{N_{jt}} (s^Y_{j,it} - \overline{s}^Y_{jit})\{[\hat{a}_0 + \hat{a}_1 P_{j,it-1}(\hat{a}_{IC} IC_{jj} + \hat{a}_C C_{jj} + \hat{a}_{Ds} D_j + \hat{a}_{DT} D_t + \hat{a}_P + u_{jit})] \\ - [\hat{a}_0 + \hat{a}_1 \overline{P}_{j,it-1}(a_{IC} \overline{IC}_j + a_C \overline{C}_j + a_{Ds} \overline{D}_j + a_{DT} \overline{D}_t + a_P + \overline{u}_{j,t})]\} \quad (25)$$

Notice that as in sub-section we will assume for simplicity that IC_{it}, C_{it}, D_j and D_t represent scalars. Simplifying in (25) we are able to obtain an expression for average productivity in levels in terms of IC, C and D variables and productivity in levels at time t-1:

$$\overline{P}_{jt} = \hat{a}_0 + \hat{a}_P \hat{a}_1 \overline{P}_{j,t-1} + \hat{a}_{IC} \overline{IC}_j \hat{a}_1 \overline{P}_{jt-1} + \hat{a}_C \overline{C}_j \hat{a}_1 \overline{P}_{j,t-1} + \hat{a}_{Ds} \overline{D}_j \hat{a}_1 \overline{P}_{jt-1} + \hat{a}_{DT} \overline{D}_t \hat{a}_1 \overline{P}_{jt-1} + \overline{u}_{j,t} \hat{a}_1 \overline{P}_{jt-1} \quad (26)$$

and another one for the efficiency in terms of covariances between shares of sales and the product of IC, C and D variables and the productivity in levels at time t-1:

$$\hat{\mathrm{cov}}(s^Y_{jit}, P_{jit}) = \sum_{i=1}^{N_{jt}} \hat{a}_1 (s^Y_{j,it} - \overline{s}^Y_{j,it})(P_{j,it-1} \hat{a}_{IC} IC_{j,i} - \overline{P}_{j,t-1} \hat{a}_{IC} \overline{IC}_j) \\ + \sum_{i=1}^{N_{jt}} \hat{a}_1 (s^Y_{j,it} - \overline{s}^Y_{j,it})(P_{j,it-1} \hat{a}_{IC} C_{j,i} - \overline{P}_{j,t-1} \hat{a}_{IC} \overline{C}_j) + \sum_{i=1}^{N_{jt}} \hat{a}_1 (s^Y_{j,it} - \overline{s}^Y_{j,it})(P_{j,it-1} \hat{a}_{Ds} D_j - \overline{P}_{j,t-1} \hat{a}_{Ds} \overline{D}_j) \\ + \sum_{i=1}^{N_{jt}} \hat{a}_1 (s^Y_{j,it} - \overline{s}^Y_{j,it})(P_{j,it-1} \hat{a}_{DT} D_t - \overline{P}_{j,t-1} \hat{a}_{DT} \overline{D}_t) + \sum_{i=1}^{N_{jt}} \hat{a}_1 (s^Y_{j,it} - \overline{s}^Y_{jit})(P_{j,it-1} u_{jit} - \overline{P}_{j,t-1} \overline{\mu}_{jt}) \\ + \sum_{i=1}^{N_{jt}} \hat{a}_1 \hat{a}_P (s^Y_{jit} - \overline{s}^Y_{jit})(P_{j,it-1} - \overline{P}_{j,t-1}) \quad (27)$$

Since we are interested on the relative contribution of each component of equations (26) and (27) with respect to aggregate productivity in levels, we may replace (26) and (27) in (23) and operate, so that we have

$$
\begin{aligned}
100 = {} & \frac{\hat{a}_0}{P_{jt}}100 + \frac{\hat{a}_P \hat{a}_1 \overline{P}_{j\,t-1}}{P_{jt}}100 + \frac{\hat{a}_{IC} \overline{IC}_j \hat{a}_1 \overline{P}_{j,\,t-1}}{P_{jt}}100 + \frac{\hat{a}_C \overline{C}_j \hat{a}_1 \overline{P}_{j\,t-1}}{P_{jt}}100 + \frac{\hat{a}_{Ds} \overline{D}_j \hat{a}_1 \overline{P}_{j\,t-1}}{P_{jt}}100 \\
& + \frac{\hat{a}_{DT} \overline{D}_t \hat{a}_1 \overline{P}_{j\,t-1}}{P_{jt}}100 + \frac{\overline{u}_{j,t} \hat{a}_1 \overline{P}_{j\,t-1}}{P_{jt}}100 \\
& + 100\frac{\hat{a}_1 \hat{a}_{IC} cov(\tilde{s}^Y_{j,it}, IC_{j,i} P_{jit-1})}{P_{jt}}100 + \frac{\hat{a}_1 \hat{a}_C cov(\tilde{s}^Y_{j,it}, C_{j,i} P_{jit-1})}{P_{jt}}100 + \frac{\hat{a}_1 \hat{a}_{Ds} cov(\tilde{s}^Y_{j,it}, D_j P_{j,it-1})}{P_{jt}}100 \\
& + \frac{\hat{a}_1 \hat{a}_{DT} cov(\tilde{s}^Y_{j,it}, D_t P_{j,it-1})}{P_{jt}}100 + \frac{\hat{a}_1 cov(\tilde{s}^Y_{j,it}, \tilde{u}_{jit} P_{j,it-1})}{P_{jt}}100 + \frac{\hat{a}_1 \hat{a}_P cov(\tilde{s}^Y_{j,it}, P_{j,it-1})}{P_{jt}}100
\end{aligned}
\tag{28}
$$

Results of equation (26) are in Tables G and Figure 11.2 and will be commented in sub-section 4.4.

4.3 Simulations: Impacts of Changes of ICA Variables on Productivity

By improving the investment and business climate in which firms operate we may generate gains in terms of productivity. This gains may came from two sources, the first source is the progress of the general development of firms; the second source of gains comes from the *allocative efficiency*, if this term is positive the change in the investment climate is causing production going from less efficient to more efficient firms. The aim of this section is to simulate a change in investment climate variables and compute the rate of change in the aggregate productivity of the *Olley and Pakes* decomposition in levels.

Let the O&P decomposition in levels (see equation (8)) at moment 0 prior to the change in the IC variable and let IC_i, C_i, D_j and D_t represents scalars instead vectors for simplicity

$$P^0_{jt} = \overline{P}^0_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}^{Y0}_{jit} \tilde{P}^0_{jit}\,,$$

where

$$P^0_{j,i,t} = \exp(\hat{a}_{IC} IC^0_{j,i} + \hat{a}_C C^0_{j,i} + \hat{a}_{Ds} D^0_i + \hat{a}_{DT} D^0_t + \hat{a}_P + \hat{u}_{j,i,t}),$$

being the expression for the share of sales at moment 0

$$s^{Y0}_{j,i,t} = \frac{Y^0_{j\,i\,t}}{\sum_{i=1}^{N_{jt}} Y^0_{j\,i\,t}},$$

with

$$Y^0_{j,i,t} = \exp(a^L \log L_{j,i,t} + a^M \log M_{j,i,t} + a^K \log K_{j\,i\,t} + P^0_{j\,i\,t})$$

Therefore, at moment 1 when for instance IC goes from IC^0 to IC^1 we would have

$$P^1_{jt} = \overline{P}^1_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}^{Y1}_{j,i,t} \tilde{P}^1_{j\,i\,t}$$

with

$$P^1_{j\,i\,t} = \exp(a'_{IC} IC^1_{j,i} + a'_C C^0_{j,i} + a'_{Ds} D^0_i + a'_{DT} D^0_t + a_P + u_{j\,i\,t}).$$

similarly for the share of sales

$$s^{Y1}_{j\,i\,t} = \frac{Y^1_{j\,i\,t}}{\sum_{i=1}^{N_{jt}} Y^1_{j\,i\,t}} \qquad \text{and} \qquad Y^1_{j,i,t} = \exp(a^L \log L_{j,i,t} + a^M \log M_{j,i,t} + a^K \log K_{j\,i\,t} + P^1_{j\,i\,t}).$$

Being the rate of change of interest

$$\frac{P^1_{jt} - P^0_{jt}}{P^0_{jt}} 100 = \frac{\overline{P}^1_{jt} - \overline{P}^0_{jt}}{P^0_{jt}} 100 + \frac{\sum_{i=1}^{N_{jt}} \tilde{s}^{Y1}_{j,i,t} \tilde{P}^1_{j\,i\,t} - \sum_{i=1}^{N_{jt}} \tilde{s}^{Y0}_{j\,i\,t} \tilde{P}^0_{j\,i\,t}}{P^0_{jt}} 100 \qquad (29)$$

The rates of change of (29) can easily be applied by industries, regions, sizes or at the aggregate level, by only making the sums running across industries, regions, etc. Results of expression (29) at the aggregate level are in Figure 12.1, whereas figures 12.2, 12.3 and 12.4 report the results of equation (29) by size. It must be pointed out that the simulations were performed variable by variable and not all variables at a time. All results obtained from simulating a 20% improvement in IC and C variables will be commented below.[11]

4.4 Empirical Results: Comparison Between Alternative Decompositions of Efficiency

Figure 10 of appendix compares the three IC-impact evaluations proposed above. In order to make the comparison as readable as possible we put the results of equations (20), (28) and (29) in terms of relative importance of each group of variables with respect all IC and C variables, to do that we sum the absolute values of IC and C contributions across groups of variables and then we compute the relative importance of each group with respect the sum of all IC and C variables (excluding D_j and D_t). Three first columns compare the impacts on *aggregate productivity* of the decomposition in logs, the approximate decomposition in levels and the simulations. Although all relative percentages vary within a reasonable range of values, the greatest homogeneity is between the decompositions in logs and in levels, being the main difference in the *Quality, Innovation and Labor Skills* group which contribution measured with the decomposition in logs is 23.26% versus 21.43% when measured in levels. Column C (simulations) reaches to different results, the importance of *Infrastructures* and *Red Tape, Corruption and Crime* is larger now.

The conclusio ns are very similar for the case of *average productivity.*

Regarding the covariance term, the decomposition in levels and the simulations give more similar results (only in Finance and Corporate Governance and Quality, Innovation and Labor Skills there is a considerable gap between both methods). We observe more convergences in the decomposition in logs compared with the decomposition in levels.

[11] Notice that in order to simulate a 20% improvement in continuous variables (and dummies that enter the equation in form of industry-region averages) we only have to multiply by 1.2 (or 0.8 if the coefficient is <0) the corresponding value of the variable for firm i at time t ($IC_{it}^{1}=1.2*IC_{it}^{1}$). However, to simulate a 20% improvement in dummy variables is more complicated, we have to choose 20% of firms which took value 0 in the dummy variable X which will take value 1 after the simulation (vice versa if the coefficient of the dummy variable is <0); to make the election of firms as less arbitrary as possible we chose those firms by dividing the dataset in industries and sizes.

Figure 11.1 shows the results of equation (20) for IC and C variables, Table F includes also the results of D_j and D_t variables as well as the residual term and the constant. The largest contributions come from *Capacity utilization, Experience of the manager* and *Sucurity.* As it has been noticed in section 3 when measured in logs the covariance term becomes almost insignificant, being virtually no differences between aggregate and average productivity; thus the interest of this method lies in the decomposition of average productivity rathe r than aggregate productivity, what will be discussed in section 5 of the paper.

The measure of the covariance term dramatically changes if we perform the approximate decomposition in levels, acquiring in this case a key role explaining aggregate productivity as Figure 11.2 shows based on equation (28)[12]. The interesting properties of this approximate decomposition allow us knowing which part of the contribution of IC variables on aggregate productivity comes from either average productivity or the covariance term. For instance if we focus on those variables with the largest impact (notice that this variables fit with the results from the decomposition in logs), 16.24% of the 27.27% contribution of *Capacity utilization* on aggregate productivity comes from the average productivity and 11.03% from the covariance term; in *Experience of the manager*, the 9.54% contribution on aggregate productivity is decomposed on 5.24% from average productivity and 4.30% from the covariance term. The economic intuition underlying this decomposition is also easy to explain: if an IC variable is affecting positively aggregate productivity through the covariance term then that variable is making production going to more productive firms, whereas if its effect comes from the aggregate productivity what that variable is doing is improving the general development of the firms.

Results from the simulations at the aggregate level are in Figure 12.1. Results in terms of largest contributions are given by: *Rent land, Exporter, FDI* and *Financing Line Program*.

Figures 12.2 to 12.4 show the results of the simulations when applied by size. There are interesting differences, which means that the effect of many IC variables dramatically differs

[12] Table G also includes the results for industry and year dummies and residuals and constants terms, see equation (28).

among sizes. For instance, *University staff* has a larger effect on small and medium than in large firms.

5. ICA-Evaluation on the Average Value of Each Dependent Variable

From now on we come back to the whole system of equations (7.1-7.5). We want to measure the *partial direct effect* of each IC variable on each dependent variable at different aggregation levels (aggregate level, sector by sector, region by region, by size of the firm, by age of the firm, etc.) on each of the *endogenous* variables. For that purpose, we evaluate the impact of the average IC variable on the sample average values of the dependent variables (productivity, exports, FDI, wages, employment, etc.). Later on, we will also compute the *partial net effect* of each IC variable on each dependent variable, by expressing the structural form of the system in its reduced form and evaluating all the simultaneous effects of each IC variable. In what follows, we substitute all the unknown parameters from the system (7.1) to (7.5) by their corresponding 2SLS estimated values.

All what has been said in sections 3 and 4 about measuring average productivity in logs acquire additional relevance here. If we are interested on disentangle the effect that IC and C variables have on the average value of productivity we can use the average productivity decomposition in logs since it approximate well the average productivity in levels. Moreover, we may apply the same decomposition to employment, wages, probability of exporting and probability of receiving FDI.

5.1 ICA-Impact on Average (log) Productivity

Equation (4), estimated by 2SLS with a constant term, implies that the mean of the residuals is zero and therefore that we can evaluate the 2SLS estimation results of (3) at their sample mean values without including an error term. Therefore, the corresponding expression for the first term of Olley and Pakes (O&P) decomposition (11) becomes,

$$\overline{\log P_{jt}} = \hat{a}_P + \hat{a}'_{IC}\overline{IC} + \hat{a}'_C\overline{C} + \hat{a}'_{Ds}\overline{D}_j + \hat{a}'_{DT}\overline{D}_t \qquad (30.1a)$$

where the variables with bars on top indicate the vector of sample averages of each variable and therefore we can evaluate the impact of each $\overline{IC}$ variable on average log productivity.

Dividing the whole expression by the dependent variable $\log \overline{P}_{j,t}$ and multiplying by 100 we get, following Escribano and Guasch (2005), the direct contribution of each variable. That is,

$$100 = \frac{\hat{a}_P}{\log \overline{P}_{jt}}100 + \frac{\hat{a}'_{IC}\overline{IC}}{\log \overline{P}_{jt}}100 + \frac{\hat{a}'_C \overline{C}}{\log \overline{P}_{jt}}100 + \frac{\hat{a}'_{Ds}\overline{D}_j}{\log \overline{P}_{jt}}100 + \frac{\hat{a}'_{DT}\overline{D}_t}{\log \overline{P}_{jt}}100 \qquad (30.1b)$$

represents the sum of the percentage productivity gains and losses from all the explanatory variables of the regression, relative to the average (log) productivity of industry j at time t. In particular the contribution of r component of the vector of IC variables, relative to average (log) productivity, is given by the term $\left(\frac{\hat{a}_{IC,r}\overline{IC}_r}{\log \overline{P}_{jt}} 100 \right)$.

If the average log productivity is not calculated across all the firms of the country, but it is calculated industry by industry, sector by sector, by size, by age of the firm, etc., then the sample mean of those residuals, $\hat{u}_{rjt} = (\hat{v}_{ri} + \hat{e}_{rjt})$ from (7.1), will not be exactly zero and the decomposition is not exact. In this case the residual mean would also have a contribution (although small) to the average log productivity.

<u>Empirical Results</u>

Numbers in Figure 13 are relative percentages computed with the absolute values of percentage contributions of equation (30.1b); that is, Figure 13 shows in this first column the relative weight of each group of IC variables with respect all IC variables for the log-productivity case. The main group explaining average log-productivity is Other Control Variables with a percentage relative to other investment climate variables of 56.54%; thus, more than half log-productivity may be explained with this group of IC variables. Next group is Quality, Innovation and Labor Skills with 19.36%, followed by Red Tape, Corruption and Crime with 14.83% and Infrastructures with 8.38%. Finance and Corporate Governance is the last group in order of importance representing only 0.90% within all IC variables.

To disentangle the impact of each group of Figure 13 variable by variable we can use Figure 14, which directly reports the results obtained by applying equation 13.1b to Chiles` dataset. The variables with the largest percentage contributions are *Average duration of power* *outages* (-6.98%) and *Shipment losses* (-6.91) in Infrastructures group; *Security* (-18.59%) in the Red Tape, Corruption and Crime group; *Financing Line Program* (1.97%) in Finance and Corporate governance; *Experience of the manager* (29.90%) in Quality, Innovation and Labor Skills group and *Capacity utilization* (102.34%) in Other Control Variables group. Notice that the percentages in Figure 13 are computed by taking the absolute values of numbers in Figure 14, we add up this absolute values for each group of IC variables and then we calculate the relative percentage with respect all IC variables.

Figures 15 through 18 reports the results obtained from applying equation (30.1b) by industries, regions, sizes and years instead of at the aggregate level. The cumulative absolute contributions are computed by adding up the percentage contributions to average log-productivity of IC variables by groups in absolute values, while the last column (grand total absolute contribution) is simply the sum of the cumulative contributions of every group of IC variables. Results do not differ much among industries, regions, sizes and years.

5.2 ICA-Impact on the Average (log) Employment

Labor demand equation,

$$\overline{\log L}_{jit} = \hat{g}_L + \hat{g}_P \overline{\log P}_{jit} + \hat{g}_W \overline{\log W}_{jit} + \hat{g}'_{IC}\overline{IC} + \hat{g}'_C \overline{C} + \hat{g}'_{Ds}\overline{D}_j + \hat{g}'_{DT}\overline{D}_t \qquad (30.2a)$$

where $\overline{\log L}_{jit} = \frac{1}{N_{jt}} \sum_{i=1}^{N_{jt}} \log L_{jit}$.

$$100 = \frac{\hat{g}_L}{\overline{\log L}_{jit}}100 + \frac{\hat{g}_P \overline{\log P}_{jit}}{\overline{\log L}_{jit}}100 + \frac{\hat{g}_W \overline{\log W}_{j,it}}{\overline{\log L}_{jit}}100 + \frac{\hat{g}'_{IC}\overline{IC}}{\overline{\log L}_{jit}}100 + \frac{\hat{g}'_C \overline{C}}{\overline{\log L}_{jit}}100 + \frac{\hat{g}'_{Ds}\overline{D}_j}{\overline{\log L}_{ji,t}}100 + \frac{\hat{g}'_{DT}\overline{D}_t}{\overline{\log L}_{ji,t}}100 \qquad (30.2b)$$

<u>Empirical Results</u>

Second column of Figure 13 summarizes results obtained from applying equation (30.2b) to Chile. The main group explained average employment is Real wage (35.51%), although the relative importance of other Control Variables (25.01%) and Red Tape, Corruption and Crime (24.28%) is important too.

Figure 19 shows the results obtained for each term of equation (30.2b). We must highlight that *Real wage* has the highest contribution with -63.09%. The percentage contribution to average employment in Infrastructures, Finance and Corporate Governance and Quality, Innovation and Labor Skills groups are lower than in the rest of groups, only *Internal training* (Quality, Innovation and labor Skills) is over 3.5%. The variables with the largest percentage contributions are in Red Tape, Corruption and Crime: *Security* (23.74%) and *Number of inspections* (-10.86%). In Other Control Variables group the largest percentage contribution comes from *Small* (-21.29%).

In what refers to the decomposition by industry, region and size, figure 20, 21 and 22 respectively, the main source of differences comes from the decomposition by size where the grand total cumulative contribution of small firms is double than a the contributions of large firms. Decompositions by industry and region present more homogeneous results.

5.3 ICA-Impact on the Average (log) Wages

Wage (earnings) equation,

$$\overline{\log W}_{jit} = \hat{b}_W + \hat{b}_P \overline{\log P}_{jit} + \hat{b}'_{IC}\overline{IC} + \hat{b}'_C\overline{C} + \hat{b}'_{Ds}\overline{D}_j + \hat{b}'_{DT}\overline{D}_t \qquad (30.3a)$$

where $\overline{\log W}_{jit} = \frac{1}{N_{jt}}\sum_{i=1}^{N_{jt}} \log W_{jit}$.

$$100 = \frac{\hat{b}_W}{\overline{\log W}_{jit}}100 + \frac{\hat{b}_P \overline{\log P}_{jit}}{\overline{\log W}_{jit}}100 + \frac{\hat{b}'_{IC}\overline{IC}}{\overline{\log W}_{jit}}100 + \frac{\hat{b}'_C\overline{C}}{\overline{\log W}_{jit}}100 + \frac{\hat{b}'_{Ds}\overline{D}_j}{\overline{\log W}_{jit}}100 + \frac{\hat{b}'_{DT}\overline{D}_t}{\overline{\log W}_{jit}}100 \qquad (30.3b)$$

Empirical Results

From Figure 13, third column, it is clear that Productivity and Finance and Corporate Governance are the more important groups explaining Real wages representing 32.51% and 27.43% respectively, within all IC variables

Figure 23 breaks down the results for Real wages of Figure 13 variable by variable. *Productivity* is the most important variable whit 11.34% contribution to average log-wage. In the other important group, Finance and Corporative Governance, the largest contribution comes from *Credit line* with 8.08%. The contribution of the rest of variables is not over 3.3%.

Regarding the decomposition by industry, region and size (Figures 24, 25 and 26), results does not differ much among industries, regions and sizes.

5.4 ICA-Impact on the Probability of Exporting

Since y_{it}^{Exp} is a binary variable, evaluating the impact at the sample mean implies the evaluation on the probability (frequency) of exporting. In particular the equation (7.4) evaluated at the sample mean becomes

Probability of exporting equation,

$$\hat{P}(Exp_{j,t} \succ 0) = \hat{d}_{Exp} + \hat{d}_P \log\overline{g}\overline{P}_{jt} + \hat{d}'_{IC}\overline{IC} + \hat{d}'_C\overline{C} + \hat{d}'_{Ds}\overline{D}_j + \hat{d}'_{DT}\overline{D}_t \qquad (30.4a)$$

where $\hat{P}(Exp_{j,t} \succ 0) = \frac{1}{N_{jt}}\sum_{i=1}^{N_{jt}} y^{Exp}{}_{jit}$. From equation (30.4a) we can, as we did previously, evaluate the impact of the average IC variables on the probability of exporting,

$$100 = \frac{\hat{d}_{Exp}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{d}_P \log\overline{g}\overline{P}_{jt}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{d}'_{IC}\overline{IC}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{d}'_C\overline{C}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{d}'_{Ds}\overline{D}_j}{\hat{P}(Exp_{j,t} \succ 0)} + \frac{\hat{d}'_{DT}\overline{D}_t}{\hat{P}(Exp_{j,t} \succ 0)}100 \qquad (30.4b)$$

<u>Empirical Results</u>

Quality, Innovation and Labor Skills is the key group of variables affecting the probability of exporting in Chile as Figure 13 in its fourth column shows, being its relative percentage contribution among all IC variables 35.18%. Finance and Corporate Governance has also a considerable contribution, 22.02%.

Figure 27 breaks down groups of fourth column of Figure 13 in key components. Within Quality, Innovation and Labor Skills group the more prominent contribution to the probability of exporting comes from *Experience of the manager* (72.39%). *Trade association* has the largest impact within Finance and Corporate Governance variables (51.52%), and *E-mail* within Infrastructures variables (58.14%). *Productivity* has a clear positive impact on the probability of exports, being its percentage contribution 25.67%.

The decomposition of the probability of exporting performed by industry, region and size highlights huge differences among groups. In what refers to sector by sector decomposition, the probability of exporting on "Papers Products" is more likely to be affected by IC variables. The same happens With "Santiago" and "Antofagasta" and small firms in the decomposition by region and by size respectively.

5.5 ICA-Impact on the Probability of Receiving Foreign Direct Investment

Similarly, y_{it}^{FDI} is also a binary variable, therefore evaluating the impact at their sample mean implies evaluating the impact on the probability (frequency) of receiving foreign direct investment. In particular the equation (7.5) evaluated at the sample mean becomes (30.5a).

Probability of receiving foreign direct investment equation,

$$\hat{P}(FDI_{j,t} \succ 0) = \hat{r}_{FDI} + \hat{r}_P \log \overline{P}_{jt} + \hat{r}'_{IC}\overline{IC} + \hat{r}'_C\overline{C} + \hat{r}'_{Ds}\overline{D}_j + \hat{r}'_{DT}\overline{D}_t \qquad (30.5a)$$

and $\hat{P}(FDI_{j,t} \succ 0) = \frac{1}{N_{jt}}\sum_{i=1}^{N_{jt}} y^{FDI}{}_{jit}$. From equation (30.5a) we can, as we did previously, evaluate the impact of the average IC variables on the probability of receiving foreign direct investment.

$$100 = \frac{\hat{r}_{FDI}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{r}_P \log \overline{P}_{jt}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{r}'_{IC}\overline{IC}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{r}'_C\overline{C}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{r}'_{Ds}\overline{D}_j}{\hat{P}(FDI_{j,t} \succ 0)} + \frac{\hat{r}'_{DT}\overline{D}_t}{\hat{P}(FDI_{j,t} \succ 0)}100 \qquad (30.5b)$$

Empirical Results

Fifth column of Figure 13 reports the results in terms of relative importance of each group of IC variables. Finance and Corporate Governance, Quality ; Innovation and Labor Skills and Infrastructures are the tree more relevant groups affecting the probability of receiving foreign direct investment in Chile, being their relative contributions 34.34%, 24.38% and 18.78% respectively.

To decompose the groups of fifth column of Figure 13 in key variables we include Figure 31. in what refers to Finance and corporate Governance four variables of this group are significant in FDI equation, being *Credit line* the most important (80.08%). In Quality, Innovation and Labor Skills the two more important variables are *Internal training* and *University staff*, whit contributions of 33.66% and 33.14% respectively. Only one variable is significant in FDI equation in Infrastructures group, Days to clear customs for imports (-66.87). *Productivity* has a clear positive impact on the probability of receiving foreign direct investment, being its percentage contribution 36.48%.

When the decomposition is performed by industries, regions and sizes we obtain interesting results and differences among groups. The sector which probability of receiving FDI is more likely to be affected by IC variables is "Machinery and Equipment". The same holds for small firms in the decomposition by size. Decomposition by region presents more homogeneous results.

5.6 ICA-Impact on the System of Equation in Reduced Form

Partial net effects of IC and C variables on the system of equations (7.1-7.5) are given by

$$100 = \frac{\hat{p}_P^1}{\log \bar{P}_{jt}}100 + \frac{\hat{p}_{IC}^1 \times \overline{IC}}{\log \bar{P}_{jt}}100 + \frac{\hat{p}_C^1 \times \bar{C}}{\log \bar{P}_{jt}}100 + \frac{\hat{p}_{Ds}^1 \times \bar{D}_j}{\log \bar{P}_{jt}}100 + \frac{\hat{p}_{DT}^1 \times \bar{D}_t}{\log \bar{P}_{jt}}100 \quad (31a)$$

$$100 = \frac{\hat{p}_L^2}{\log \bar{L}_{jt}}100 + \frac{\hat{p}_{IC}^2 \times \overline{IC}}{\log \bar{L}_{jt}}100 + \frac{\hat{p}_C^2 \times \bar{C}}{\log \bar{L}_{jt}}100 + \frac{\hat{p}_{Ds}^2 \times \bar{D}_j}{\log \bar{L}_{jt}}100 + \frac{\hat{p}_{DT}^2 \times \bar{D}_t}{\log \bar{L}_{jt}}100 \quad (31b)$$

$$100 = \frac{\hat{p}_W^3}{\log \bar{W}_{jt}}100 + \frac{\hat{p}_{IC}^3 \times \overline{IC}}{\log \bar{W}_{jt}}100 + \frac{\hat{p}_C^3 \times \bar{C}}{\log \bar{W}_{jt}}100 + \frac{\hat{p}_{Ds}^3 \times \bar{D}_j}{\log \bar{W}_{jt}}100 + \frac{\hat{p}_{DT}^3 \times \bar{D}_t}{\log \bar{W}_{jt}}100 \quad (31c)$$

$$100 = \frac{\hat{p}_{Exp}^4}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{p}_{IC}^4 \times \overline{IC}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{p}_C^4 \times \bar{C}}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{p}_{Ds}^4 \times \bar{D}_j}{\hat{P}(Exp_{j,t} \succ 0)}100 + \frac{\hat{p}_{DT}^4 \times \bar{D}_t}{\hat{P}(Exp_{j,t} \succ 0)}100 \quad (31d)$$

$$100 = \frac{\hat{p}_P^5}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{p}_{IC}^5 \times \overline{IC}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{p}_C^5 \times \bar{C}}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{p}_{Ds}^5 \times \bar{D}_j}{\hat{P}(FDI_{j,t} \succ 0)}100 + \frac{\hat{p}_{DT}^5 \times \bar{D}_t}{\hat{P}(FDI_{j,t} \succ 0)}100 \quad (32d)$$

where $(\hat{p}_P^m, \hat{p}_{IC}^m, \hat{p}_C^m, \hat{p}_{Ds}^m, \hat{p}_{DT}^m)$ is the m^{th} row vector of matrix **?** from (9) where m=1, 2, 3, 4, 5; assuming the first row of matrix $\mathbf{y_t}$ and therefore of **?** corresponds to productivity equation, the second to employment demand equation, the third to real wages, the fourth to exports and the fifth to FDI.

By following section 2.11 we can also compute the partial net effect of IC and C variables on output. The partial net effect of variable IC_{it}^{m} on log sales is given by $\frac{[\hat{a}_L(\hat{g}_L^{IC^m}) + \hat{a}_{IC^m}]}{\log \overline{Y}_{it}} 100$, where $\hat{a}_L$ is the input-output elasticity of employment (approximated by the corresponding cost-share of the restricted Solow residual case), $\hat{g}_L^{IC^m}$ is the marginal effect of IC_{it}^{m} on employment, and $\hat{a}_{IC^m}$ is the marginal effect of IC_{it}^{m} on productivity.

Results of equations (31a)-(31d) are in Table H.4 of the appendix.

6. Further Robustness Analysis to Alternative Probability Models and to Recent Productivity Estimation Procedures

6.1 PROBIT Models for Exports and for Foreign Direct Investment

It is well known that linear probability models (LPM) are only approximations to nonlinear probability models. This approximation is usually good if we are close the mean of the explanatory variables. Nonlinear probability models (PROBIT or LOGIT) have the advantage of generating predicted probabilities between 0 and 1 and marginal effects of IC variables that are not constant. In this section we show with a PROBIT model that if we evaluate those marginal effects at their mean values, the numerical effects are very similar to the ones we have obtained with the linear probability model. The results reported in Table E.1b and Table E.2b show robust results with equal signs of the coefficients and similar numerical marginal effects. Table E.1b shows the PROBIT and LPM results for the probability of exporting and Table E.2b the results of PROBIT and LPM for the probability of receiving foreign direct investment.

6.2 ICA Analysis based on Levinsohn and Petrin´s (L&P) and on Ackerberg and Caves´s (A&C) Productivity Estimates

In this last sub section we want to show that the previous results are very robust to recent productivity estimation procedures proposed by Levinsohn and Petrin (2003) and Ackerberg and Caves (2003). We introduce a modification both approches, L&P and A&C, to control for the IC effects on the two steps.

The empirical results are in Table C.2c of the appendix. The input-output elasticities on labor (L), intermediate materials (M) and capital (K) are reported, together with the cost shares from Solow´s residuals and the OLS based on the Cobb-Douglas production function. The values of the estimated input-output elasticities vary but their impact is not affecting the IC elasticities reported in Table C.2c Even the correlation matrix between the new and previous productivity measures, reported in Table C.2d, shows similar results to the ones discussed in Table B.6. Therefore, we conclude that for policy recommendations, this econometric methodology reports robust empirical IC elasticities and semi-elasticities for several measures of economic performance.

7 Main Empirical Results

So far we have proposed a way to measure how the investment climate (IC) firms are facing affects their economic performance. We have proposed a system of equations using as dependent variables of such system productivity, demand of employment, real wages, probability of exporting and probability of receiving foreign direct investment and as explanatory variables a extensive list of IC variables classified by groups (infrastructures, red tape corruption and crime, finance and corporate governance and quality, innovation and labor skills) as well as a group of other control (C) variables.

Due to the special issues underlying productivity, we have proposed an estimation procedure which leads to robust results across different productivity measures in terms of IC and C elasticities and semi-elasticities with respect to the endogenous variables of the system. In order to compare and rank IC and C variables, we compute their percentage contribution to the average value of the dependent variables of the system.

For the special case of productivity the Olley and Pakes decomposition of aggregate productivity were performed both in levels and in logs. An additional decomposition of both terms of the Olley and Pakes decomposition in levels as a sum of contributions of IC and C variables were also performed.

Since the econometric issues underlying the methodology proposed has been widely commented in previous sections, the aim now is to emphasize the main empirical results obtained for each equation of the system.

Key Results on Productivity

Figure 13 in its first column compare the relative importance of groups of IC and C variables in terms of contributions to average log-productivity at the aggregate level. Other Control Variables group represents 56.54% of the whole contribution of IC and C variables to average log-productivity. Four variables of this group have positive effect on productivity (see Figure 14) those variables are: being incorporated company, receiving foreign direct investment, being an exporter firm and the percentage of firm’s capacity utilized. The percentage of capacity utilized has a percentage contribution on average log-productivity much higher than the rest. In the other hand two variables have negative effect on productivity: the percentage of unionized workers and if the firm rents almost all its lands.

Quality, Innovation and Labor Skills is the second group in order of importance representing 19.36% of the whole contribution of IC and C variables to average log-productivity (see Figure 13). Figure 14 breaks down this percentage in key factors: if the firm performs R+D activities, if it provides internal training to its employees, the percentage of staff with at least one year of university and number of years of experience of the manager. The largest contributions are given by the experience of the manager.

Red Tape, Corruption and Crime relative importance with respect to all IC and C variables in productivity equation is 14.86%, as Figure 13 shows. Within this group firms’ productivity is affected by the cost of security, the number of inspections in the last year, the cost of entry to the market in terms of number of days spent waiting for permissions and licenses and the number of days of production lost due to absenteeism. The largest contribution comes from the cost of security with negative effect on productivity.

Next group in order of importance is Infrastructures, which relative importance with respect all IC and C variables in productivity equation is 8.38%, as Figure 13 shows. The factors of this group with negative effect on productivity are: the time spent dealing with customs to export, the average duration of power outages and the fraction of the value of the firms` average cargo consignment that was lost in transit due to breakage, theft, spoilage or other deficiencies of the transport means used. One variable has positive effect on productivity in this group, if the firm has an internet website.

Last group in order of importance is Finance and Corporate Governance which relative weight within all IC and C variables is only 0.9% see Figure 13. Only one variable in this group affects on productivity, if the firm is at the present time in the Financing Line Program (CORFO).

Figures 15, 16, 17 and 18 stress the differences of the impact of IC and C groups of variables on productivity by industries, regions, sizes and years respectively. The impact of infrastructures is lower in the IT services sector than in other industries, being the largest impacts located in farm-fishing. In the rest of groups the lower impact comes from IT services sector and the most important effects are in paper products and metal products (ex m&e). By regions, firms in La Araucania are more affected by all IC factors but infrastructures and finance and corporate governance from which groups this region receives low impacts (being 0.0 from finance and corporate governance). Firms located in Los Lagos region are more sensitive to factors of infrastructures than the rest of regions. In what refers to the decomposition by size, productivity of small firms are more likely of being affected by all IC and C factors than medium and large firms although the results are homogeneous in the decomposition by sizes. By years, the results are more similar.

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We focus now on the decomposition of the allocative efficiency term (or covariance term) of the Olley and Pakes decomposition in levels. Column B of the covariance term section of Figure 10 shows the relative impact of each group of IC and C variables on this term at the aggregate level. The main group affecting the allocative efficiency is other control variables representing 48.63% of the whole contribution of IC and C variables to the allocative efficiency. Next group is quality innovation and labor skills being its weight 25.92%, followed by red tape, corruption and crime which weight is 14.75%. The relative contributions of infrastructures and finance and corporate governance are 9.49% and 1.21% respectively. Figure 11.2 shows what variables have the largest contributions on the allocative efficiency, these variables are: the percentage of firm's capacity utilized, the percentage of staff with at least one year of university and the cost of security. These contributions have a straightforward interpretation, the larger and positive the contribution of an IC variable the more productions is causing that variable going from less efficient firms to more efficient ones, vice versa if the effect is negative.

Key Results on Employment

Figure 13 in its second column compares the relative importance of groups of IC and C variables in terms of contributions to average log-employment at the aggregate level. The largest relative impact comes from Real wage, representing 35.81% of the whole contribution of IC and C variables to average log-employment. From Figure 19 it is clear that the most important variable on demand of employment is real wage with a negative effect.

Nest group in order of importance is Other Control Variables, with a relative impact on average log-employment of 25.01%, as Figure 13 shows. The factors of this group involving the demand of employment are presented in Figure 19 and they are commented in what follows: receiving FDI, the age of the firm, being exporter or a high percentage of unionized workers stimulate the demand of employment. In the other hand, the demand of employment decrease with small and medium firms.

Regarding Red Tape, Corruption and Crime group its relative weight in Figure 13 is 24.28%. Within this group firms' employment is affected the cost of security, the number of inspections in the last year, the cost of entry to the market in terms of number of days spent waiting for permissions and licenses and the number of days of production lost due to absenteeism (see Figure 19). The largest contributions of this group of variables come from the cost spent in security with a positive effect.

Demand of employment is closely related with Quality, innovation and Labor Skills, as the 6.99% relative weight of this group in Figure 13 shows. Figure 19 describes the factors of this group that affect employment: quality factors such as having quality certifications affect positively employment, in the same line, firms producing new products, providing internal or external training to its employees and firms with managers with more years of experience also demand more employment; other characteristic of the staff also affects the demand of employment, the percentage of staff with at least one year of university has a negative effect on employment demand.

The relative weight of Finance and Corporate Governance in Figure 13 is 3.12%. The factors of this group involving the demand of employment are presented in Figure 19 and they are commented in what follows: joining a trade association and having the annual statements reviewed by an external auditor increase the demand of employment.

In what refers to Infrastructures group its relative weight in Figure 13 is only 2.41%. Figure 19 describes the factors of this group affecting employment: the number of power outage suffered by a firm reduces the employment demand; in the other hand having an internet website stimulates the demand of employment.

Productivity relative weight is 2.38% the lowest among groups of variables, nevertheless when its contribution to average log-employment is compared to other variables separately its relative importance grows. One possible explanation of the negative effect of productivity on average log-employment is that more productive firms become more capital intensive and therefore they demand less employment.

Figures 20, 21 and 22 illustrate the differences among sectors, regions and sizes in the decomposition of average log-employment. Employment of firms belonging to IT services sector receives the largest impact of infrastructures, productivity, wages, quality, innovation and labor skills and other control variables factors; employment in the other sectors receives similar impact, being grand total absolute contribution homogeneous. In the decomposition of average log-employment by regions the most important result is in the impact on employment of other control variables, which is much higher in the case of La Aracunia region than the rest of regions of Chile. Regarding the decomposition by size there is a considerable gap between small firms and the other sizes, what implies that employment in small firms is more sensitive to IC and C factors than employment in other firms; the same could be said of medium with respect medium and large firms.

<u>Key Results on Real Wages</u>

Third column of Figure 13 illustrates the relative importance explaining average log-wages of each group of IC and C variables. Productivity represents 32.51% of the whole contribution of IC and C variables to average log-wage. Specifically, this factor has a positive effect on wages are shown in Figure 23, having the most important contribution of the whole contributions of IC and C variables to average log-wage.

The second group in order of importance is Finance and Corporate Governance; the relative weight of this group in Figure 13 is 27.43%. Figure 23 highlights which concrete factors of this group have effect on wages. Joining a trade association has a negative effect on wage. In the other hand, having access to a credit line or having the annual statements reviewed by an external auditor have a positive effect, being the impact of credit line the most important.

Infrastructures are behind Finance and Corporate Governance in order of importance, being its relative weight in Figure 13 12.10%. As Figure 23 illustrates, two variables of this group have an impact on wages. Infrastructures factors affect negatively real wages through average duration of power outages. However having an internet website increases the level of wages.

Next group is Red Tape, Corruption and Crime; the relative weight of this group in Figure 13 is 10.68%. Figure 23 enumerate the specific factors of this group: the cost of entry to the market in terms of number of days spent waiting for permissions and licenses and the number of days of production lost due to absenteeism decrease real wage. But the largest impact within this group is positive and comes from the cost in security.

Within Other Control Variables group tree factors are related with wages, with a relative importance smaller than other groups, as Figure 13 shows (8.69%). Figure 23 list the factors of this group: firms with high percentage of unionized workers are more likely to pay higher wages than other firms; similarly, firms receiving FDI or older pay higher wages on average.

Last group in order of importance is Quality, Innovation and Labor Skills, being its weigh in Figure 13 only 8.57%. The number of years of experience of the manager has an impact on wages; more experienced manager implies lower wages. In the other hand, firms with a high percentage of staff with at least one year of university pay higher wages on average.

Figures 24, 25 and 26 explore the differences among the decomposition of average log-wage by sectors, regions and sizes. Productivity affects more real wages on IT services and machinery and equipment firms, the differences are very littlies. The results are very homogeneous for the rest of IC and C variables groups. By regions, the conclusion is very similar, the most specific characteristic is in La Aracunia region, this region has the smallest impact of productivity, infrastructures and quality, innovation and labor skills groups, but it has the largest impact of finance and corporate governance and other control variables groups. In what refers to the decomposition by size, there are not considerable changes among sizes.

Key Results on the Probability of Exporting

Quality, Innovation and Labor Skills are of key importance for exports as Figure 13 in its fourth column shows; this group explains 35.18% of the whole impact of IC and C variables on the probability of exporting. From Figure 27 we are able to identify which are the factors with impact on the probability of exports: having a quality certification, performing R+D activities, introducing products improvements, providing internal training to its employees and the number of years of experience of the manager. All effects are positives on the probability of exporting and the largest comes from the experience of the manager.

Finance and Corporate Governance weight in Figure 13 is 22.02%. Firms belonging to a trade association are more likely to export. Using derivatives to cover some kind of financial risk or having the annual statements reviewed by an external auditor increase the probability of exporting too, although its impact is lower. (See Figure 27)

Infrastructures factors are the third in order of importance explaining the probability of exporting; their joint relative weight in Figure 13 is 17.57%. only one variable of this group has an impact on the probability of exporting, but this impact is very important. As Figure 27 illustrates, using of IC technologies such an email when doing business increases the probability of exporting in Chile.

Other Control Variables is behind Infrastructures factors in order of importance as Figure 13 shows, being its relative weight 15.96%. Within this group, incorporated companies are more likely to export than other kind of firms, the same occurs with firms that rent almost all its buildings. The age of the firms also plays a role on the probability of exporting; older firms are less likely to export. (See Figure 27)

Productivity weight in Figure 13 is 7.76%. The marginal effect of productivity on the probability of exporting is positive and large, the more productivity the more probability of becoming exporter. From Figure 27 it is clear that when compared individually with other IC factors productivity become more important.

Red Tape, Corruption and Crime group weight in Figure 13 is the smallest, only 1.5%. Within this group, only one variable has impact on export. Having to pay to accelerate bureaucratic processes decreases the probability of exporting, as Figure 27 shows.

The contributions of IC and C variables on the probability of exporting vary enormously among sectors, regions and sizes, as Figures 28, 29 and 30 shows. The probability of exporting in firms belonging to IT services is much more sensitive to IC and C factors than other sectors; food and beverages, wood and cork products and farm-fishing represent the opposite cases. By regions, firms located in Santiago or Antofagasta regions are more likely to be affected by IC factors than firms located in other regions. The same occurs with small firms in the decomposition performed by size, the probability of becoming exporter of these firms is more sensitive to IC and C factors. These differences can be easily explained if we take into account that a large proportion of non-exporter firms in one sector, region or size implies that any improvement in one IC variable in that sector is more likely to make one of those non-exporter firms to become exporter.

Key Results on the Probability of Receiving Foreign Direct Investment

We now focus on the results of the foreign direct investment equation. Last column of Figure 13 shows that the main group is Finance and Corporate Governance representing 34.34% of the whole contribution of IC and C variables to the probability of receiving FDI. The finance factors that affect positively of receiving FDI are joining a trade association, having access to a credit line, using derivatives to cover some kind of financial risk and having the annual statements reviewed by an external auditor. The largest contribution of this group is given by having access to a credit line. (See Figure 31)

Quality, Innovation and Labor Skills is the second group in order of importance, with a relative weight in Figure 13 of 24.38%. In what respect to quality and innovation variables; having a quality certification or performing R+D activities to design new products increase the probability of receiving FDI. Regarding labor skills the significant factors are: if the firm provides internal training to its employees and the percentage of staff with at least one year of university education, all with positive effect. From Figure 31, it is clear that the most important contributions are given by labor skills variables.

Infrastructures is the next group in order of importance in Figure 13, being its relative weight 18.78%. Within this group, only one variable has an impact on probability of receiving FDI, this is high and negative. (See Figure 31)

Other Control Variables group weight in Figure 13 is 12.25%. As Figure 31 illustrates, firms that rent almost all its buildings are more likely to receive FDI.

Productivity relative weight in Figure 11 is 10.24%. Its effect is positive, meaning that more productivity implies more probability of receive FDI. From Figure 31 it is clear that productivity has the largest contribution to the probability of receiving FDI among all IC and C variables.

Red Tape, Corruption and Crime group has not any impact on probability of receiving FDI in the case of Chile.

The sensitivity to IC factors of the probability of receiving FDI vary among sectors, regions and sizes, see Figures 32, 33 and 34. By sector, firms belonging to machinery and equipment sector are more likely to be affected by IC factors. In what respect to the decomposition by region, firms located in Valparaiso are more likely to be affected by IC factors than firms located in other regions. The same occurs with small firms in the decomposition performed by size, the probability of becoming exporter of these firms is more sensitive to IC and C factors.

8 Summary and Conclusions

For the analysis of the investment climate (IC) determinants of productivity in Chile, *productivity* is the production of goods (sales) that is not explained by the main inputs (labor, intermediate materials and capital). This productivity concept is sometimes called total factor productivity (TFP) or multifactor productivity (MFP).

Following the methodology of Escribano and Guasch (2005) we show, by using ten different productivity measures, that it is possible to get *consistent and robust* estimates (elasticities) of investment climate determinants of productivity. Five important categories of investment climate (IC) variables are identified for Chile: (a) Infrastructure (b) Read Tape, Corruption and Crime, (c) c) Finance and Corporate Governance d) Quality, Innovation and Labor Skills, and (e) other plant control characteristics. Within each group, most of the IC variables have the expected signs and the estimated elasticities or semi-elasticities are always within a reasonable value range for the ten different productivity measures considered. Obviously, the numerical values of those elasticities parameters vary from one productivity measure to the next, but the range of values is reasonable and significant in most cases.

The robustness of these empirical results, across all those productivity measures, allows us to obtain consistent empirical results for policy evaluations of the IC effects on productivity and other performance variables.

A summary of the direct empirical results of each IC variable on productivity, real wages, employment demand, probability of exporting and the probability of receiving foreign direct investment is included in Table H.1 of the appendix.

The policy implications are clear. Investment climate matters enormously and the relative size of the impact of the various investment climate variables indicates where the efforts of reform should be placed.

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APPENDIX ON CHILE: TABLES AND FIGURES.

Table A.1: General Information at Plant Level and Production Function Variables.

General Information at Plant Level	Sector classification	Food and Beverages, Chemicals, Metal Products (excluded Machinery and Equipment), Machinery and Equipment, Wood and Cork Products (excluded Furniture), Paper Products, Information and Technology Services, Farm-Fishing.
	Regional classification	Antofagasta, Valparaíso, Bio-Bio, La Araucania, Los Lagos and Metropolitan Region of Santiago.
Production Function Variables	Sales	Used as the measure of output for the production function estimation. Sales is defined as total sales plus the changes in the inventories of finished goods. The series are deflated by using sector specific implicit price index, base 1996 used.
	Employment	Total number of permanent workers (full or part time).
	Total hours worked per year	Total number of employees multiplied by the average hours worked per year.
	Materials	Total costs of intermediate and raw materials used in production (excluding fuel). The series are deflated by using specific implicit price index, base 1996 used.
	Capital stock	Net book value of all fixed assets (log). The series are deflated by using the whole manufacturing industry price index, base 1996 used.
	User cost of capital	The user cost of capital is defined in terms of the opportunity cost of using capital; it is defined as the long term interest rate in Chile (more than 5 years) plus a depreciation rate of 20% minus the rate of growth of the consumption price index.
	Labor cost	Total expenditures on personnel (logs).
Dependent Variables in other Regressions and in Linear Probability Models (LPM)	Exports (LPM)	Dummy variable that takes value 1 if exports are greater than 10%.
	Foreign Direct Investment (LPM)	Dummy variable that takes value 1 if any part of the capital of the firm is foreign.
	Wages	Real wage is defined as the total expenditures on personnel (deflated by using the whole manufacturing price index, base 1996) divided by the total number of permanent workers (total or part-time). (logs)
	Employment	Total number of permanent workers (full or part time). (logs)

All series were translated to US Dollars, the rate of change used were obtained from the Chilean Central Bank statistics.

Table A.2 (I): Investment Climate (IC) and Control (C) Variables.

Infrastructures	Days to clear customs for exports	Average number of days to clear customs for export.
	Days to clear customs for imports	Average number of days to clear customs for imports.
	Average duration of power outages	Average duration of power outages suffered by the plant in hours.
	Losses due to power outages	Value of the losses due to power outages as a percentage of sales (conditional on the plant reporting power outages).
	Power outages	Number of power outages suffered by a plant in 2003.
	Average duration of water outages	Average duration of water outages suffered by the plant in hours.
	Water outages	Number of water outages suffered by a plant in 2003.
	Average duration of fuel outages Wait for phone	Average duration of fuel outages suffered by the plant in hours. Average time waiting for a phone connection.
	Shipment losses	Fraction of the value of the plant's average cargo consignment that was lost in transit due to breakage, theft, spoilage or other deficiencies of the transport means used.
	Email	Dummy variable that takes value 1 if the plant uses email.
	Internet page	Dummy variable that takes value 1 if the plant has an internet website.
Red Tape, Corruption and Crime	Criminal attempt	Dummy variable that takes value 1 if the plant suffered any criminal attempt during last year.
	Losses due to criminal activity	Value of losses due to criminal activity.
	Security	Cost in security (equipment, staff, etc).
	Illegal payments for protection	Total costs due to payments in protection (e. g. payments to criminals to avoid violence).
	Payments to accelerate bureaucratic processes	Percentage of total sales designated to accelerate bureaucratic process (customs, taxes…)
	Sales declared to taxes	Percentage of total sales declared to taxes.
	Labor costs declared to taxes	Percentage of labor costs declared to taxes.
	Number of inspections	In the last year, total number of inspections.
	Payments to obtain a contract with the government	Dummy variable that takes value 1 if in plant's sector it is common to pay an extra amount of money in order to obtain a contract with the government.
	Conflicts whit clients	Percentage of conflicts with clients solved in the courts int he last two years.
	Conflicts whit employees	Percentage of conflicts with employees solved in the labor inspection in the last two years.
	Cost of entry	Cost of entry to the market in terms of days spent waiting for permissions and licenses.
	Cost of continuing	Cost of continuing in the market in terms of number of days spent waiting for permissions and licenses.
	Absenteeism	Days of production lost due to absenteeism.
	Civil protest	Days of production lost due to civil protest.
Finance and Corporate Governance	Trade association	Dummy variable that takes value 1 if the plant belongs any association or trade chamber.
	Credit line	Dummy variable that takes value 1 if the plant reports that it has a credit line.
	Loan	Dummy variable that takes value 1 if the plant reports that it has a bank loan.
	Derivatives	Dummy variable that takes value 1 if the plant uses derivatives to cover some kind of financial risk.
	Manager with bachelor or post grade	Dummy variable that takes value 1 if the manager has a bachelor degree or post grade degree.
	FinancingLine Program	Dummy variable that takes value 1 if the plant is at the present time in the FinancingLine Program (CORFO).
	Debt Line Program	Dummy variable that takes value 1 if the firm is at the present time in the Debt Line Program (CORFO).
	External auditory	Dummy variable that takes value 1 if firm's annual statements are engaged in a process of external auditory.

Table A.2 (II): Investment Climate (IC) and Control (C) Variables.

Quality, Innovation and Labor Skills	Quality certification	Dummy variable that takes value 1 if the plant has a quality certification.
	ISO certification	Dummy variable that takes value 1 if the plant has any kind of ISO certification.
	New product	Dummy variable that takes value 1 if the plant has developed a new product line.
	Product improvement	Dummy variable that takes value 1 if the plant has developed a product improvement.
	R + D	Dummy variable that takes value 1 if the plant reports to perform R+D activities.
	Internal R + D	Dummy variable that takes value 1 if the plant performed internal R+D activities during 2003.
	External R + D	Dummy variable that takes value 1 if the plant performed external R+D activities during 2003.
	Internal and external R + D	Dummy variable that takes value 1 if the plant performed both internal and external R+D activities during 2003.
	R + D new product	Dummy variable that takes value 1 if the R+D activity is design of new products.
	R + D productive process	Dummy variable that takes value 1 if the R+D activity is improvement of the productive process.
	R + D product qualities	Dummy variable that takes value 1 if the R+D activity is improvement of the product qualities.
	R + D software applications	Dummy variable that takes value 1 if the R+D activity is development of the new software applications.
	New technology purchased	Dummy variable that takes value 1 if the firm purchased any new technology during 2003.
	Internal training	Dummy variable that takes value 1 if the plant provides internal training to its employees.
	External training	Dummy variable that takes value 1 if the plant provides external training to its employees.
	Workers in internal training	Percentage of workers that received internal training during last year.
	Workers in external training	Percentage of workers that received external training during last year.
	Weeks of internal training	Average number of weeks of internal training during last year.
	Weeks of external training	Average number of weeks of internal train during last year.
	University staff	Percentage of staff with at least one year of university.
	Middle education staff	Percentage of staff with middle education (complete).
	Basic education staff	Percentage of staff with basic education (complete or incomplete) or middle education incomplete.
	FAT	Dummy variable that takes value 1 if the firm is at the present time in the FAT program.
	PROFO	Dummy variable that takes value 1 if the plant is at the present time in the PROFO program.
	PDP	Dummy variable that takes value 1 if the plant is at the present time in the PDP program.
	Technological innovation	Dummy variable that takes value 1 if the firm is at the present time in the Technological Innovation program (CORFO).
	Technical transfer	Dummy variable that takes value 1 if the plant is at the present time in the Technical Transfer Program (CORFO).
	SENCE	Dummy variable that takes value 1 if the firm used the SENCE program during last year.
	Experience of the manager	Number of years of experience of the manager.

Table A.2 (III): Investment Climate (IC) and Control (C) Variables.

Other Control Variables	Open incorporated company	Dummy variable that takes value 1 if the plant is an open incorporated company.
	Closed incorporated company	Dummy variable that takes value 1 if the plant is a close incorporated company.
	Incorporated company	Dummy variable that takes value 1 if the plant is an incorporated company.
	Private limited company	Dummy variable that takes value 1 if the plant is a private limited company.
	Individual proprietorship	Dummy variable that takes value 1 if the owner of the plant is a single person.
	Foreign direct investment	Dummy variable that takes value 1 if any part of the capital of the firm is foreign.
	Age	Difference between the year that the plant started operations and current year.
	Competitors	Number of competitors in the main market.
	Exporter	Dummy variable that takes value 1 if exports are greater than 10%.
	Capacity utilization	Percentage of capacity utilized.
	Rent land	Dummy variable that takes value 1 if the plant rents almost all its lands.
	Rent buildings	Dummy variable that takes value 1 if the plant rents almost all its buildings.
	Trade Union	Percentage of workers that belongs to a syndicate.
	Strikes	Days of production lost due to strikes.
	Income from manufacturing activities	Dummy variable that takes value one if at least 50% of firm's income comes from manufacturing activities.
	Income from services related activities	Dummy variable that takes value one if at least 50% of firm's income comes from services related activities.
	Income from trade related activities	Dummy variable that takes value one if at least 50% of firm's income comes from trade related activities.
	Income from "other" activities	Dummy variable that takes value one if at least 50% of firm's income comes from other (non manufactures, services nor trade) activities.
	Small	Dummy variable that takes value 1 if firm's sales are lower than 25.000 UF (Unidades de Fomento).
	Medium	Dummy variable that takes value 1 if firm's sales are in between 25.001 and 100.000 UF (Unidades de Fomento).
	Large	Dummy variable that takes value 1 if firm's sales are greater than 100.001 UF (Unidades de Fomento).

Table B.1: Number of Observations that Enter into the IC Regressions by Industry and by Region.

	Region						
Sector	**Antofagasta**	**Valparaiso**	**Bio-Bio**	**La Araucania**	**Los Lagos**	**Santiago (Metropolitan Area)**	**Total**
Food and Beverages	33	66	171	0	135	171	**576**
Chemicals	48	15	30	0	0	225	**318**
Metal Products	33	24	54	0	18	213	**342**
Machinery and Equipment	21	0	30	0	3	96	**150**
Wood and Cork Products (excluded Furniture)	3	12	144	3	54	63	**279**
Paper Products	0	15	21	0	3	123	**162**
Information and Technology Services	6	57	30	0	0	444	**537**
Farm-Fishing	6	6	24	0	105	36	**177**
Total	**150**	**195**	**504**	**3**	**318**	**1371**	**2541**

Table B.2: Number of Firms that Enter into the IC Regressions by Industry and by Year.

	Year			
Sector	**2001**	**2002**	**2003**	**Total**
Food and Beverages	192	192	192	**576**
Chemicals	106	106	106	**318**
Metal Products	114	114	114	**342**
Machinery and Equipment	50	50	50	**150**
Wood and Cork Products (excluded Furniture)	93	93	93	**279**
Paper Products	54	54	54	**162**
Information and Technology Services	179	179	179	**537**
Farm-Fishing	59	59	59	**177**
Total	**847**	**847**	**847**	**2541**

Table B.3: Total Number of Observations, Missing Values and Zeros for Production Function Variables in the Original Sample Before and After Dropping Outliers (2001-2003).

	Sales	Materials	Capital	Employment	Labor Cost
Maximum number of observations for each year 2001-2003.	***948***	***948***	***948***	***948***	***948***
(1.A) Missing Values 2001	12	13	36	18	13
(1.B) Missing Values 2002	3	3	3	3	3
(1.C) Missing Values 2003	0	0	0	0	0
(2.A) Zeros 2001	0	0	11	0	0
(2.B) Zeros 2002	0	0	1	0	0
(2.C) Zeros 2003	0	0	0	0	0
(3.A) Observations not available in 2001: (1.A)+(2.A)	**12**	**13**	**47**	**18**	**13**
(3.B) Observations not available in 2002: (1.B)+(2.B)	**3**	**3**	**4**	**3**	**3**
(3.C) Observations not available in 2003: (1.B)+(2.B)	**0**	**0**	**0**	**0**	**0**
Available observations including outliers in 2001: (5.A)-(3.A)	936	935	901	930	935
Available observations including outliers in 2002: (5.B)-(3.B)	945	945	944	945	945
Available observations including outliers in 2003: (5.B)-(3.B)	948	948	948	948	948
Final number of observations for each year after correction for outliers[1]	**847**	**847**	**847**	**847**	**847**

[1]See the appendix for a description of the methodology used to deal with outliers and to replace missing values and zeros.

Table B.4 (I): Total Number of Missing Values in the Panel Data for IC and C Variables in the Original Sample before dropping outliers (2001-2003).

Infrastructures	Days to clear customs for exports	2031
	Days to clear customs for imports	1734
	Average duration of power outages	1059
	Losses due to power outages	1353
	Power outages	54
	Average duration of water outages	168
	Water outages	165
	Average duration of fuel outages	2796
	Wait for phone	2112
	Shipment losses	1935
	Email	240
	Internet page	786
Red Tape, Corruption and Crime	Criminal attempt	3
	Losses due to criminal activity	2073
	Security	117
	Illegal payments for protection	564
	Payments to accelerate bureaucratic processes	2571
	Sales declared to taxes	159
	Labor costs declared to taxes	162
	Number of inspections	156
	Payments to obtain a contract with the government	66
	Conflicts whit clients	402
	Conflicts whit employees	291
	Cost of entry	0
	Cost of continuing	0
	Absenteeism	171
	Civil Protest	69
Finance and Corporate Governance	Trade association	6
	Credit line	3
	Loan	0
	Derivatives	21
	Manager with Bachelor or post grade	24
	Financing Line Program	0
	Debt Line Program	0
	External auditory	81

Table B.4 (II): Total Number of Missing Values in the Panel Data for IC and C Variables in the Original Sample before dropping outliers (2001-2003).

Quality, Innovation and Labor Skills	Quality certification	27
	ISO certification	0
	New product	15
	Product improvement	15
	R + D	6
	Internal R + D	1566
	External R + D	1566
	Internal and external R + D	2130
	R + D new product	6
	R + D productive process	6
	R + D product qualities	6
	R + D software applications	6
	New technology purchased	6
	Internal training	0
	External training	0
	Workers in internal training	165
	Workers in external training	573
	Weeks of internal training	0
	Weeks of external training	0
	University staff	57
	Middle education staff	57
	Basic education staff	57
	FAT	1395
	PROFO	1386
	PDP	2031
	Technological Innovation	1245
	Technical Transfer	1686
	SENCE	804
	Experience of the manager	72
Other Control Variables	Open incorporated company	0
	Closed incorporated company	0
	Incorporated company	0
	Private limited company	0
	Individual proprietorship	0
	Foreign direct investment	0
	Age	0
	Competitors	438
	Exports	0
	Capacity utilization	21
	Rent land	33
	Rent buildings	15
	Trade Union	105
	Strikes	75
	Income from manufacturing activities	0
	Income from services related activities	0
	Income from trade related activities	0
	Income from "other" activities	0
	Small	0
	Medium	0

	Large	0

Table B.5 (I): List of Significant IC and C Variables, their Measurement Units, Equations in Which they are Significant and Form (Industry-Region Averages or not) in Which Each Variable Enters the Equations.

	Explanatory ICA Variables	Measurement Units	Equation/s	Industry-Region Averages
Infrastructures	*Days to clear customs for exports*	Logs	P	Yes
	Days to clear customs for imports	Logs	FDI	Yes
	Power outages	Logs	P, L	Yes
	Average duration of power outages	Logs	W	Yes
	Shipment losses	Percentage	P	Yes
	E-mail	0 or 1	Exp	No
	Internet page	0 or 1	P, L,W	Yes but only in employment eq.
Red Tape, Corruption and Crime	*Security*	Logs	P, L, W	Yes
	Illegal payments for protection	Logs	Exp	Yes
	Number of inspections	Logs	P, L	Yes
	Cost of entry	Logs	P, L, W	Yes but only in employment eq.
	Absenteeism	Logs	P, L, W	Yes in productivity and employment eqs
Finance and Corporate Governance	*Trade association*	0 or 1	L, W, Exp, FDI,	Yes but only in exports eq
	Credit line	0 or 1	W	Yes
	Derivatives	0 or 1	Exp, FDI	No
	Financing Line program	0 or 1	P	No

P: productivity equation.
L: employment equation.
W: wages equation.
Exp: exports equation.
FDI: foreign direct investment equation.

Table B.5 (II): List of Significant IC and C Variables, their Measurement Units, Equations in Which they are Significant and Form (Industry-Region Averages or not) in Which Each Variable Enters the Equations.

	Explanatory ICA Variables	Measurement Units	Equation/s	Industry-Region Averages
Quality, Innovation and Labor Skills	*Quality certification*	0 or 1	L, Exp	No
	New product	0 or 1	L	No
	R + D	0 or 1	P, Exp	No
	R + D new product	0 or 1	FDI	Yes
	New technology purchased	0 or 1	Exp	No
	Internal training	0 or 1	P, L, Exp, FDI	No
	External training	0 or 1	L	No
	External Auditory	0 or 1	L, W, Exp	No
	University staff	Percentage	P, L, W	No
	Experience of the manager	Logs	L, W, Exp	Yes in exports, productivity and efficiency eqs
Other Control Variables	*Incorporated company*	0 or 1	P, L, Exp	No
	Foreign direct investment	0 or 1	P, W	No
	Age	Years	Exp, L, W	No
	Exporter	0 or 1	P, L	No
	Capacity utilization	Percentage	P	Yes
	Rent land	0 or 1	P	No
	Rent buildings	0 or 1	Exp, FDI	No
	Trade Union	Percentage	P, L, W	Yes
	Income from manufacturing activities	0 or 1	Exp	No
	Small	0 or 1	L	No
	Medium	0 or 1	L	No

P: productivity equation.
L: employment equation.
W: wages equation.
Exp: exports equation.
FDI: foreign direct investment equation.

Table B.6: Correlations Between Solow Residuals in Levels and Estimated Productivity

		Two steps		Single step Restricted				Single step Unrestricted			
		Solow's Residual		Cobb Douglas		Translog		Cobb Douglas		Translog	
		Restr.	Unrestr.	OLS	RE	OLS	RE	OLS	RE	OLS	RE
Two steps	**Restricted Solow's residual**	1									
	Unrestricted Solow's residual	0.960	1								
Single step Restricted	**Cobb Douglas OLS**	0.978	0.947	1							
	Cobb Douglas RE	0.964	0.919	0.967	1						
	Translog OLS	0.896	0.866	0.916	0.893	1					
	Translog RE	0.927	0.879	0.927	0.959	0.946	1				
Single step Unrestricted	**Cobb Douglas OLS**	0.764	0.738	0.790	0.771	0.737	0.746	1			
	Cobb Douglas RE	0.775	0.821	0.779	0.760	0.716	0.729	0.677	1		
	Translog OLS	0.094	0.087	0.100	0.119	0.110	0.117	0.158	0.099	1	
	Translog RE	0.124	0.107	0.124	0.150	0.133	0.153	0.103	0.001	0.953	1

Notes:

a) Solow residuals in levels are obtained as sales (in logarithms or logs) minus a weighted average of labor, materials, capital (all in logs) where the weights are given by the share in total costs of each of the inputs.

(1) Restricted case: the cost shares are calculated as the averages of the plant-level cost shares across the entire sample in 2001, 2002 and 2003.

(2) Unrestricted by Industry case: the cost shares are calculated as the averages across plant-level cost shares in years 2001, 2002 and 2003 for each of the nine industries.

(3) Outlier plants were defined as those which had ratios of materials to sales larger than one or had ratios of labor costs to sales larger than one.

b) Estimated Productivity in levels is obtained from Cobb-Douglas and Translog production functions of sales with inputs labor, materials, and capital estimated by OLS and random effects under two different environments:

(1) Restricted: a single set of production function coefficients is obtained using data on plants in the three countries, for all industries in years 2001, 2002 and 2003 (excluding outliers).

(2) Unrestricted by Industry: a set of production function coefficients is obtained for each of nine industries using data on all plants for the three countries in years 2001, 2002 and 2003 (excluding outliers).

Table B.7: Summary Statistics of Productivity Measures in Logs.

Productivity Measure			Mean	Median	Standard deviation	Coefficient of Variation	Minimum	Maximum
Two steps	**Restricted Solow's residual**	*Whole sample*	1.8	1.64	0.92	0.51	-1.41	8.84
		Without outliers	1.68	1.61	0.67	0.40	-1.41	3.90
	Unrestricted Solow's residual	*Whole sample*	1.73	1.52	0.94	0.54	-2.04	8.28
		Without outliers	1.61	1.49	0.71	0.44	-2.04	4.55
Single step Restricted	**Cobb Douglas OLS**	*Whole sample*	1.89	1.76	0.89	0.47	-1.79	8.66
		Without outliers	1.78	1.73	0.67	0.38	-1.79	5.00
	Cobb Douglas RE	*Whole sample*	3.07	2.99	0.92	0.30	-0.83	9.81
		Without outliers	2.96	2.96	0.71	0.24	-0.83	5.33
	Translog OLS	*Whole sample*	-0.41	-0.52	0.80	-1.94	-5.94	6.54
		Without outliers	-0.49	-0.53	0.62	-1.25	-5.94	2.89
	Translog RE	*Whole sample*	3.24	3.15	0.86	0.27	-0.41	10.12
		Without outliers	3.14	3.12	0.66	0.21	-0.41	5.65
Single step Unrestricted	**Cobb Douglas OLS**	*Whole sample*	1.50	1.42	0.91	0.61	-3.12	8.33
		Without outliers	1.41	1.40	0.76	0.54	-3.12	4.47
	Cobb Douglas RE	*Whole sample*	3.15	2.90	1.18	0.37	-0.27	10.34
		Without outliers	3.04	2.86	1.03	0.34	-0.27	6.98
	Translog OLS	*Whole sample*	-3.55	-5.42	7.25	-2.04	-23.39	20.31
		Without outliers	-3.57	-5.45	7.34	-2.06	-23.39	20.31
	Translog RE	*Whole sample*	0.84	-0.44	9.23	10.95	-23.71	32.72
		Without outliers	0.80	-0.51	9.32	11.71	-23.71	32.72

Table B.8: Summary Statistics of Productivity Measures in Levels.

Productivity Measure			Mean	Median	Standard deviation	Coefficient of Variation	Minimum	Maximum
Two steps	Restricted Solow's residual	*Whole sample*	20.94	5.13	213.65	10.20	0.24	6905.28
		Without outliers	6.87	5.00	6.45	0.94	0.24	49.62
	Unrestricted Solow's residual	*Whole sample*	16.90	4.59	142.03	8.41	0.13	3943.45
		Without outliers	6.64	4.46	6.84	1.03	0.13	94.23
Single step Restricted	Cobb Douglas OLS	*Whole sample*	20.35	5.79	204.52	10.05	0.17	5742.05
		Without outliers	7.60	5.65	7.75	1.02	0.17	148.43
	Cobb Douglas RE	*Whole sample*	66.38	19.84	666.27	10.04	0.44	18216.78
		Without outliers	24.82	19.37	21.51	0.87	0.44	206.01
	Translog OLS	*Whole sample*	1.86	0.60	21.41	11.49	0.00	689.35
		Without outliers	0.75	0.59	0.74	0.98	0.00	18.06
	Translog RE	*Whole sample*	79.44	23.45	857.76	10.80	0.66	24819.66
		Without outliers	29.15	22.75	25.95	0.89	0.66	284.71
Single step Unrestricted	Cobb Douglas OLS	*Whole sample*	12.54	4.15	129.54	10.33	0.04	4156.52
		Without outliers	5.52	4.04	5.82	1.05	0.04	87.73
	Cobb Douglas RE	*Whole sample*	82.84	18.26	728.66	8.80	0.76	31066.68
		Without outliers	39.46	17.46	6.93E+01	1.76	7.64E-01	1.07E+03
	Translog OLS	*Whole sample*	743880.80	0.00	1.72E+07	23.06	0	6.60E+08
		Without outliers	6.47E+05	0.00	1.64E+07	25.35	6.93E-11	6.60E+08
	Translog RE	*Whole sample*	1.56E+11	0.65	3.90E+12	25.03	0	1.62E+14
		Without outliers	1.43E+11	0.60	3.86E+12	27.10	5.05E-11	1.62E+14

Table C.1: IC Elasticities and Semielasticities with respect to Productivity; Restricted Estimation.

	Two step estimation Solow's Residual		One step estimation Cobb-Douglas		Translog	
	Pool OLS	Random Efts.	Pool OLS	R. E.	Pool OLS	R. E.
Explanatory variables	**Dep. Var: Restr. Solow's Resid.**		**Dep. Var: log of sales.**			
Infrastructures						
Days to clear customs for exports	-0.042	-0.042	-0.046	-0.036	-0.068	-0.116
	[0.083]	[0.118]	[0.082]	[0.117]	[0.070]	[0.106]
Power outages	-0.128**	-0.128	-0.148***	-0.172**	-0.206***	-0.227***
	[0.054]	[0.082]	[0.053]	[0.081]	[0.047]	[0.074]
Shipment losses	-0.124***	-0.124***	-0.119***	-0.146***	-0.128***	-0.166***
	[0.028]	[0.048]	[0.028]	[0.047]	[0.025]	[0.043]
Internet page	0.036	0.036	0.035	0.064	0.009	0.045
	[0.034]	[0.065]	[0.035]	[0.065]	[0.035]	[0.058]
Red Tape, Corruption and Crime						
Security	-0.053***	-0.053*	-0.046**	-0.037	-0.051***	-0.046*
	[0.020]	[0.028]	[0.019]	[0.028]	[0.018]	[0.025]
Number of inspections	-0.068	-0.068	-0.091	-0.144	-0.118	-0.163
	[0.087]	[0.133]	[0.086]	[0.132]	[0.077]	[0.119]
Cost of entry	-0.155***	-0.155**	-0.139***	-0.152**	-0.129***	-0.149**
	[0.035]	[0.073]	[0.038]	[0.073]	[0.031]	[0.066]
Absenteeism	-0.126*	-0.126	-0.11	-0.132	-0.092	-0.127
	[0.070]	[0.100]	[0.069]	[0.099]	[0.060]	[0.090]
Finance and Corporate Governance						
Financing Line Program	0.039**	0.039	0.033*	0.037	0.017	0.025
	[0.019]	[0.029]	[0.018]	[0.029]	[0.016]	[0.026]
Quality, Innovation and Labor Skills						
R + D	0.059	0.059	0.068*	0.112*	0.076**	0.119**
	[0.038]	[0.061]	[0.039]	[0.061]	[0.034]	[0.055]
Internal training	0.149***	0.149**	0.104***	0.184***	0.130***	0.199***
	[0.035]	[0.062]	[0.038]	[0.063]	[0.035]	[0.057]
University staff	0.006***	0.006***	0.005***	0.005***	0.004***	0.005***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Experience of the manager	0.304***	0.304**	0.261***	0.276**	0.220***	0.265**
	[0.084]	[0.123]	[0.082]	[0.122]	[0.075]	[0.110]
Other Control Variables						
Incorporated company	0.023	0.023	0.009	0.07	0.044	0.076
	[0.036]	[0.067]	[0.037]	[0.067]	[0.034]	[0.061]
Foreign direct investment	0.208***	0.208**	0.212***	0.304***	0.148***	0.290***
	[0.057]	[0.081]	[0.058]	[0.082]	[0.051]	[0.074]
Exporter	0.156***	0.156**	0.152***	0.270***	0.165***	0.250***
	[0.051]	[0.075]	[0.051]	[0.076]	[0.045]	[0.069]
Capacity utilization	0.022***	0.022***	0.024***	0.026***	0.023***	0.028***
	[0.005]	[0.007]	[0.005]	[0.007]	[0.005]	[0.007]
Rent land	-0.163***	-0.163**	-0.147***	-0.078	-0.070*	-0.043
	[0.041]	[0.069]	[0.043]	[0.070]	[0.039]	[0.063]
Trade union	-0.013***	-0.013*	-0.014***	-0.011	-0.011***	-0.01
	[0.003]	[0.007]	[0.003]	[0.007]	[0.003]	[0.006]
Observations	2439	2439	2439	2439	2439	2439
R2	0.19	0.19	0.87	0.86	0.89	0.88

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
[2] The restricted Solow Residual is obtained using cost shares for inputs (labor, materials and capital) calculated as averages across all plants in the three countries in years 2001, 2002 and 2003 (excluding outliers).
[3] The regressions include a constant, industry dummies and year dummies.
[4] Hausman Tests for endogeneity of the regressors do not reject the null hypotheses (exogeneity) in all the cases except for exports.

Table C.2: IC Elasticities and Semielasticities with respect to Productivity; Unrestricted Estimation.

	Two step estimation Solow's Residual		One step estimation Cobb-Douglas		Translog	
	Pool OLS	Random Efts.	Pool OLS	R. E.	Pool OLS	R.E.
Explanatory variables	**Dep. Var: Restr. Solow's Resid.**		**Dep. Var: log of sales.**			
Infrastructures						
Days to clear customs for exports	-0.049	-0.049	-0.104	-0.019	-0.124*	-0.091
	[0.083]	[0.116]	[0.079]	[0.117]	[0.069]	[0.104]
Power outages	-0.135**	-0.135*	-0.146***	-0.206**	-0.177***	-0.232***
	[0.054]	[0.081]	[0.050]	[0.080]	[0.043]	[0.071]
Shipment losses	-0.109***	-0.109**	-0.119***	-0.154***	-0.076***	-0.097**
	[0.029]	[0.047]	[0.030]	[0.047]	[0.028]	[0.043]
Internet page	0.021	0.021	0.05	0.077	0.056*	0.046
	[0.034]	[0.064]	[0.033]	[0.064]	[0.032]	[0.056]
Red Tape, Corruption and Crime						
Security	-0.052**	-0.052*	-0.062***	-0.061**	-0.033*	-0.024
	[0.021]	[0.027]	[0.020]	[0.028]	[0.017]	[0.025]
Number of inspections	-0.074	-0.074	-0.083	-0.138	-0.176**	-0.241**
	[0.087]	[0.131]	[0.083]	[0.130]	[0.074]	[0.114]
Cost of entry	-0.142***	-0.142**	-0.123***	-0.162**	-0.072*	-0.138**
	[0.036]	[0.072]	[0.036]	[0.071]	[0.037]	[0.063]
Absenteeism	-0.166**	-0.166*	-0.085	-0.12	-0.083*	-0.147*
	[0.072]	[0.098]	[0.061]	[0.099]	[0.045]	[0.089]
Finance and Corporate Governance						
Financing Line Program	0.039**	0.039	0.032*	0.037	0.018	0.018
	[0.018]	[0.029]	[0.017]	[0.029]	[0.014]	[0.025]
Quality, Innovation and Labor Skills						
R + D	0.073**	0.073	0.085**	0.134**	0.097***	0.135**
	[0.037]	[0.060]	[0.038]	[0.060]	[0.033]	[0.053]
Internal training	0.112***	0.112*	0.085**	0.169***	0.070**	0.135**
	[0.034]	[0.061]	[0.038]	[0.062]	[0.035]	[0.054]
University staff	0.005***	0.005***	0.003***	0.005***	0.003***	0.004***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Experience of the manager	0.329***	0.329***	0.246***	0.241**	0.158***	0.231**
	[0.086]	[0.121]	[0.076]	[0.120]	[0.060]	[0.107]
Other Control Variables						
Incorporated company	0.049	0.049	0.029	0.077	0.087***	0.094
	[0.035]	[0.066]	[0.035]	[0.066]	[0.032]	[0.058]
Foreign direct investment	0.210***	0.210***	0.214***	0.327***	0.147***	0.295***
	[0.057]	[0.080]	[0.054]	[0.080]	[0.050]	[0.071]
Exporter	0.152***	0.152**	0.161***	0.237***	0.124***	0.162**
	[0.051]	[0.074]	[0.048]	[0.076]	[0.047]	[0.067]
Capacity utilization	0.022***	0.022***	0.028***	0.023***	0.019***	0.020***
	[0.005]	[0.007]	[0.006]	[0.007]	[0.005]	[0.007]
Rent land	-0.116***	-0.116*	-0.081*	-0.039	-0.053	-0.034
	[0.042]	[0.068]	[0.043]	[0.068]	[0.038]	[0.060]
Trade union	-0.014***	-0.014**	-0.011***	-0.01	-0.004	-0.006
	[0.003]	[0.007]	[0.004]	[0.007]	[0.003]	[0.006]
Observations	2439	2439	2439	2439	2439	2439
R2	0.24	0.24	0.88	0.88	0.91	0.91

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

[2] The restricted Solow Residual is obtained using cost shares for inputs (labor, materials and capital) calculated as averages across all plants in the three countries in years 2001, 2002 and 2003 (excluding outliers).

[3] The regressions include a constant, industry dummies and year dummies.

[4] Hausman Tests for endogeneity of the regressors do not reject the null hypotheses (exogeneity) in all the cases except for exports.

Table C.2b: IC Elasticities and Semielasticities With Respect to Productivity; Two Stage Least Squares (2SLS) Estimation.

	Two step estimation		One step estimation			
	Solow's Residual		Cobb-Douglas		Translog	
	Restricted	Unrestricted	Restricted	Unrestricted	Restricted	Unrestricted
Explanatory variables	**Dep. Var: Restr. Solow's Resid.**		**Dep. Var: log of sales.**			
Infrastructures						
Days to clear customs for exports	-0.042	-0.059	-0.053	-0.106	-0.072	-0.107
	[0.082]	[0.085]	[0.083]	[0.081]	[0.071]	[0.069]
Power outages	-0.128**	-0.134**	-0.149***	-0.142***	-0.204***	-0.183***
	[0.054]	[0.053]	[0.053]	[0.050]	[0.046]	[0.043]
Shipment losses	-0.124***	-0.109***	-0.118***	-0.116***	-0.127***	-0.074***
	[0.028]	[0.029]	[0.028]	[0.030]	[0.024]	[0.028]
Internet page	0.036	0.017	0.031	0.046	0.008	0.04
	[0.034]	[0.034]	[0.035]	[0.033]	[0.034]	[0.031]
Red Tape, Corruption and Crime						
Security	-0.053***	-0.052**	-0.045**	-0.064***	-0.051***	-0.036**
	[0.020]	[0.021]	[0.019]	[0.020]	[0.018]	[0.017]
Number of inspections	-0.068	-0.084	-0.107	-0.106	-0.121	-0.205***
	[0.086]	[0.086]	[0.086]	[0.082]	[0.077]	[0.074]
Cost of entry	-0.155***	-0.140***	-0.137***	-0.122***	-0.129***	-0.072*
	[0.034]	[0.036]	[0.038]	[0.035]	[0.030]	[0.039]
Absenteeism	-0.126*	-0.169**	-0.115*	-0.088	-0.095	-0.082*
	[0.070]	[0.072]	[0.069]	[0.061]	[0.060]	[0.044]
Finance and Corporate Governance						
Financing Line Program	0.039**	0.040**	0.034*	0.035**	0.017	0.02
	[0.019]	[0.018]	[0.018]	[0.017]	[0.016]	[0.014]
Quality, Innovation and Labor Skills						
R + D	0.059	0.070*	0.069*	0.083**	0.074**	0.084**
	[0.038]	[0.037]	[0.039]	[0.037]	[0.033]	[0.033]
Internal training	0.149***	0.108***	0.104***	0.085**	0.126***	0.068*
	[0.034]	[0.034]	[0.037]	[0.038]	[0.035]	[0.035]
University staff	0.006***	0.004***	0.005***	0.003***	0.004***	0.003***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Experience of the manager	0.304***	0.329***	0.259***	0.232***	0.218***	0.156***
	[0.084]	[0.086]	[0.082]	[0.076]	[0.075]	[0.059]
Other Control Variables						
Incorporated company	0.023	0.047	0.006	0.026	0.043	0.070**
	[0.036]	[0.035]	[0.037]	[0.035]	[0.034]	[0.031]
Foreign direct investment	0.208***	0.220***	0.216***	0.216***	0.159***	0.176***
	[0.056]	[0.058]	[0.058]	[0.054]	[0.051]	[0.050]
Exporter	0.156***	0.164***	0.169***	0.182***	0.174***	0.136***
	[0.051]	[0.051]	[0.051]	[0.048]	[0.045]	[0.047]
Capacity utilization	0.022***	0.022***	0.024***	0.027***	0.023***	0.019***
	[0.005]	[0.006]	[0.005]	[0.006]	[0.005]	[0.005]
Rent land	-0.163***	-0.116***	-0.142***	-0.076*	-0.075*	-0.062
	[0.041]	[0.042]	[0.042]	[0.042]	[0.039]	[0.038]
Trade union	-0.013***	-0.014***	-0.014***	-0.011***	-0.011***	-0.005
	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]	[0.003]
Observations	2439	2421	2421	2421	2421	2421
Instruments Evaluation (exports equation)						
F test (p-values)	0.000	0.000	0.000	0.000	0.000	0.000
Instruments Evaluation (FDI equation)						
F test (p-values)	0.000	0.000	0.000	0.000	0.000	0.000
Overidentifying Restrictions Hansen test (p-values.)	0.605	0.379	0.564	0.062	0.621	0.169

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
[1] Exports and FDI are endogenous and are instrumented with new technology purchased, days to clear customs for exports (industry-region averages), credit (i-r averages), derivatives, internal train, experience of the manager (i-r averages) and rent build.
[3] All regressions include a constant, industry dummies and year dummies.

Table C.2c: Levinsohn and Petrin and Ackerberg and Caves Estimation Procedures of Production Function Coefficients.

	Restricted Solow Residual; Cost-Shares[4]	Single Step Restricted OLS[5]	Levinsohn and Petrin		Ackerberg and Caves		
			Standard procedure	Modified with cost-shares procedure	Static Labor	Dynamic Labor	Non-Variable labor
Production Function Variables (Dependent variable: log of total sales)							
Labor	0.31	0.29***	0.27***	0.31	0.42***	0.43***	0.44***
Materials	0.59	0.51***	0.43***	0.43***	0.42***	0.35***	0.42***
Capital	0.1	0.20***	0.18***	0.18***	0.16***	0.17***	0.16***
Observations first step			2439	2439	*2439*	1626	2439
R^2 first step			0.89	0.89	0.87	0.89	0.893
Observations second step			1626	1626	1626	813	1626
R^2 second step			0.996	0.996	0.998	0.998	0.998
Results of the Regressions of IC and C Variables on the Probability Measures (Dependent Variable: Log of Productivity)							
Infrastructures							
Days to clear customs for exports	-0.042	-0.046	-0.040	-0.045	-0.065	-0.065	-0.068
Power outages	-0.128**	-0.148***	-0.187***	-0.182***	-0.164***	-0.190***	-0.159***
Shipment losses	-0.124***	-0.119***	-0.145***	-0.144***	-0.143***	-0.158***	-0.140***
Internet page	0.036	0.035	0.062*	0.055	0.023	0.036	0.016
Red Tape, Corruption and Crime							
Security	-0.053***	-0.046**	-0.033*	-0.035*	-0.046**	-0.038**	-0.049**
Number of inspections	-0.068	-0.091	-0.163*	-0.156*	-0.133	-0.180**	-0.124
Cost of entry	-0.155***	-0.139***	-0.141***	-0.137***	-0.126***	-0.121**	-0.124***
Absenteeism	-0.126*	-0.11	-0.118*	-0.110*	-0.077	-0.074	-0.085
Finance and Corporate Governance							
Financing Line Program	0.039**	0.033*	0.033*	0.033*	0.03	0.03	0.031*
Quality, Innovation and Labor Skills							
R + D	0.059	0.068*	0.119***	0.111***	0.081**	0.111***	0.072*
Internal training	0.149***	0.104***	0.154***	0.142***	0.100***	0.116***	0.089**
University staff	0.006***	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
Experience of the manager	0.304***	0.261***	0.245***	0.243***	0.236***	0.215***	0.235***
Other Control Variables							
Incorporated company	0.023	0.009	0.063*	0.055	0.030	0.057	0.022
Foreign direct investment	0.208***	0.212***	0.313***	0.305***	0.282***	0.344***	0.272***
Exporter	0.156***	0.152***	0.275***	0.261***	0.216***	0.286***	0.200***
Capacity utilization	0.022***	0.024***	0.028***	0.027***	0.027***	0.029***	0.026***
Rent land	-0.163***	-0.147***	-0.061	-0.067	-0.085**	-0.029	-0.093**
Trade union	-0.013***	-0.014***	-0.012***	-0.012***	-0.012***	-0.011***	-0.012***
Observations	2439	2439	2439	2439	2439	2439	2439
R^2	0.2	0.87	0.19	0.18	0.17	0.17	0.17

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

[2] The regressions include a constant, industry dummies and year dummies.

[3] Labor cost-share.

[4] Results of the two steps case, restricted case; inputs elasticities are the corresponding cost-shares; productivity regression is the OLS case.

[5] Results from the single step case, restricted estimation, Cobb-Douglas production function, OLS case.

Table C.2d: Correlations of Levinsohn & Petrin and Ackerberg & Caves Productivity Measures.

			Levinsohn and Petrin		Ackerberg and Caves[2]		
			Standard[1]	Mdf. with cost shares	Static Labor	Dynamic Labor	Non-Variable Labor
Two steps	**Solow's Residual**	**Restr.**	0.93	0.94	0.94	0.87	0.94
		Unrestr.	0.89	0.90	0.91	0.84	0.91
Single step Restricted	**Cobb-Douglas**	**OLS**	0.96	0.97	0.97	0.92	0.97
		RE	0.99	0.99	0.98	0.96	0.98
	Tanslog	**OLS**	0.89	0.89	0.89	0.85	0.90
		RE	0.95	0.95	0.94	0.91	0.93
Single step Unrestricted	**Cobb-Douglas**	**OLS**	0.77	0.78	0.77	0.74	0.77
		RE	0.75	0.75	0.75	0.71	0.76
	Translog	**OLS**	0.12	0.12	0.12	0.13	0.12
		RE	0.15	0.15	0.15	0.16	0.15

[1] Standard method simply applies the parametrical variation of the method explained in Levinsohn and Petrin (2002), the method modified with cost-shares uses the labor cost-share instead of the labor elasticity in estimating the capital and intermediate materials elasticities in the second stage of the estimation algorithm.

[2] The three methods of the Ackerberg and Caves algorithm, which are all widely explained in Ackerberg and Caves (2003), differ in the assumptions they use about labor.

Table C.3: Production Function Parameters from the Restricted Estimation

	Labor (L)	Materials (M)	Capital (K)	L2	M2	K2	L*M	L*K	M*K
Cost-shares	0.31	0.59	0.1						
Cobb-Douglas									
Pool OLS	0.29***	0.51***	0.20***	-	-	-	-	-	-
RE	0.28***	0.49***	0.13***	-	-	-	-	-	-
Test for CRS		OLS	Prob > F = 0.934		RE		Prob > chi2 = 0.0000		
Translog									
Pool OLS	1.27***	0.17	0.03	-0.09***	0.04***	0.01***	0.02	0.08***	-0.08***
RE	0.63***	0.24***	0.04	-0.07***	0.005*	0.02***	0.06***	0.03***	-0.05***
Test for CRS		OLS	Prob > F = 0.0000		RE		Prob > F = 0.0000		
Test for Cobb-Douglas		OLS	Prob > chi2 = 0.0000		RE		Prob > chi2 = 0.0000		

Notes:

(1) Significance is given by robust standard errors.* significant at 10%; ** significant at 5%; *** significant at 1%.

(2) The cost shares of labor, materials and capital are calculated as averages of the plant-level cost shares of labor, materials and capital across all plants in years 2001, 2002 and 2003 (excluding outliers).

(3) The sample generating the sets of production function coefficients is constituted by all plants in years 2001, 2002 and 2003 (excluding outliers).

Table C.4: Production Function Parameters from the Unrestricted Estimation by Industry; Cobb-Douglas Specification.

	Coefficients	Labor	Materials	Capital	Test for Constant Returns to Scale
Food and Beverages	Cost-share	0.20	0.69	0.11	
	Pool OLS	0.20***	0.58***	0.22***	Prob>F=0.846
	RE	0.31***	0.50***	0.14***	Prob > chi2 = 0.234
Chemicals	Cost-share	0.24	0.66	0.10	
	Pool OLS	0.46***	0.42**	0.18	Prob>F=0.063
	RE	0.44	0.41**	0.12	Prob > chi2 =0.67
Metal Products (excluding Machinery and Equipment)	Cost-share	0.27	0.64	0.09	
	Pool OLS	0.04**	0.78***	0.13*	Prob>F=0.028
	RE	0.18*	0.56	0.11	Prob > chi2 =0.006
Machinery and Equipment.	Cost-share	0.34	0.57	0.09	
	Pool OLS	0.43**	0.51	-0.001***	Prob>F=0.297
	RE	0.20	0.49	0.03**	Prob > chi2 = 0.0005
Wood and Cork Products (excluding Furniture)	Cost-share	0.26	0.64	0.09	
	Pool OLS	0.47***	0.53	0.05***	Prob>F=0.166
	RE	0.41	0.48	0.06**	Prob > chi2 =0.411
Paper Products.	Cost-share	0.21	0.67	0.13	
	Pool OLS	0.26	0.55	0.18	Prob>F=0.953
	RE	0.14*	0.68***	0.09	Prob > chi2 = 0.145
IT-Services	Cost-share	0.53	0.39	0.09	
	Pool OLS	0.40**	0.39***	0.30	Prob>F=0.029
	RE	0.27	0.41***	0.16	Prob > chi2 = 0.0000
Farm-Fishing	Cost-share	0.32	0.58	0.09	
	Pool OLS	0.07	0.50	0.34*	Prob>F=0.009
	RE	0.22	0.61***	0.13	Prob > chi2 = 0.3915

Notes:

(1) Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

(2) The cost shares of labor, materials and capital are calculated as averages of the plant-level cost shares of labor, materials and capital for each industry using all plants for years 2001, 2002 and 2003 (excluding outliers).

Table C.5: Production Function Parameters from the Unrestricted Estimation by Industry; Translog Specification.

	L	M	K	L2	M2	K2	L*M	L*K	M*K	Test for CD[1]	Test for CRS [1]
Food											
Pool OLS	0.0004	1.37***	0.24	-0.01	-0.005	0.04***	0.03	0.01	-0.08***	0.0000	0.011
RE	-0.67	1.69***	0.70***	0.02	-0.03***	0.05***	0.07***	-0.03*	-0.09***	0.0000	0.0000
Chemicals											
Pool OLS	0.54	1.28	-0.45***	0.03	0.06***	0.03	-0.12***	0.07*	-0.07	0.0000	0.0013
RE	-0.56	1.27	-0.22***	0.07	0.04***	0.04	-0.09***	0.03*	-0.07*	0.0000	0.267
Metal											
Pool OLS	0.60	-0.10***	0.67*	-0.06	0.06**	0.04	0.06	0.004	-0.12	0.036	0.283
RE	0.85	-0.03***	0.62	-0.08*	0.02**	0.05	0.12	-0.04	-0.10	0.0000	0.007
M & E											
Pool OLS	-1.86**	1.23	0.02	0.16**	0.05**	0.0005***	-0.14***	0.04	-0.03	0.0000	0.0000
RE	-1.21	1.17	-0.19	0.17*	0.04***	0.004***	-0.17***	-0.01	0.02***	0.014	0.001
Wood											
Pool OLS	-0.18	0.97	0.19	0.24***	0.15***	0.03	-0.34	-0.03	-0.04**	0.0000	0.0007
RE	-0.87	1.99	-0.33***	0.25***	0.11***	0.02***	-0.36***	0.04**	-0.03***	0.0000	0
Paper											
Pool OLS	0.34	0.06***	-0.09	-0.09	0.09***	0.03	0.02	0.14***	-0.16***	0.0000	0.0001
RE	-0.19	0.22**	-0.07	-0.04	0.05***	0.03	0.03	0.07*	-0.11	0.0009	0.636
IT											
Pool OLS	1.66**	-0.14***	0.65	-0.10*	0.06***	-0.04***	-0.02***	0.10**	-0.06	0.0000	0.0000
RE	2.01***	-0.38***	0.06***	-0.16***	0.02***	-0.01***	0.08	0.08***	-0.04***	0.0000	0.0000
Farm -Fish.											
Pool OLS	1.32	0.30**	0.39	-0.07	0.04	0.07	0.06	-0.02	-0.11	0.0000	0.049
RE	1.36**	-0.18***	0.73	-0.07*	0.01***	0.07*	0.13*	-0.11**	-0.08	0.0000	0.0000

Notes:

[1] p-values.

Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

The cost shares of labor, materials and capital are calculated as averages of the plant-level cost shares of labor, materials and capital for each industry using all plants for years 2001, 2002 and 2003 (excluding outliers).

Table D.1: Two Stage Least Squares (2SLS) Estimation of Employment Demand Equation; Coefficients and Percentage Contribution to the Average (log) Employment.

	Restricted Solow Residual		Unrestricted Solow Residual	
Explanatory Variables	*Coefficient*	*% Contribution*	*Coefficient*	*% Contribution*
Productivity				
Log of Productivity	-0.094*** [0.027]	-4.65	-0.078*** [0.028]	-3.72
Real Wage Per Employee				
Log of Real wage	-0.267*** [0.019]	-62.68	-0.270*** [0.019]	-63.50
Infrastructures				
Power outages	-0.079 [0.049]	-1.83	-0.081* [0.049]	-1.88
Internet page	0.124*** [0.041]	2.43	0.119*** [0.042]	2.35
Red Tape, Corruption and Crime				
Security	0.133*** [0.017]	23.63	0.134*** [0.017]	23.85
Number of inspections	-0.295*** [0.079]	-10.81	-0.297*** [0.079]	-10.92
Cost of entry	-0.779*** [0.246]	-0.77	-0.752*** [0.244]	-0.74
Absenteeism	-0.275*** [0.050]	-7.37	-0.279*** [0.050]	-7.47
Finance and Corporate Governance				
Trade association	0.184*** [0.038]	2.60	0.185*** [0.039]	2.61
External auditory	0.043*** [0.016]	2.22	0.043*** [0.016]	2.21
Quality, Innovation and Labor Skills				
Quality certification	0.233*** [0.049]	1.49	0.242*** [0.049]	1.55
New product	0.070* [0.037]	0.88	0.073* [0.037]	0.92
Internal training	0.239*** [0.040]	3.78	0.235*** [0.040]	3.72
External training	0.135*** [0.041]	2.11	0.135*** [0.041]	2.11
University staff	-0.003*** [0.001]	-1.75	-0.003*** [0.001]	-1.90
Experience of the manager	0.178*** [0.037]	2.87	0.182*** [0.037]	2.93
Other Control Variables				
Incorporated company	0.130*** [0.041]	2.72	0.132*** [0.041]	2.75
Age	0.008*** [0.001]	5.30	0.008*** [0.001]	5.32
Exporter	0.312*** [0.050]	2.05	0.312*** [0.050]	2.05
Trade union	0.014*** [0.003]	6.73	0.014*** [0.003]	6.64
Small	-1.898*** [0.061]	-21.37	-1.884*** [0.061]	-21.22
Medium	-1.007*** [0.053]	-6.01	-0.999*** [0.053]	-5.97
Observations	2253		2253	
Instruments Evaluation				
F test (p-values)	0.001		0.000	
Overidentifying Restrictions Hansen Test (p-values)	0.179		0.171	

[1] Dependent variable is defined as the total number of permanent workers total or part time (logs) (see equation ?.?).
[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
[2] Productivity is endogenous and is instrumented with: days to clear customs for exports (i-r averages), power outages (i-r averages), water outages (i-r averages), shipment losses (i-r averages), security (i-r averages), number of inspections (i-r averages), cost of entry, absenteeism (i-r averages).
[3] All regressions include a constant, industry dummies and year dummies.

Table D.2: Two Stage Least Squares (2SLS) Estimation of the Wage Equation.

	Restricted Solow Residual		**Unrestricted Solow Residual**	
Explanatory Variables	*Coefficient*	*% Contribution*	*Coefficient*	*% Contribution*
Productivity				
Log of Productivity[2]	0.569*** [0.074]	12.064	0.572*** [0.071]	13.008
Infrastructures				
Average duration of power outages	-0.140** [0.062]	-1.127	-0.142** [0.061]	-0.979
Internet page	0.371* [0.191]	3.144	0.377* [0.199]	3.617
Red Tape, Corruption and Crime				
Security	0.040* [0.024]	2.991	0.037 [0.024]	3.012
Cost of entry	-0.190*** [0.053]	-0.086	-0.194*** [0.052]	-0.093
Absenteeism	-0.035* [0.021]	-0.396	-0.038* [0.021]	-0.423
Finance and Corporate Governance				
Trade association	-0.123** [0.052]	-0.742	-0.121** [0.052]	-0.833
Credit line	0.836*** [0.284]	8.218	0.839*** [0.290]	7.842
External auditory	0.104** [0.046]	0.716	0.082* [0.045]	0.809
Quality, Innovation and Labor Skills				
University staff	0.007*** [0.001]	1.906	0.008*** [0.001]	2.125
Experience of the manager	-0.035* [0.018]	-0.769	-0.032* [0.018]	-0.847
Other Control Variables				
Foreign direct investment	0.122 [0.089]	0.218	0.122 [0.090]	0.211
Age	0.002** [0.001]	0.681	0.002** [0.001]	0.727
Trade union	0.010*** [0.004]	1.962	0.011*** [0.004]	2.166
Observations	2178		2178	
Instruments Evaluation				
F test (p-values)	0		0	
Overidentifying Restrictions Hansen Test (p-values)	0.801		0.822	

[1] Dependent variable enters the equation in in logs, ant it is defined as the total expenditures in labor, deflated by the whole manufacturing price index (base 1996), divided by the total number of permanent workers (total or part time) (see equation ?.?).
[2] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
[3] Productivity is endogenous and is instrumented with: days to clear customs for exports (industry-region averages), power outages (i-r averages), water outages (i-r averages), shipment losses (i-r averages), number of inspections (i-r averages), internal training, financing line program, incorporated company, capacity utilization (i-r averages) and rent land.
[4] The regressions include a constant, industry dummies and year dummies.

Table E.1a: Two Stage Least Squares (2SLS) Estimation of Exporting Decisions; Coefficients and Percentage Impact on the Probability of Exporting.

Productivity Measure Used:	**Restricted Solow Residual**		**Unrestricted Solow Residual**	
	Coefficients	*% Probability contribution*	*Coefficients*	*% Probability contribution*
Productivity				
Log of Productivity	0.036*** [0.011]	27.23	0.033*** [0.011]	24.11
Infrastructures				
E-mail	0.151*** [0.023]	58.00	0.152*** [0.024]	58.27
Red Tape, Corruption and Crime				
Illegal payments for protection	-0.255*** [0.045]	-5.54	-0.202*** [0.044]	-4.38
Finance and Corporate Governance				
Trade association	0.296*** [0.091]	64.78	0.175* [0.093]	38.26
Derivatives	0.126*** [0.032]	6.11	0.111*** [0.032]	5.40
External auditory	0.066*** [0.017]	16.47	0.059*** [0.017]	14.65
Quality, Innovation and Labor Skills				
Quality certification	0.129*** [0.023]	12.53	0.126*** [0.023]	12.23
R+D	0.057*** [0.018]	10.44	0.063*** [0.018]	11.52
New technology purchased	0.060*** [0.019]	6.46	0.072*** [0.019]	7.79
Internal training	0.058*** [0.017]	13.97	0.054*** [0.017]	13.05
Experience of the manager	0.120*** [0.028]	95.08	0.063** [0.029]	49.70
Other Control Variables				
Incorporated company	0.100*** [0.016]	31.71	0.099*** [0.016]	31.41
Age	-0.001*** [0.000]	-13.21	-0.001*** [0.000]	-11.08
Rent buildings	0.031* [0.018]	9.09	0.031* [0.018]	9.22
Observations	2319		2319	
Instruments Evaluation				
F test (p-values)	0.000		0.000	
Overidentifying Restrictions Hansen Test (p-values)	0.145		0.092	

[1] Dependent variable is a dichotomous variable that takes value one if the firm exports at least the 10% of it production and zero otherwise (Exporter) (see equation ?.?).
[2] Productivity is endogenous and is instrumented with: power outages (i-r averages), shipment losses (i-r averages), security (i-r averages), cost of entry, internal training, university staff, financing line program and rent land.
[3] Specification also includes a constant term, industry and year dummies.
[4] Significance is given by robust standard errors. *significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.1b: Modeling the Probability of Export; Comparison Between Probit and Linear Probability Models.

	Probit		Linear Probability
	Coefficients	**Marginal Effects**	**Coefficients**
Log of Productivity	0.156***	0.039***	0.035***
Infrastructures			
E-mail	0.691***	0.127***	0.151***
Red Tape, Corruption and Crime			
Payments for protection	-0.869***	-0.217***	-0.203***
Finance and Corporate Governance			
Trade association	0.637*	0.156	0.178*
Derivatives	0.374***	0.107***	0.108***
External auditory	0.280***	0.068***	0.060***
Quality, Innovation and Labor Skills			
Quality certification	0.300***	0.082***	0.127***
R+D	0.282***	0.073***	0.063***
New technology purchased	0.252***	0.067***	0.072***
Internal training	0.246***	0.060***	0.052***
Experience of the manager	0.222**	0.058**	0.062**
Other Control Variables			
Incorporated Company	0.474***	0.105***	0.099***
Age	-0.003**	-0.001**	-0.001***
Rent buildings	0.12	0.029	0.033*
Observations	2382	2382	2322

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.
[2] The regressions include a constant, industry dummies and year dummies.

Table E.2a: Two Stage Least Squares (2SLS) Estimation of Foreign Direct Investment Decisions; Linear Probability Coefficients and Percentage Impact on the Probability of Receiving Foreign Direct Investment.

Productivity Measure Used:	**Restricted Solow Residual**		**Unrestricted Solow Residual**	
	Coefficients	*% Probability contribution*	*Coefficients*	*% Probability contribution*
Productivity				
Log of Productivity	0.031*** [0.009]	36.49	0.032*** [0.010]	36.46
Infrastructures				
Days to clear customs for imports	-0.072** [0.033]	-67.14	-0.072** [0.033]	-66.61
Finance and Corporate Governance				
Trade association	0.046*** [0.016]	15.36	0.046*** [0.016]	15.37
Credit	0.146** [0.068]	80.74	0.144** [0.068]	79.42
Derivatives	0.069** [0.030]	5.24	0.071** [0.030]	5.44
External auditory	0.057*** [0.013]	21.83	0.055*** [0.013]	21.24
Quality, Innovation and Labor Skills				
Quality certification	0.055** [0.023]	8.37	0.053** [0.023]	8.13
R+D new product	0.177** [0.079]	11.86	0.174** [0.079]	11.70
Internal training	0.088*** [0.014]	33.40	0.090*** [0.014]	33.93
University staff	0.002*** [0.000]	32.80	0.002*** [0.000]	33.49
Other Control Variables				
Rent buildings	0.095*** [0.014]	43.77	0.094*** [0.014]	43.51
Observations	2325		2325	
Instruments Evaluation				
F test (p-values)	0.000		0.000	
Overidentifying Restrictions Hansen Test (p-values)	0.117		0.112	

[1] Dependent Variable is a dichotomous variable that takes value one if any part of firm's capital is foreign and zero otherwise (see equation ?.?).

[2] Productivity is endogenous and is instrumented with: days to clear customs for exports (industry-region averages), power outages (i-r averages), shipment losses (i-r averages), security (i-r averages), number of inspections (i-r averges), internal training, university staff, financing line program, incorporated company, capacity utilization (i-r averages), trade union (i-r averages) and rent land.

[3] Specification also includes a constant, industry and year dummies.

[4] Significance is given by robust standard errors. *significant at 10%; ** significant at 5%; *** significant at 1%.

Table E.2b: Modeling the Probability of Receiving Foreign Direct Investment; Comparison between Probit and Linear Probability Models.

	Probit		Linear Probability
	Coefficients	**Marginal Effects**	**Coefficients**
Log of Productivity	0.137***	0.025***	0.033***
Infrastructures			
Days to clear customs for imports	-0.327**	-0.059**	-0.071**
Finance and Corporate Governance			
Trade association	0.255***	0.046***	0.052***
Credit	0.748**	0.136**	0.162**
Derivatives	0.191*	0.038*	0.066**
External auditory	0.347***	0.061***	0.062***
Quality, Innovation and Labor Skills			
Quality certification	0.172**	0.033*	0.053**
I+D new product	1.119**	0.203**	0.184**
Internal training	0.494***	0.086***	0.081***
University staff	0.012***	0.002***	0.002***
Other Control Variables			
Rent buildings	0.583***	0.092***	0.088***
Observations	2346	2346	2346

[1] Significance is given by robust standard errors. * significant at 10%; ** significant at 5%; *** significant at 1%.

[2] The regressions include a constant, industry dummies and year dummies.

Table F: Percentage Contribution of IC and C Variables to the Olley and Pakes Decomposition of the Aggregate Productivity in Logs; Restricted Solow Residual.

	Aggregate Productivity	Average Productivity	Efficiency Term
Infrastructures			
Days to clear customs for exports	-2.46	-2.46	0.00
Power outages	-5.87	-5.8	-0.07
Shipment losses	-6.72	-6.6	-0.12
Internet page	1.39	1.37	0.02
Cumulative Contribution	*-13.66*	*-13.49*	*-0.17*
Red Tape, Corruption and Crime			
Security	-18.55	-18.36	-0.19
Number of inspections	-5.01	-4.93	-0.08
Cost of entry	-0.30	-0.33	0.03
Absenteeism	-6.61	-6.58	-0.03
Cumulative Contribution	*-30.47*	*-30.20*	*-0.27*
Finance and Corporate Governance			
Financing Line Program	2.05	2.02	0.03
Cumulative Contribution	*2.05*	*2.02*	*0.03*
Quality, Innovation and Labor Skills			
R + D	1.46	1.38	0.08
Internal training	4.80	4.61	0.19
University staff	7.69	7.81	-0.12
Experience of the manager	30.97	30.78	0.19
Cumulative Contribution	*44.92*	*44.58*	*0.34*
Other Control Variables			
Incorporated company	0.95	0.93	0.02
Foreign direct investment	1.92	1.73	0.19
Exporter	2.24	2.03	0.21
Capacity utilization	93.21	93.32	-0.11
Rent land	-6.39	-6.21	-0.18
Trade union	-11.92	-11.54	-0.38
Cumulative Contribution	*80.01*	*80.26*	*-0.25*
Sector Dummies			
Chemicals	-3.32	-3.14	-0.18
Metal Products	-6.39	-6.67	0.28
Mach. and Eq.	-1.43	-1.48	0.05
Wood and Cork Prods.	-1.88	-1.88	0.00
Paper Products	-1.71	-1.66	-0.05
IT Services	-6.55	-7.17	0.62
Farm-Fishing	-0.85	-0.83	-0.02
Year Dummies			
2002	1.04	1.04	0.00
2003	0.69	0.69	0.00
Constant and residual			
Constant	35.10	35.1	0.00
Residual	2.41	0	2.41
Total effect	**100**	**97.17**	**2.79**

[1]The total effect of the efficiency term may by decomposed in the terms of covariances of inputs (labor, materials and capital) and the effect of productivity with every IC variable (see equation ?.?), this way the total 2.79% contribution is decomposed in 0.00% contribution of labor,- 0.30% contribution of materials, 0.09% contribution of capital and 2.62% contribution of productivity.

Table G: Approximate* Percentage Contribution of IC and C Variables to Aggregate Productivity Based on the Olley and Pakes Decomposition in Levels; Restricted Solow Residual.

	Aggregate Productivity	Average Productivity	Efficiency Term
Infrastructures			
Days to clear customs for exports	-0.72	-0.42	-0.29
Power outages	-1.62	-0.96	-0.66
Shipment losses	-2.20	-1.17	-1.03
Internet page	0.49	0.25	0.24
Cumulative Contribution	*-4.04*	*-2.30*	*-1.75*
Red Tape, Corruption and Crime			
Security	-5.56	-3.03	-2.53
Number of inspections	-1.48	-0.79	-0.68
Cost of entry	-0.08	-0.03	-0.05
Absenteeism	-1.86	-1.06	-0.79
Cumulative Contribution	*-8.97*	*-4.92*	*-4.05*
Finance and Corporate Governance			
Financing Line Program	0.70	0.38	0.33
Cumulative Contribution	*0.70*	*0.38*	*0.33*
Quality, Innovation and Labor Skills			
R + D	0.76	0.26	0.51
Internal training	2.16	0.88	1.28
University staff	3.03	1.88	1.15
Experience of the manager	9.54	5.24	4.30
Cumulative Contribution	*15.49*	*8.26*	*7.24*
Other Control Variables			
Incorporated company	0.34	0.17	0.17
Foreign direct investment	1.46	0.43	1.02
Exporter	1.23	0.35	0.88
Capacity utilization	27.27	16.24	11.03
Rent land	-2.38	-0.96	-1.43
Trade union	-3.73	-1.74	-1.99
Cumulative Contribution	*24.18*	*14.49*	*9.69*
Sector Dummies			
Chemicals	-1.28	-0.54	-0.74
Metal Products	-0.71	-0.61	-0.10
Mach. and Eq.	-0.08	-0.21	0.14
Wood and Cork Prods.	-0.52	-0.32	-0.20
Paper Products	-0.26	-0.20	-0.06
IT Services	-2.08	-1.84	-0.24
Farm-Fishing	-0.17	-0.15	-0.02
Year Dummies			
2002	0.11	0.17	0.05
2003	0.45	0.24	0.21
Constant and residual			
Lagged Productivity	10.17	5.96	4.22
Productivity Residual	12.61	4.34	8.27
Residual Mean	0.91	0.91	0.00
Residual Covariance	29.98	0.00	29.98
Constant (C_0)	22.91	22.91	0.00
Total effect	**100.00**	**46.55**	**52.97**

*Approximation based on the fitted values from the regression: $\hat{P}_{jit} = \hat{C}_0 + \hat{a}\, P_{jit-1} \log P_{jit}$, the R^2 of such regression was -.
All numbers are percentages with respect to aggregate productivity.

Table H.1: Simultaneous Effects among Dependent and ICA Variables (System of Equations in Structural Form).

			Dependent variable				
	Explanatory variable	**Output**	**Productivity**	**Employment**	**Wage**	**Exports**	**FDI**
Production Function Variables	Employment	0.31	-	-	-	-	-
	Materials	0.59	-	-	-	-	-
	Capital stock	0.1	-	-	-	-	-
	Productivity	1	-	-0.086	0.475	0.035	0.032
	Real wage	-	-	-0.269	-	-	-
Infrastructures	Days to clear customs to export	-	-0.066	-	-	-	-
	Days to clear customs to import	-	-	-	-	-	-0.07
	Av. duration of power outages	-	-	-	-0.152	-	-
	Power outages	-	-0.17	-0.08	-	-	-
	Shipment losses	-	-0.123	-	-	-	-
	E-mail	-	-	-	-	0.152	-
	Intemet page	-	0.041	0.122	0.304	-	-
Red Tape, Corruption and Crime	Security	-	-0.048	0.134	0.035	-	-
	Number of inspections	-	-0.12	-0.296	-	-	-
	Cost of entry	-	-0.138	-0.766	-0.207	-	-
	Absenteeism	-	-0.123	-0.277	-0.036	-	-
	Illegal payments for protection	-	-	-	-	-0.225	-
Finance and Corporate Governance	Financing Line Program	-	0.031	-	-	-	-
	Trade association	-	-	0.185	-0.142	0.236	0.046
	Credit line	-	-	-	0.761	-	0.145
	Derivatives	-	-	-	-	0.119	0.07
	External auditory	-	-	0.043	0.096	0.063	0.056
Quality and Innovation	Quality certification	-	-	0.238	-	0.128	0.054
	R + D	-	0.091	-	-	0.06	-
	R+D new product	-	-	-	-	-	0.176
	New product	-	-	0.072	-	-	-
	New technology purchased	-	-	-	-	0.066	-
	Internal training	-	0.133	0.237	-	0.056	0.089
	External training	-	-	0.135	-	-	-
	University staff	-	0.005	-0.003	0.009	-	0.002
	Experience of the manager	-	0.264	0.18	-0.034	0.092	-
Other Control Variables	Incorporated company	-	0.053	0.131	-	0.1	-
	Foreign direct investment	-	0.231	-	0.126	-	-
	Age	-	-	0.008	0.002	-0.001	-
	Exporter	-	0.178	0.312	-	-	-
	Capacity utilization	-	0.023	-	-	-	-
	Rent land	-	-0.092	-	-	-	-
	Rent buildings	-	-	-	-	0.031	0.095
	Trade union	-	-0.011	0.014	0.009	-	-
	Small	-	-	-1.891	-	-	-
	Medium	-	-	-1.003	-	-	-

Table H.2: Net ICA Coefficients on Productivity, Real Wages, Employment, Export and FDI (System of Equations in Reduced Form).

			Dependent variable				
	Explanatory variable	**Output**	**Productivity**	**Employment**	**Wage**	**Exports**	**FDI**
Infrastructures	Days to clear customs to export		-0.066	-0.004	-0.032	-0.002	-0.002
	Days to clear customs to import		-0.016	-0.003	-0.017	-0.001	-0.071
	Av. duration of power outages		-	-0.041	-0.152	-	-
	Power outages		-0.172	-0.089	-0.083	-0.006	-0.006
	Shipment losses		-0.124	-0.007	-0.06	-0.004	-0.004
	E-mail		0.027	0.049	0.013	0.152	0.001
	Internet page		0.042	0.205	0.324	0.001	0.001
Red Tape, Corruption and Crime	Security		-0.048	0.14	0.012	-0.002	-0.002
	Number of inspections		-0.121	-0.303	-0.058	-0.004	-0.004
	Cost of entry		-0.14	-0.829	-0.274	-0.005	-0.004
	Absenteeism		-0.125	-0.293	-0.096	-0.004	-0.004
	Illegal payments for protection		-0.041	-0.072	-0.019	-0.226	-0.001
Finance and Corporate Governance	Financing Line Program		0.032	0.002	0.015	0.001	0.001
	Trade association		0.053	0.224	-0.111	0.237	0.048
	Credit line		0.034	0.211	0.795	0.001	0.146
	Derivatives		0.038	0.041	0.027	0.12	0.071
	External auditory		0.024	0.092	0.115	0.063	0.057
Quality and Innovation	Quality certification		0.036	0.281	0.024	0.129	0.055
	R + D		0.103	0.024	0.049	0.064	0.003
	R+D new product		0.041	0.008	0.042	0.001	0.177
	New product		-	0.072	-	-	-
	New technology purchased		0.012	0.021	0.006	0.066	0
	Internal training		0.166	0.266	0.091	0.062	0.094
	External training		-	0.135	-	-	-
	University staff		0.005	0	0.011	0	0.002
	Experience of the manager		0.284	0.215	0.102	0.101	0.009
Other Control Variables	Incorporated company		0.071	0.166	0.034	0.102	0.002
	Foreign direct investment		0.231	-	0.126	-	-
	Age		0	0.008	0.002	-0.001	0
	Exporter		0.178	0.312	-	-	-
	Capacity utilization		0.024	0.001	0.011	0.001	0.001
	Rent land		-0.093	-0.005	-0.045	-0.003	-0.003
	Rent buildings		0.028	0.014	0.025	0.032	0.095
	Trade union		-0.011	0.016	0.004	0	0
	Small		-	-1.891	-	-	-
	Medium		-	-1.003	-	-	-

Table H.3: Simultaneous Effects among Average Values of Dependent and ICA Variables; Effects from Average Values of Productivity, Real Wages, Employment, Exports and FDI (System of Equations in Structural Form)

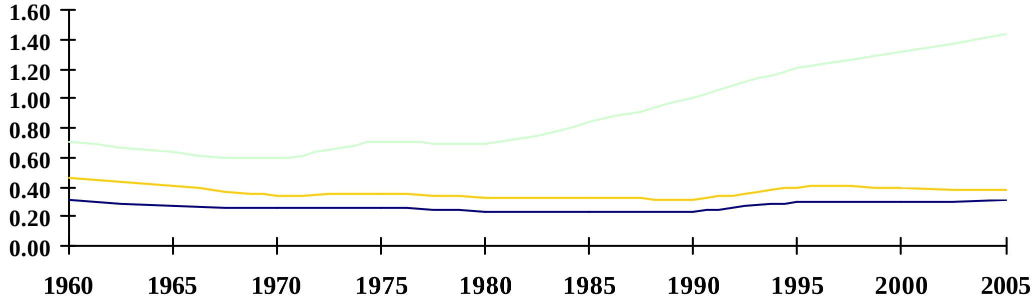
			Dependent Variable				
	Explanatory Variables	**Output**	**Productivity**	**Employment**	**Wage**	**Export**	**FDI**
Production Function Variables	Employment						
	Materials						
	Capital stock						
	Productivity		-	-4.279	10.073	26.116	37.444
	Real wage		-	-63.051	-	-	-
Infrastructures	Days to clear customs to export		-3.937	-	-	-	-
	Days to clear customs to import		-	-	-	-	-64.952
	Av. duration of power outages		-	-	-6.751	-	-
	Power outages		-7.915	-1.853	-	-	-
	Shipment losses		-6.745	-	-	-	-
	E-mail		-	-	-	58.037	-
	Internet page		1.633	2.388	2.542	-	-
Red Tape, Corruption and Crime	Security		-16.699	23.354	2.622	-	-
	Number of inspections		-8.736	-10.737	-	-	-
	Cost of entry		-0.274	-0.755	-0.087	-	-
	Absenteeism		-6.645	-7.427	-0.411	-	-
	Illegal payments for protection		-	-	-	-4.887	-
Finance and Corporate Governance	Financing Line Program		1.663	-	-	-	-
	Trade association		-	2.607	-0.854	50.617	15.526
	Credit line		-	-	7.469	-	79.844
	Derivatives		-	-	-	5.759	5.343
	External auditory		-	0.692	0.659	15.302	21.53
Quality, Innovation and Labor Skills	Quality certification		-	1.521	-	12.423	8.262
	R + D		2.196	-	-	10.981	-
	R+D new product		-	-	-	-	17.507
	New product		-	0.906	-	-	-
	New technology purchased		-	-	-	7.142	-
	Internal training		4.236	3.751	-	13.485	33.653
	External training		-	2.104	-	-	-
	University staff		6.104	-1.953	2.356	-	31.098
	Experience of the manager		27.276	9.265	-0.745	71.653	-
Other Control Variables	Incorporated company		2.198	2.729	-	31.533	-
	Foreign direct investment		1.944	-	0.224	-	-
	Age		-	5.295	0.676	-10.07	-
	Exporter		2.353	2.051	-	-	-
	Capacity utilization		99.853	-	-	-	-
	Rent land		-3.57	-	-	-	-
	Rent buildings		-	-	-	9.091	43.52
	Trade union		-10.291	6.567	1.778	-	-
	Small		-	-21.294	-	-	-
	Medium		-	-5.992	-	-	-

Table H.4: Net ICA Contributions to Average Values of Productivity, Real Wages, Employment, Exports and FDI (System of Equations in Reduced Form).

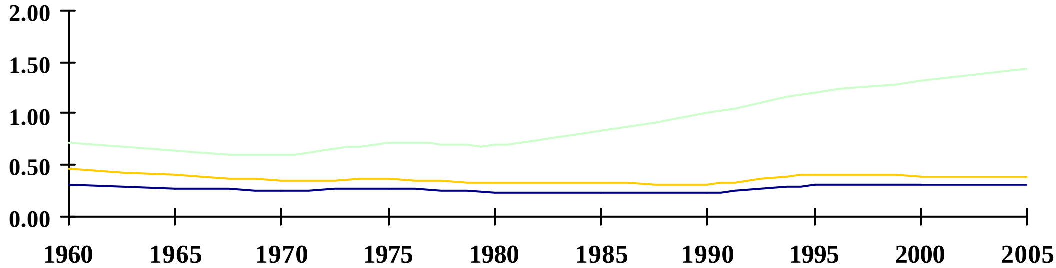
			Dependent Variable				
	Explanatory Variables	**Output**	**Productivity**	**Employment**	**Wage**	**Export**	**FDI**
Infrastructures	Days to clear customs to export		-3.991	-0.106	-0.405	-1.057	-1.518
	Days to clear customs to import		-1.28	-0.126	-0.276	-0.339	-65.439
	Av. duration of power outages		-	-4.256	-6.751	-	-
	Power outages		-8.024	-2.067	-0.815	-2.126	-3.052
	Shipment losses		-6.839	-0.182	-0.694	-1.812	-2.601
	E-mail		1.384	1.227	0.14	58.404	0.526
	Internet page		1.654	4.035	2.71	0.438	0.629
Red Tape, Corruption and Crime	Security		-16.93	24.556	0.904	-4.486	-6.44
	Number of inspections		-8.854	-10.973	-0.899	-2.346	-3.368
	Cost of entry		-0.278	-0.817	-0.115	-0.074	-0.106
	Absenteeism		-6.735	-7.865	-1.095	-1.785	-2.562
	Illegal payments for protection		-0.116	-0.103	-0.012	-4.917	-0.044
Finance and Corporate Governance	Financing Line Program		1.687	0.045	0.171	0.447	0.642
	Trade association		1.513	3.168	-0.666	51.018	16.101
	Credit line		1.573	4.864	7.808	0.417	80.443
	Derivatives		0.243	0.132	0.037	5.824	5.435
	External auditory		0.789	1.473	0.788	15.511	21.83
Quality, Innovation and Labor Skills	Quality certification		0.459	1.8	0.065	12.545	8.437
	R + D		2.487	0.291	0.252	11.64	0.946
	R+D new product		0.345	0.034	0.074	0.091	17.638
	New product		-	0.906	-	-	-
	New technology purchased		0.17	0.151	0.017	7.187	0.065
	Internal training		5.28	4.216	0.612	14.884	35.662
	External training		-	2.104	-	-	-
	University staff		6.845	-0.241	3.121	1.814	33.702
	Experience of the manager		29.364	11.047	2.235	79.433	11.17
Other Control Variables	Incorporated company		2.98	3.455	0.302	32.323	1.134
	Foreign direct investment		1.944	-	0.224	-	-
	Age		-0.24	5.509	0.652	-10.133	-0.091
	Exporter		2.353	2.051	-	-	-
	Capacity utilization		101.45	2.703	10.298	26.879	38.59
	Rent land		-3.619	-0.096	-0.367	-0.959	-1.377
	Rent buildings		1.074	0.277	0.207	9.376	43.929
	Trade union		-10.417	7.41	0.72	-2.76	-3.963
	Small		-	-21.294	-	-	-
	Medium		-	-5.992	-	-	-

Figure 1

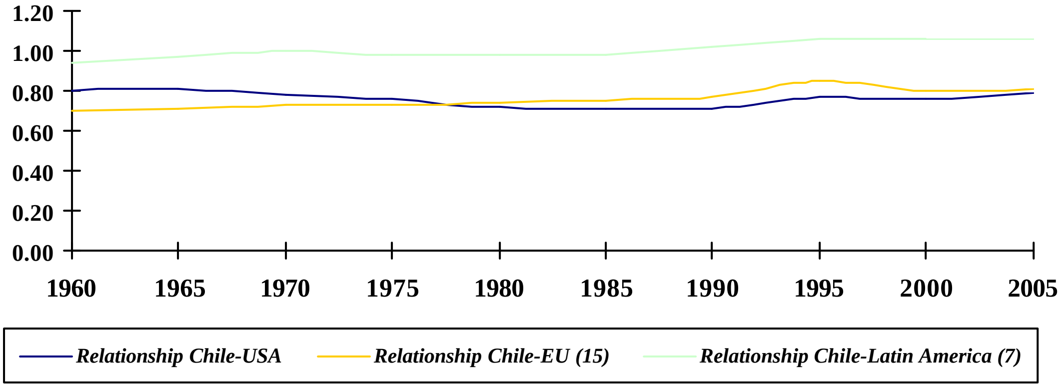
Per Capita Income in Chile Relative to U.S, E.U (15) and Latin America (7) (1960-2005)



Labor Productivity in Chile Relative to U.S, E.U (15) and Latin America (7) (1960-2005)



Employment-Population Rate in Chile Relative to U.S, E.U (15) and Latin America (7) (1960-2005)



NOTES:

1. European Union includes: Austria, Belgium, Denmark, Deutschland, Finland, France, Great Britain, Greece, Ireland, Italy, Luxemburg, Netherlands, Spain, Sweden and Portugal.
2. Latin America includes: Argentina, Brazil, Colombia, Ecuador, Mexico, Peru and Venezuela.
3. Per capita income (Y/P) is decomposed into labor productivity (y/L) and the employment-population rate (L/P) by following the next expression: Y/P=(Y/L)*(L/P); relative to the United States the decomposition becomes: $[(Y^{CH}/P^{CH})/(Y^{US}/P^{US})]= [(Y^{CH}/L^{CH})/(Y^{US}/L^{US})]*[(L^{CH}/P^{CH})/(L^{US}/P^{US})]$.

Source: Penn World Table; Center for International Comparisons at the University of Pennsylvania (CICUP).

Figure 2

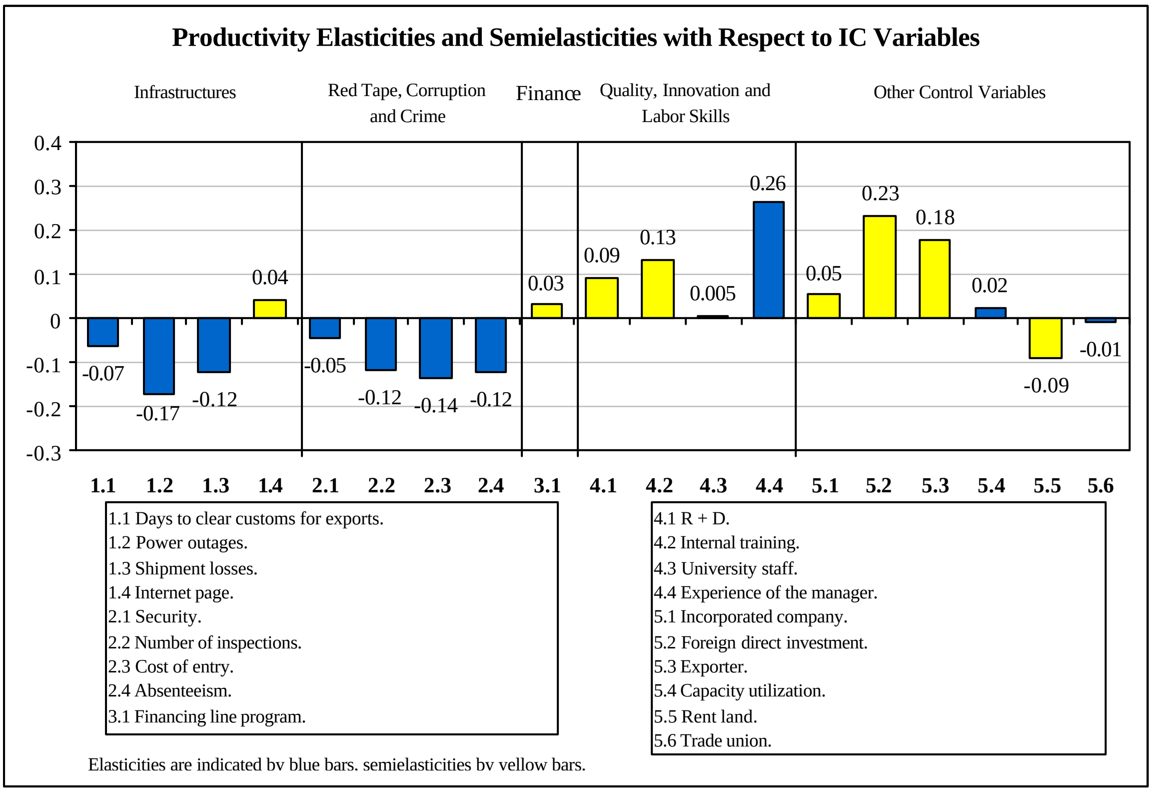


Figure 3

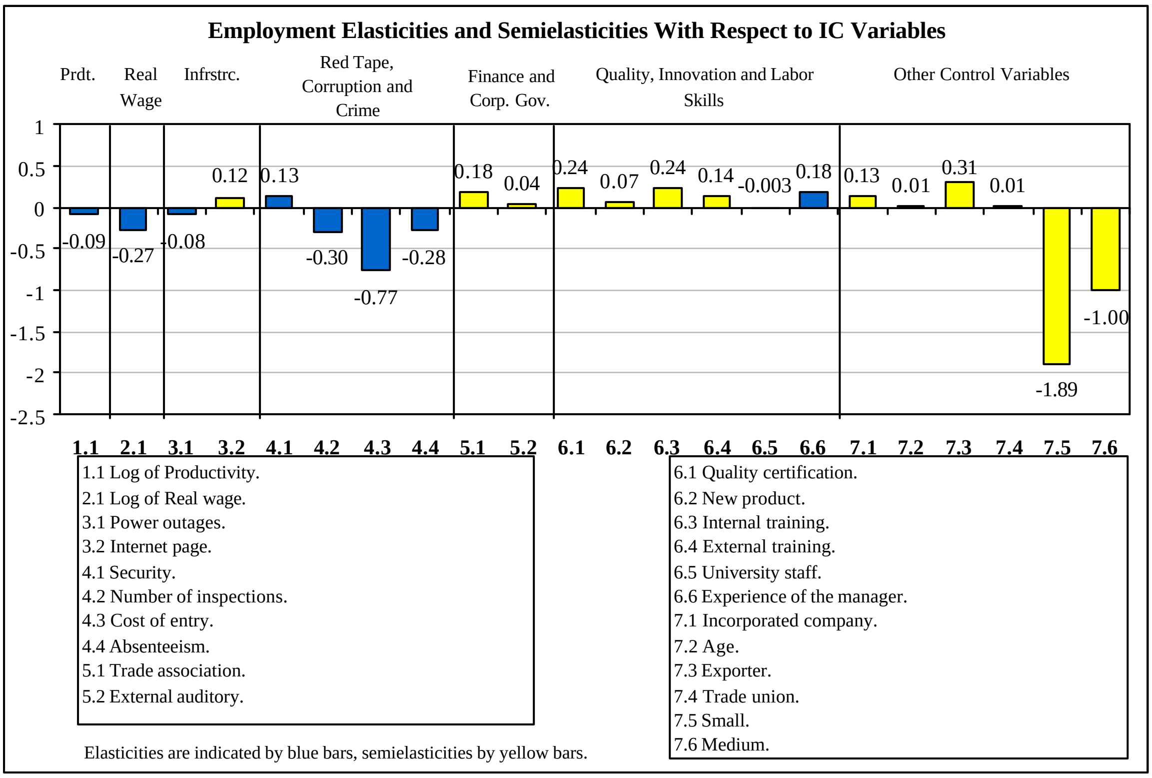


Figure 4

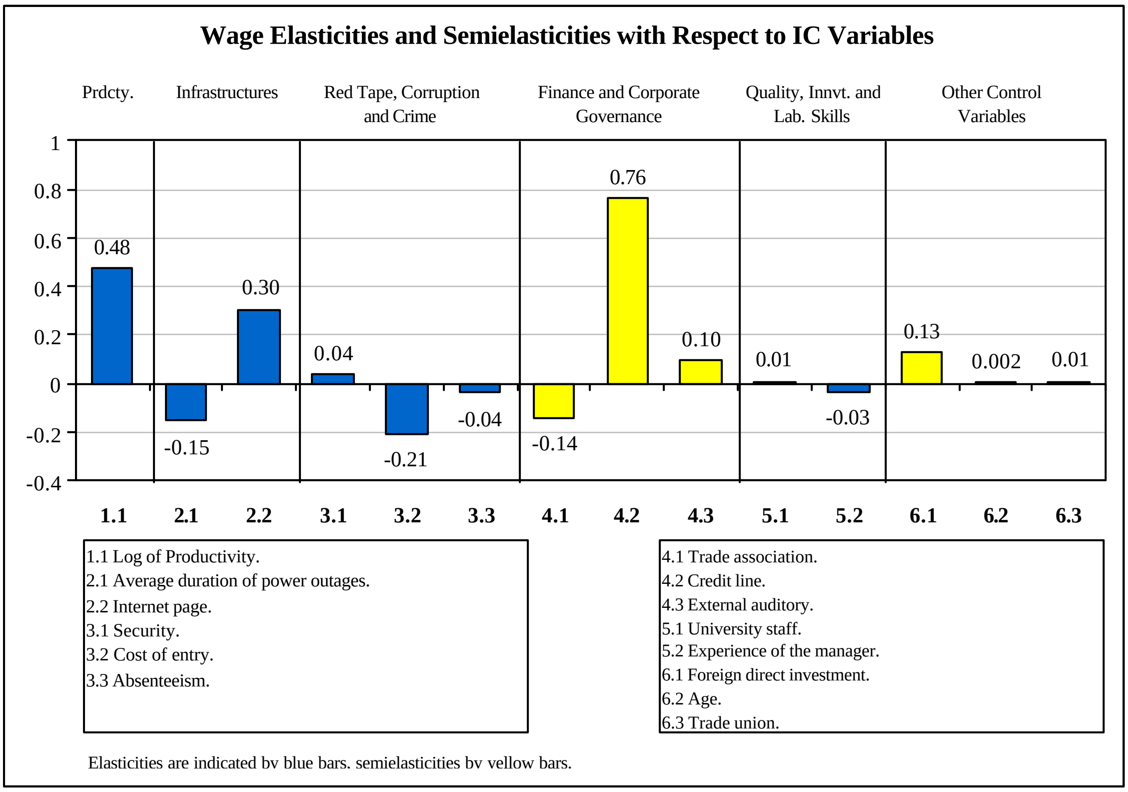


Figure 5

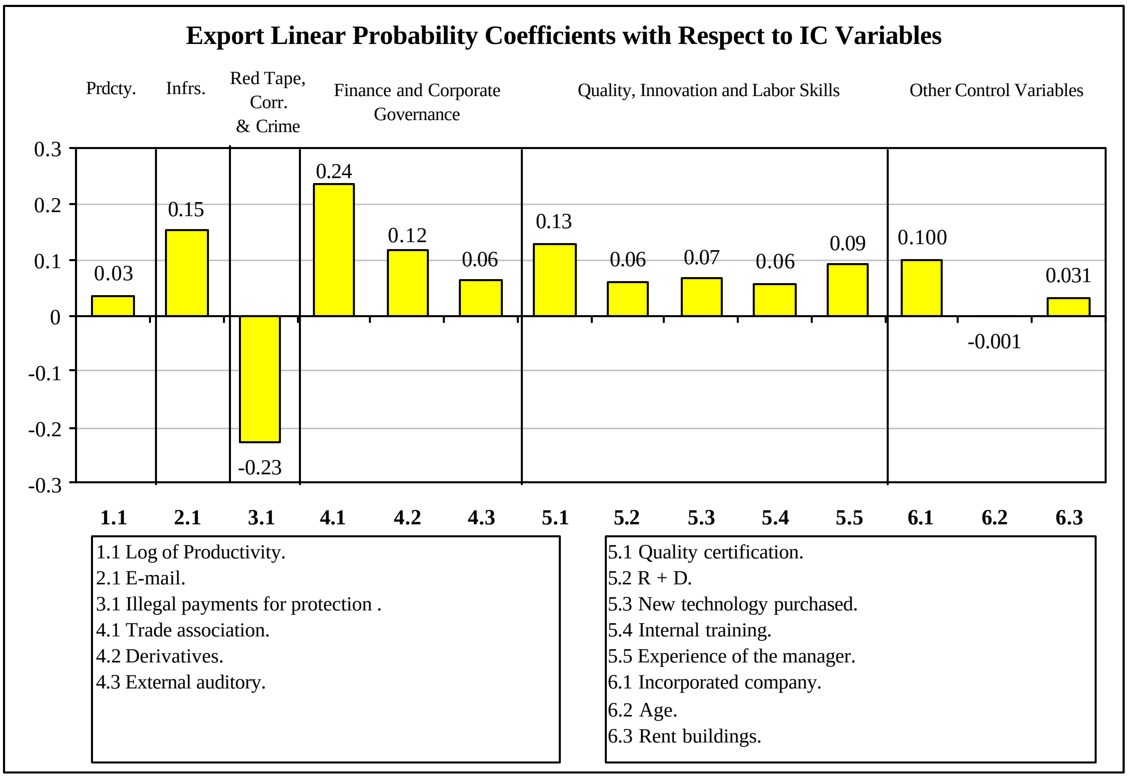


Figure 6

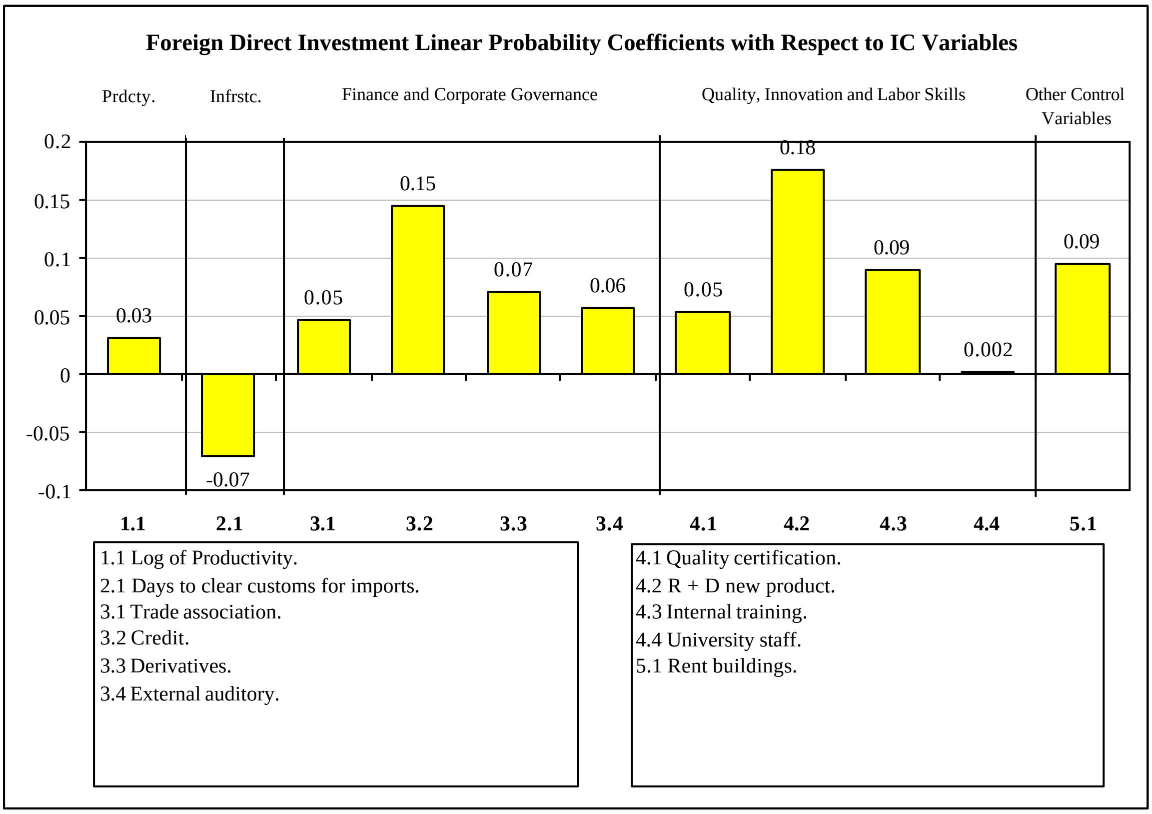

Foreign Direct Investment Linear Probability Coefficients with Respect to IC Variables
Prdcty.
Infrstc.
Finance and Corporate Governance
Quality, Innovation and Labor Skills
Other Control Variables
0.2
0.15
0.1
0.05
0
-0.05
-0.1
0.03
-0.07
0.05
0.15
0.07
0.06
0.05
0.18
0.09
0.002
0.09
1.1
2.1
3.1
3.2
3.3
3.4
4.1
4.2
4.3
4.4
5.1
1.1 Log of Productivity.
2.1 Days to clear customs for imports.
3.1 Trade association.
3.2 Credit.
3.3 Derivatives.
3.4 External auditory.
4.1 Quality certification.
4.2 R + D new product.
4.3 Internal training.
4.4 University staff.
5.1 Rent buildings.

Figure 7.1

Olley and Pakes Descomposition in Levels of Aggregate Productivity; by Industry (Restricted Solow Residual)

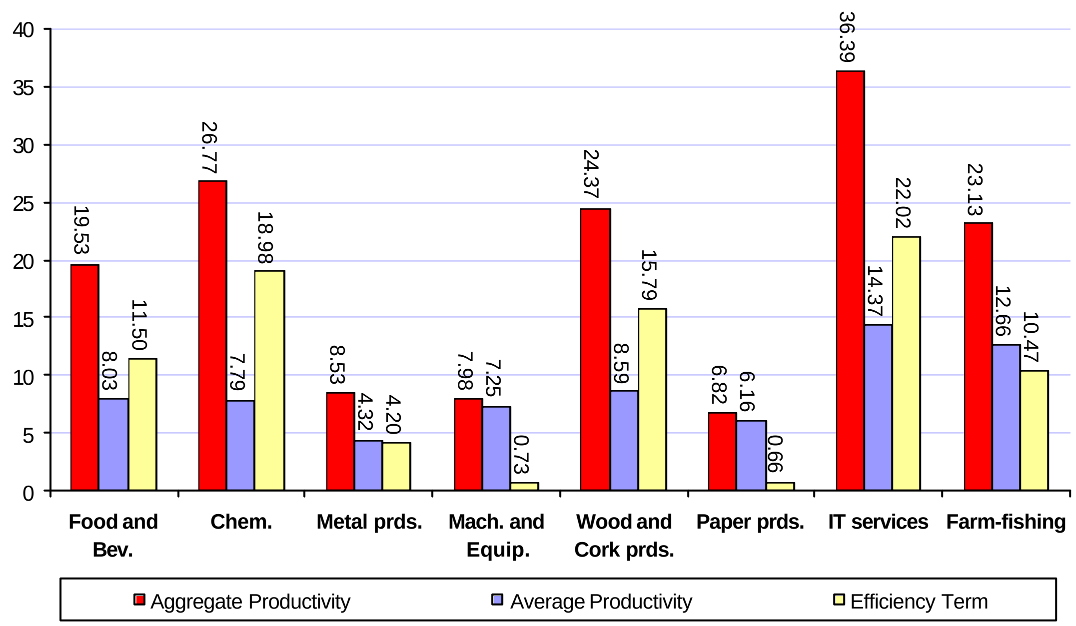


Figure 7.2

Olley and Pakes Descomposition in Levels of Aggregate Productivity; by Region (Restricted Solow Residual)

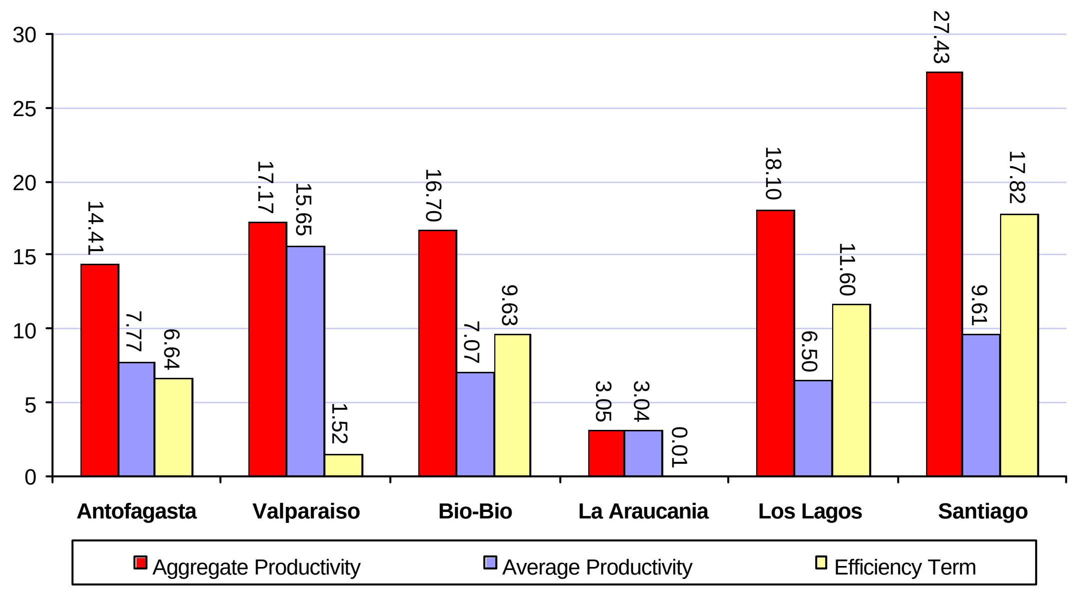


Figure 7.3

Olley and Pakes Descomposition in Levels of Aggregate Productivity; by Size and Age (Restricted Solow Residual)

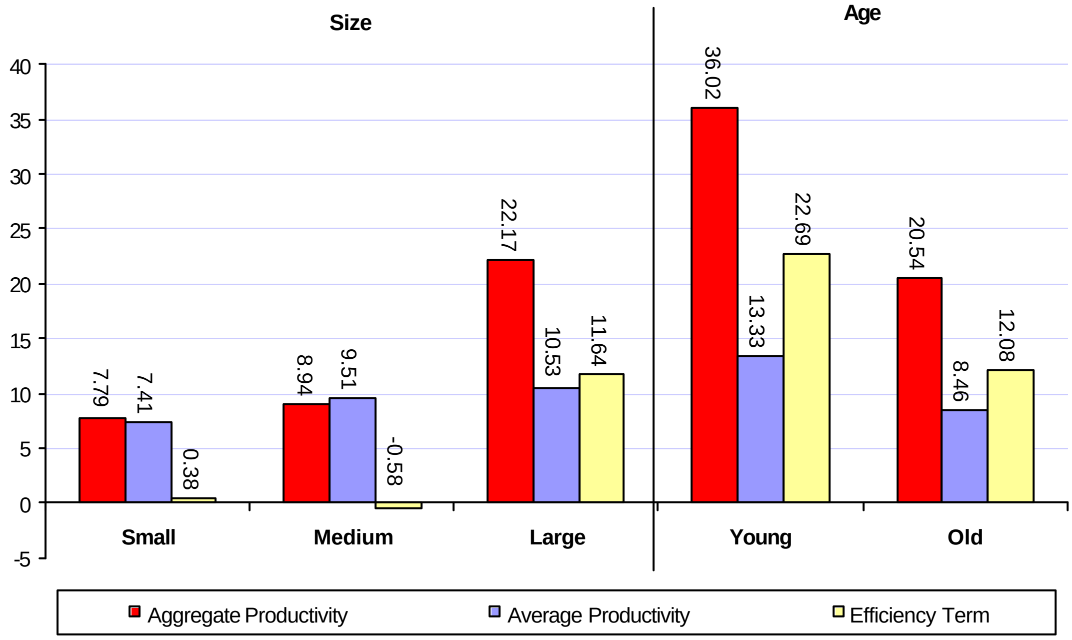


Figure 7.4

Olley and Pakes Decomposition in Levels of Aggregate Productivity; by Year (Restricted Solow Residual)

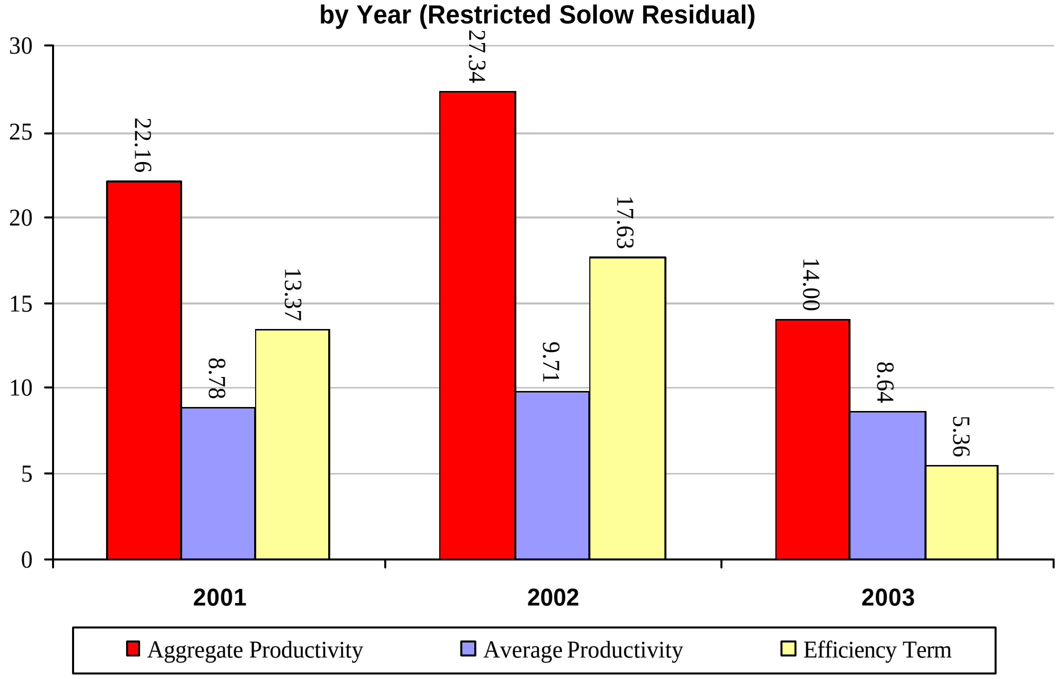


Figure 8.1

Olley and Pakes Descomposition in Logs of Aggregate Productivity; by Industry (Restricted Solow Residual)

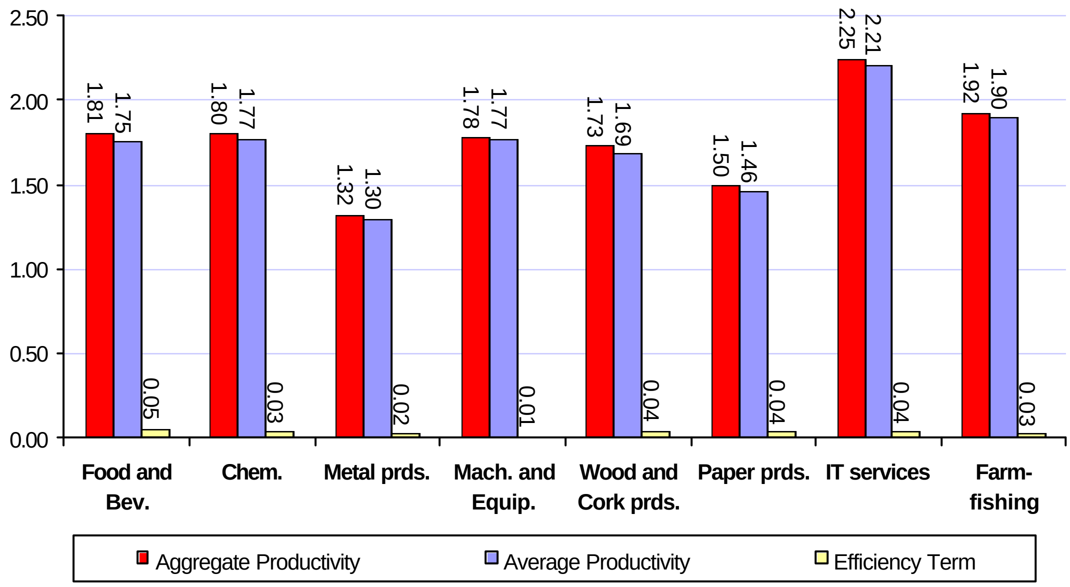


Figure 8.2

Olley and Pakes Descomposition in Logs of Aggregate Productivity; by Region (Restricted Solow Residual)

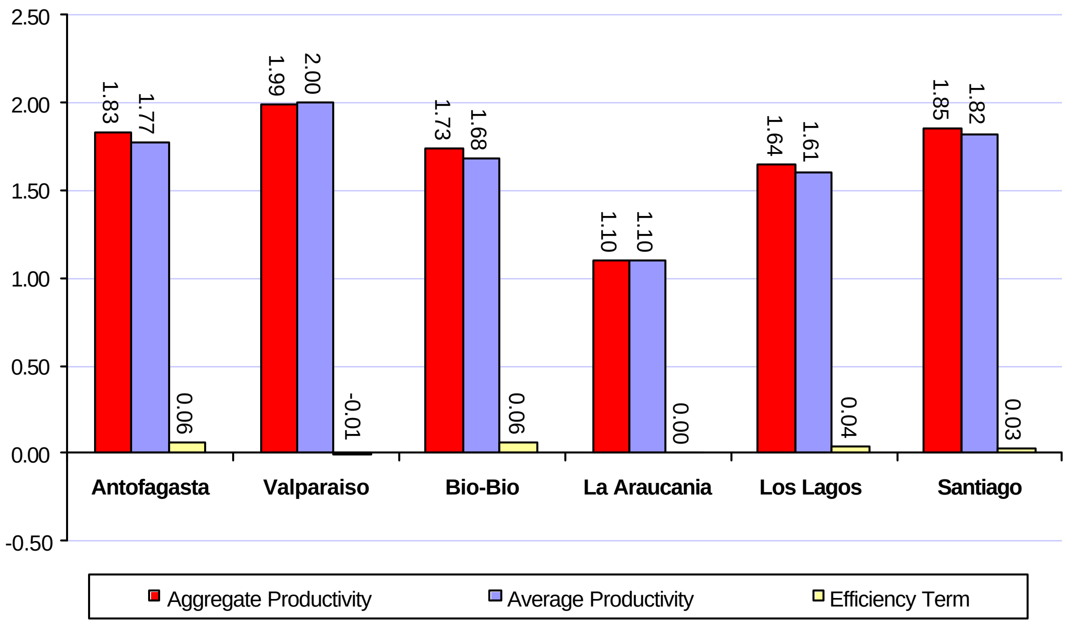


Figure 8.3

Olley and Pakes Descomposition in Logs of Aggregate Productivity; by Size and Age (Restricted Solow Residual)

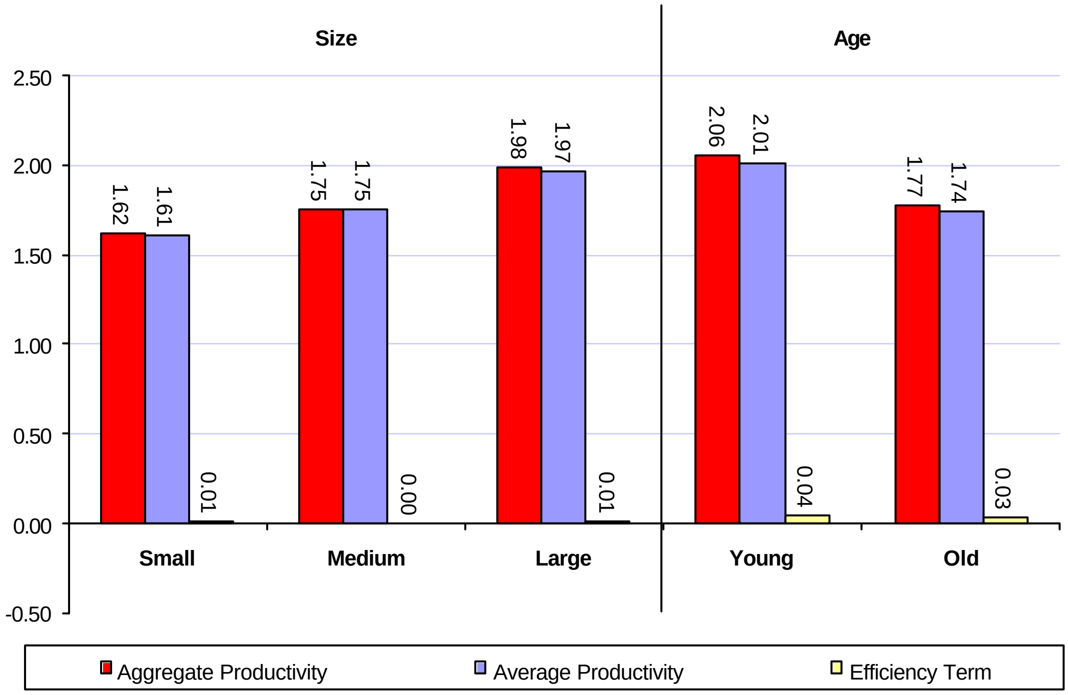


Figure 8.4

Olley and Pakes Decomposition in Logs of Aggregate Productivity; by Year (Restricted Solow Residual)

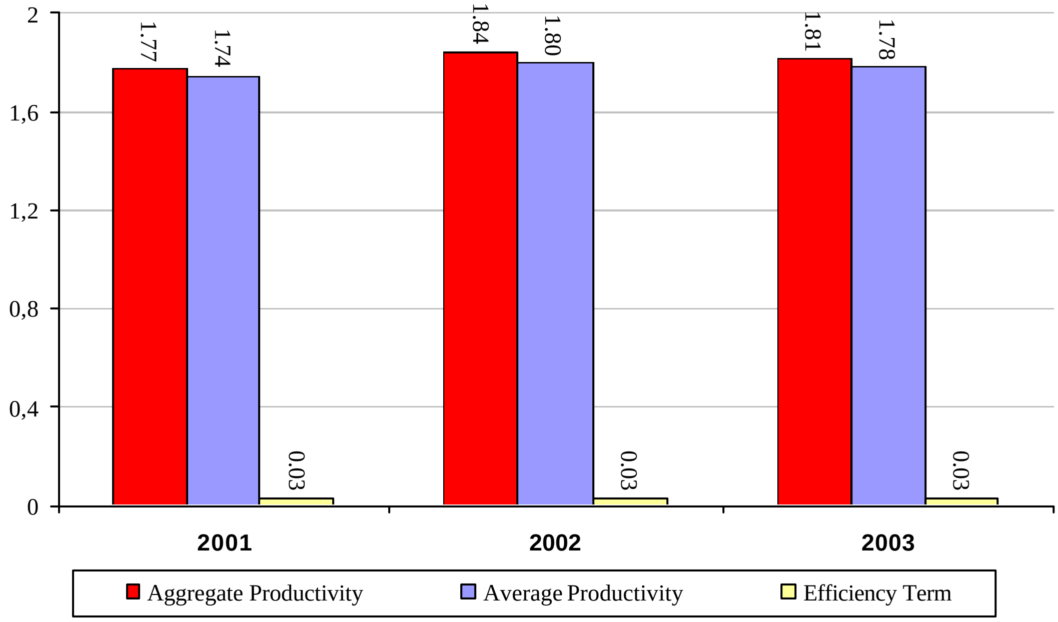


Figure 9.1

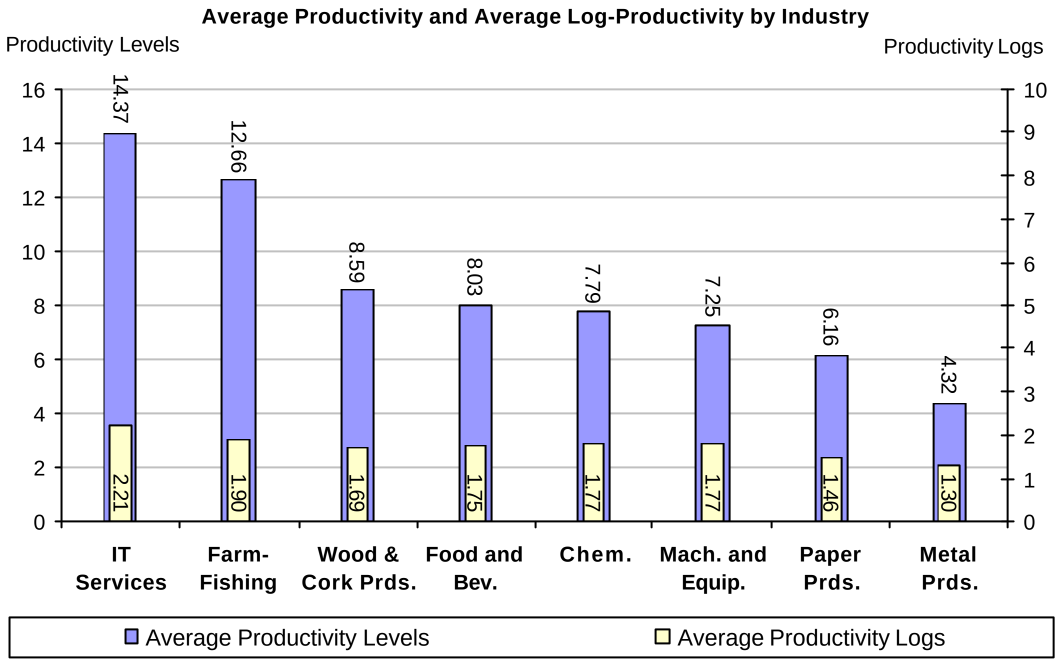


Figure 9.2

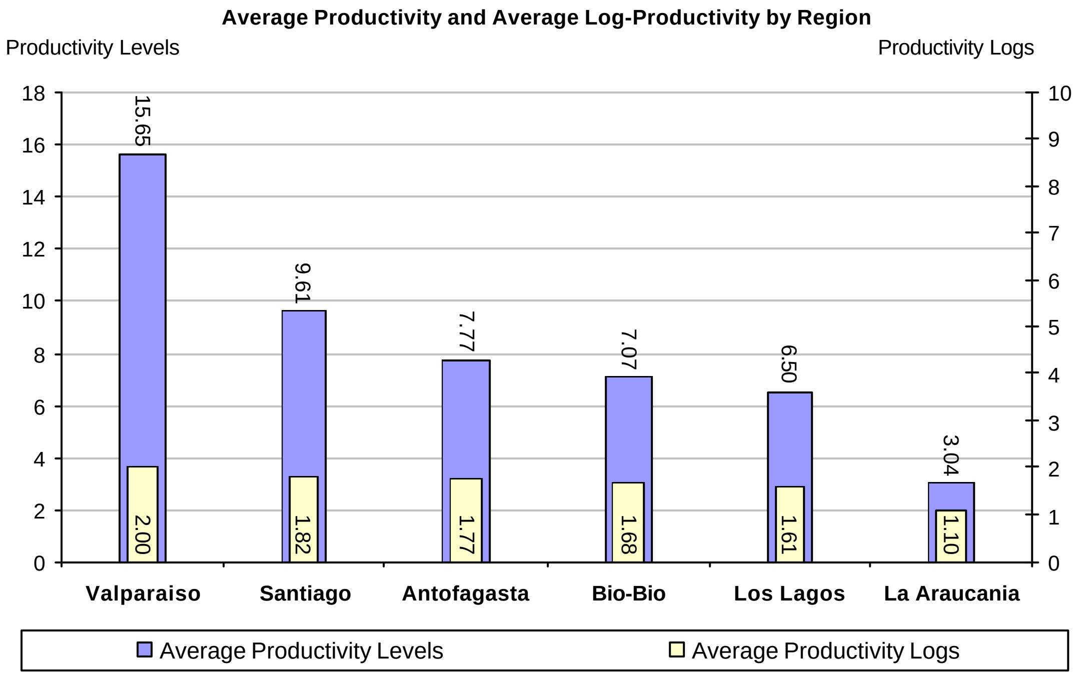


Figure 9.3

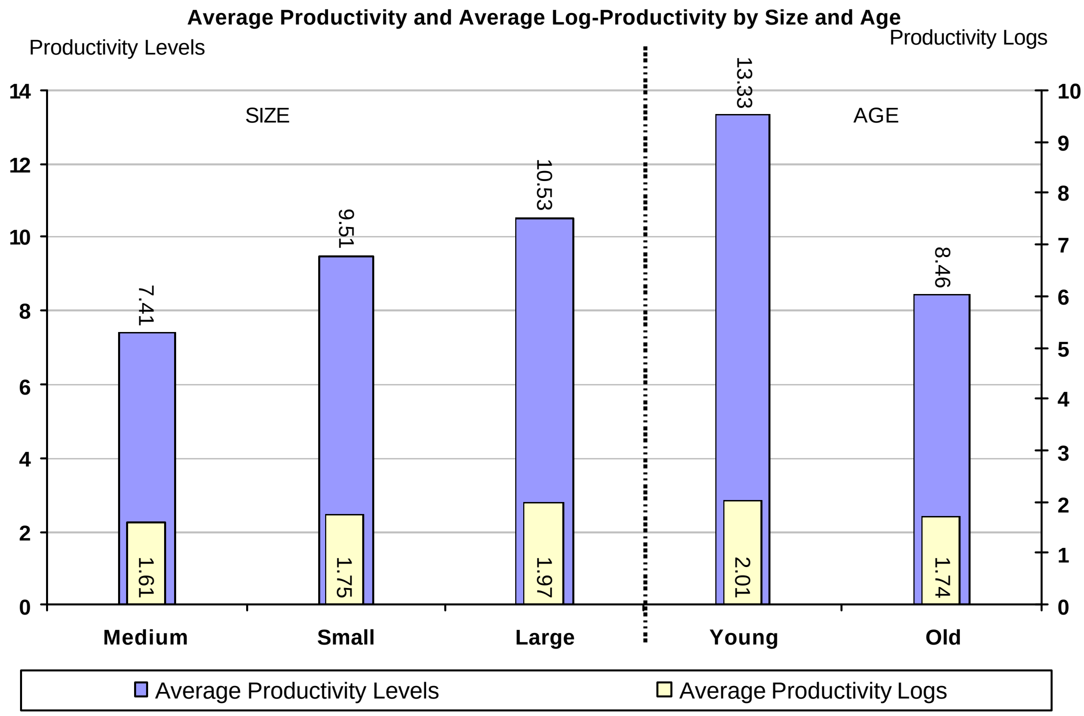


Figure 9.4

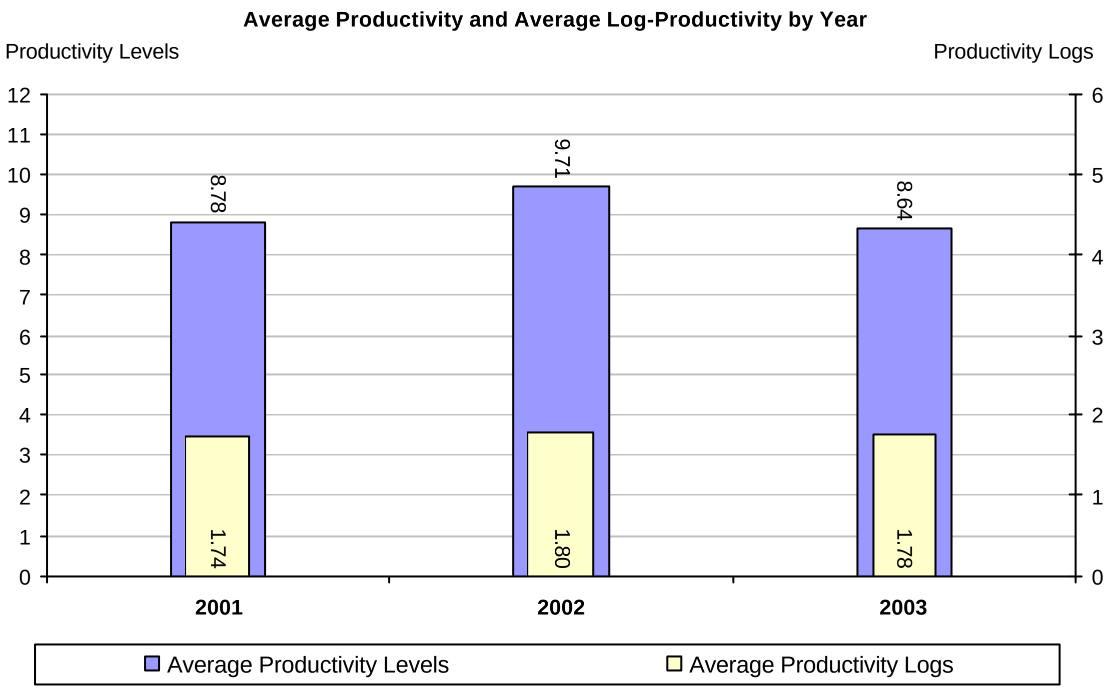
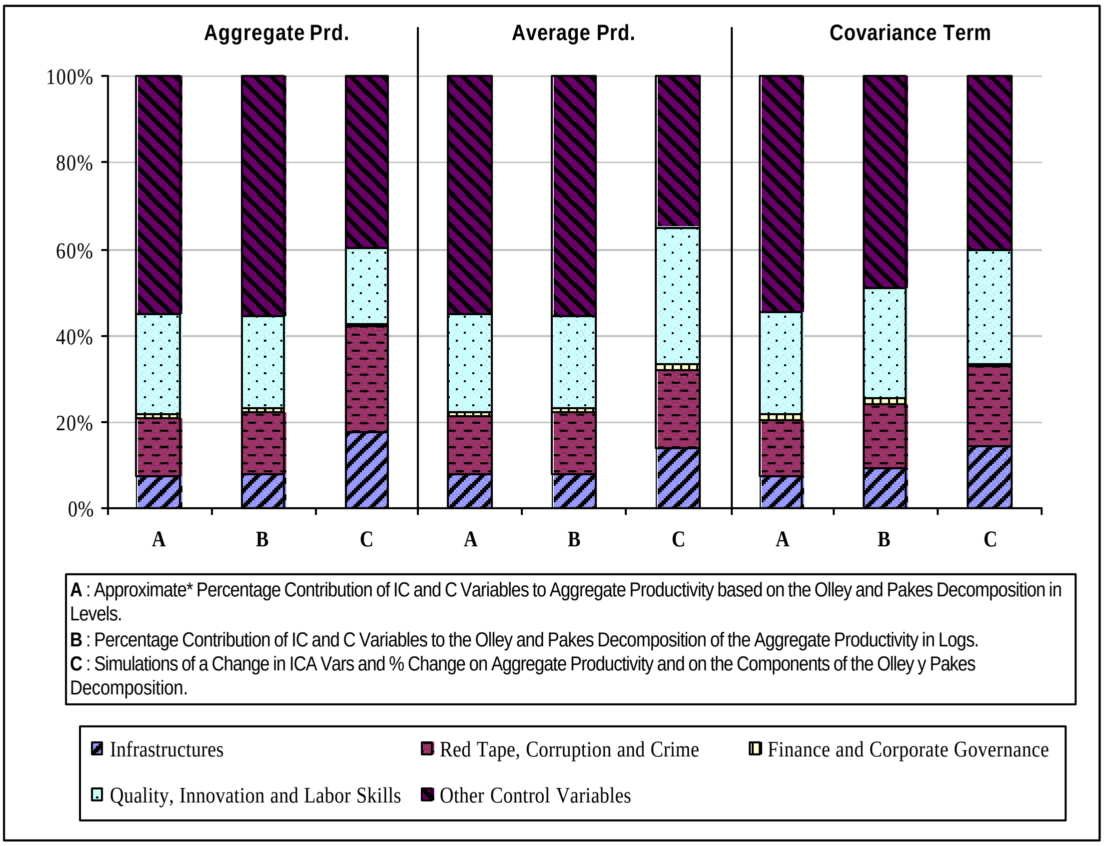


Figure 10

Relative ICA Effects by Groups of Variables on Aggregate Productivity, Average Productivity and Covariance Term (Decomposition in Logs, Approximate in Levels and Simulations of a 20% improvement in IC and C Variables).



Data

	Aggregate Prd.			Average Prd.			Covariance term		
	A	B	C	A	B	C	A	B	C
Infrastructures	7.56	7.80	17.87	7.74	7.77	14.06	7.33	9.49	14.42
Red Tape, Corruption and Crime	13.46	14.46	24.38	13.56	14.46	17.85	13.34	14.75	18.61
Finance and Corporate Governance	1.05	0.97	0.32	1.04	0.97	1.43	1.08	1.21	0.62
Quality, Innovation and Labor Skills	23.26	21.43	17.86	22.78	21.35	31.81	23.83	25.92	26.38
Other Control Variables	54.67	55.34	39.58	54.88	55.44	34.86	54.42	48.63	39.97
Total	100	100	100	100	100	100	100	100	100

NOTES:

The percentages of Figure 10 are computed by taking the percentages changes presented in Figure 12.1 (also Table F) and (also Table G). Each number is computed as the sum of the absolute values across groups of IC variables (infrastructures, red tape, etc) divided by the cumulated sum of the absolute values of all IC and C variables. For instance, the 7.56 percentage contribution of infrastructures group to the aggregate productivity in the A case (first column) is computed as the sum of the absolute values of the four infrastructure variables divided by the cumulative sum of the absolute values of all IC and C variables (including infrastructures), all multiplied by 100.

Figure 11.1

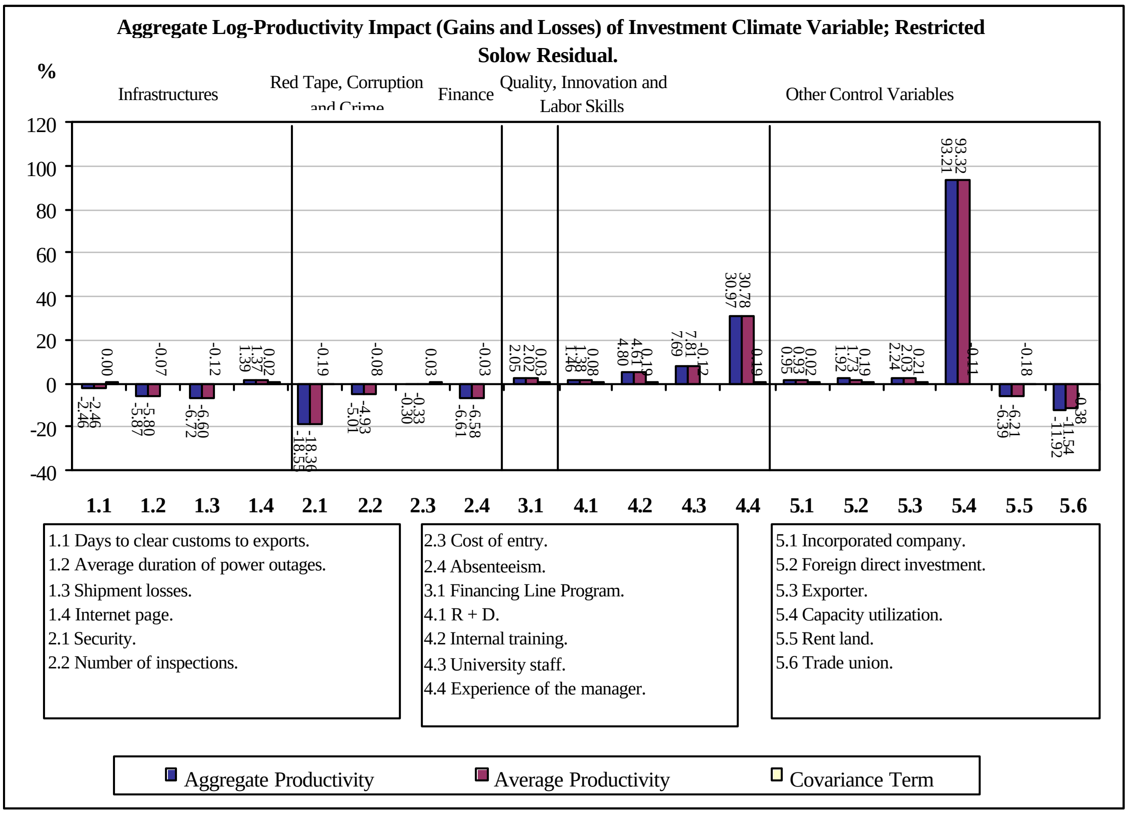


Figure 11.2

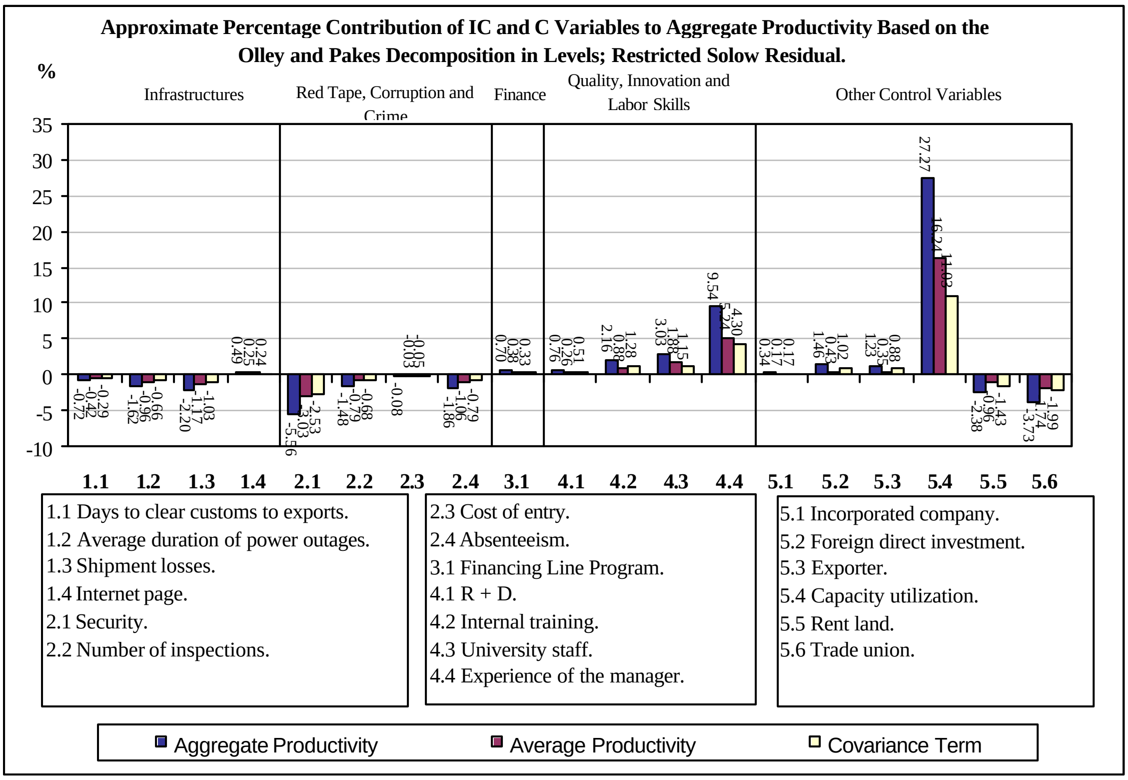


Figure 12.1

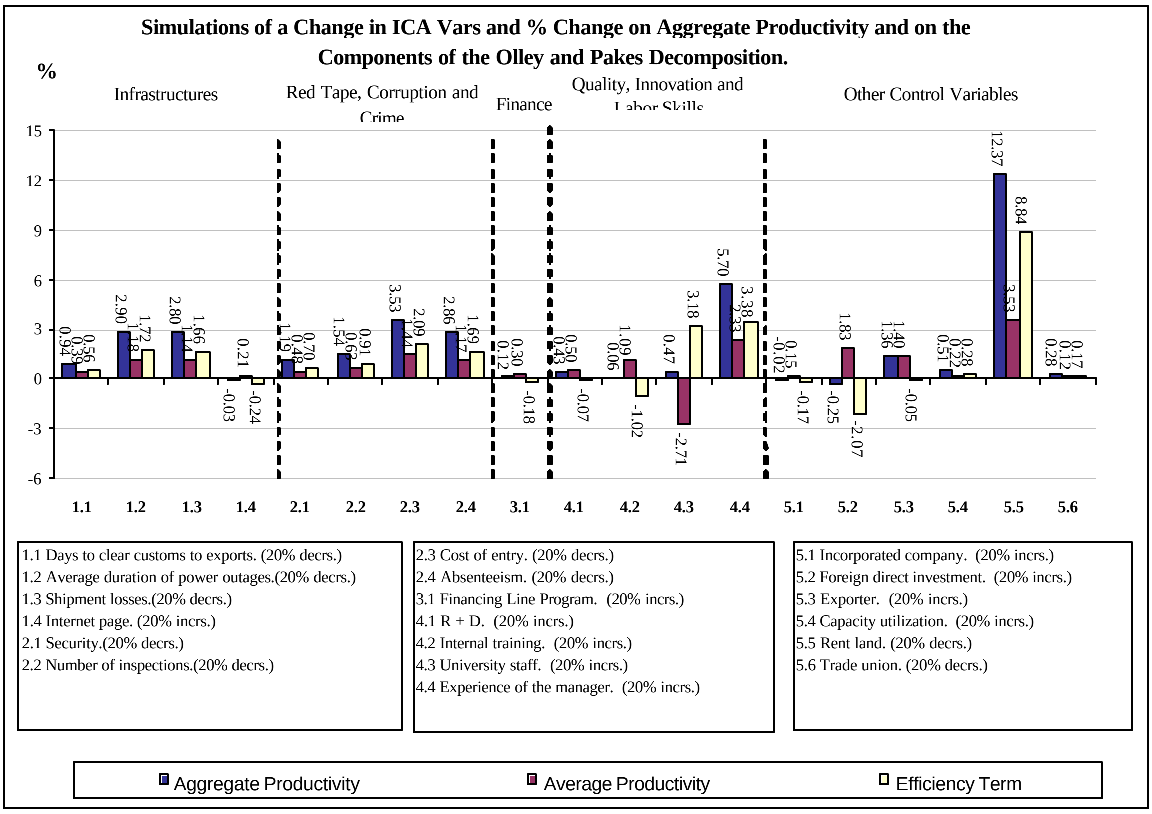


Figure 12.2

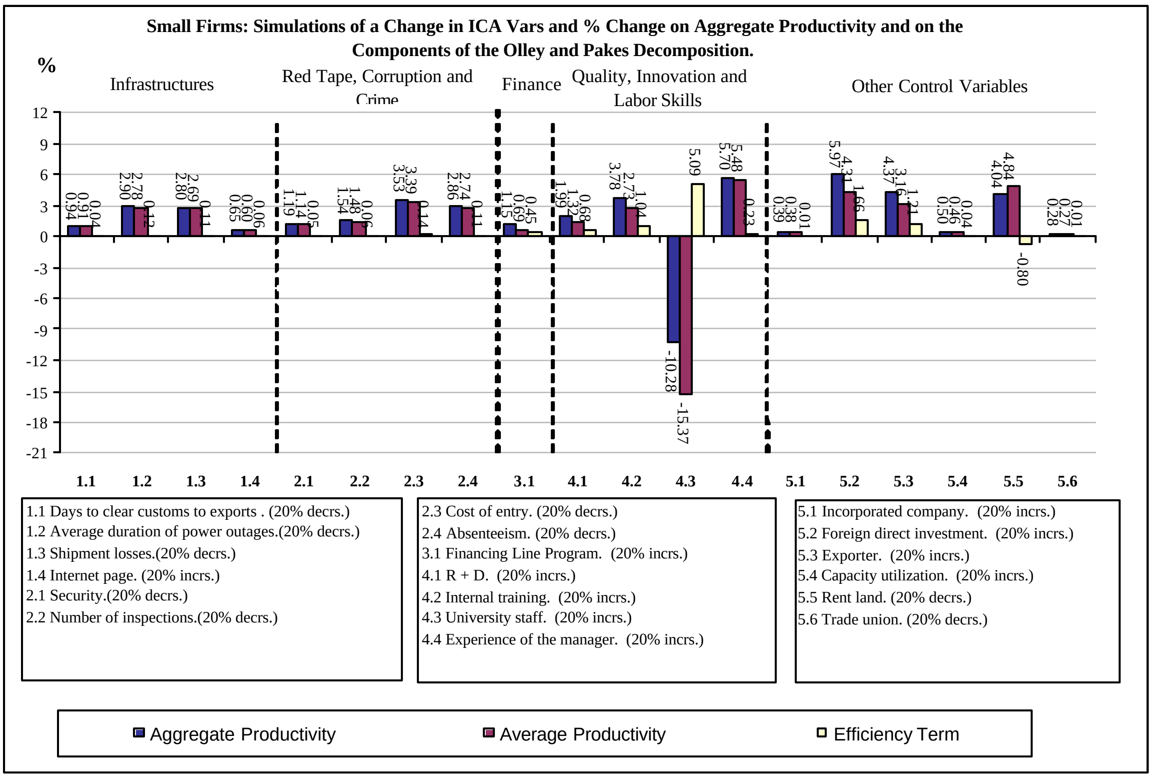
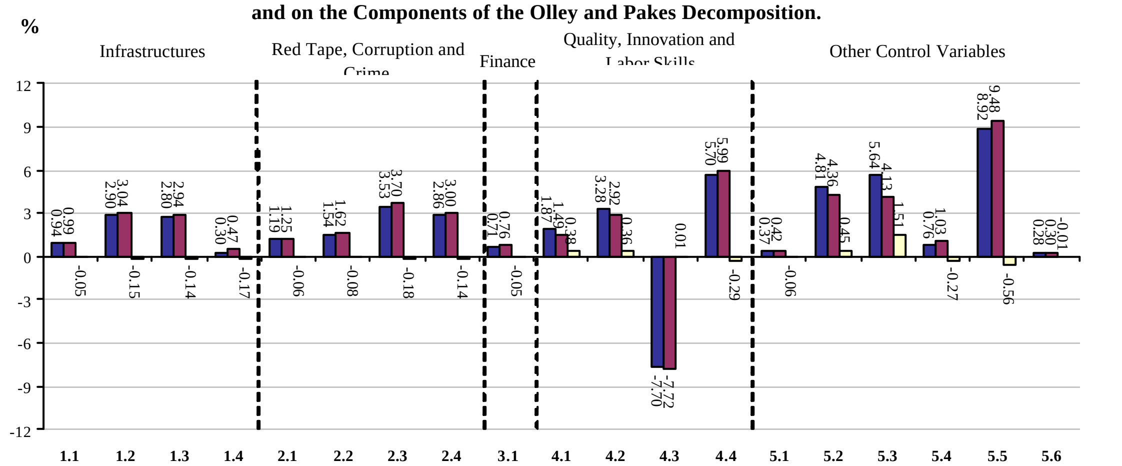


Figure 12.3

Medium Firms: Simulations of a Change in ICA Vars and % Change on Aggregate Productivity and on the Components of the Olley and Pakes Decomposition.



1.1 Days to clear customs to exports. (20% decrs.)
1.2 Average duration of power outages.(20% decrs.)
1.3 Shipment losses.(20% decrs.)
1.4 Internet page. (20% incrs.)
2.1 Security.(20% decrs.)
2.2 Number of inspections.(20% decrs.)

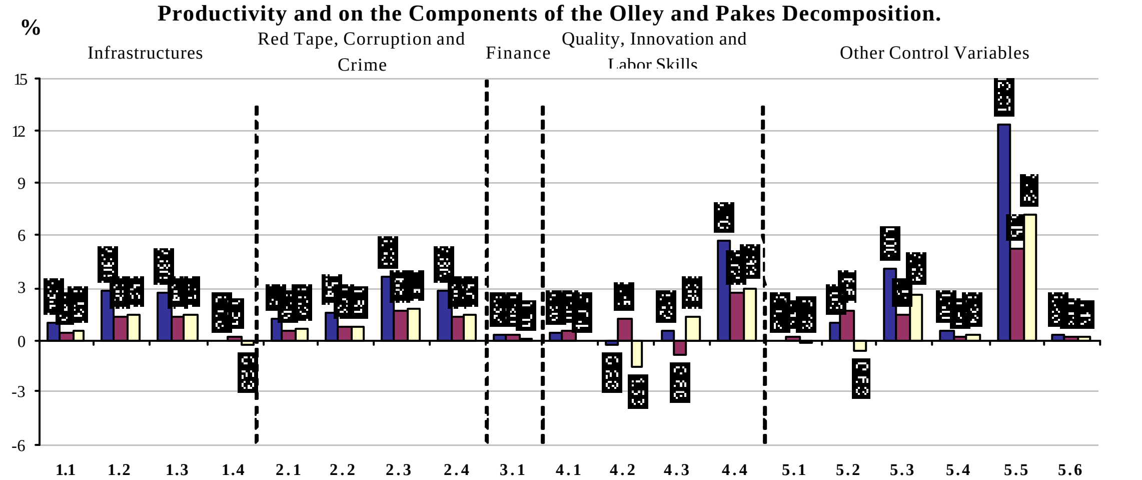
2.3 Cost of entry. (20% decrs.)
2.4 Absenteeism. (20% decrs.)
3.1 Financing Line Program. (20% incrs.)
4.1 R + D. (20% incrs.)
4.2 Internal training. (20% incrs.)
4.3 University staff. (20% incrs.)
4.4 Experience of the manager. (20% incrs.)

5.1 Incorporated company. (20% incrs.)
5.2 Foreign direct investment. (20% incrs.)
5.3 Exporter. (20% incrs.)
5.4 Capacity utilization. (20% incrs.)
5.5 Rent land. (20% decrs.)
5.6 Trade union. (20% decrs.)

Aggregate Productivity | Average Productivity | Efficiency Term

Figure 12.4

Large Firms: Simulations of a Change in ICA Vars and % Change on Aggregate Productivity and on the Components of the Olley and Pakes Decomposition.



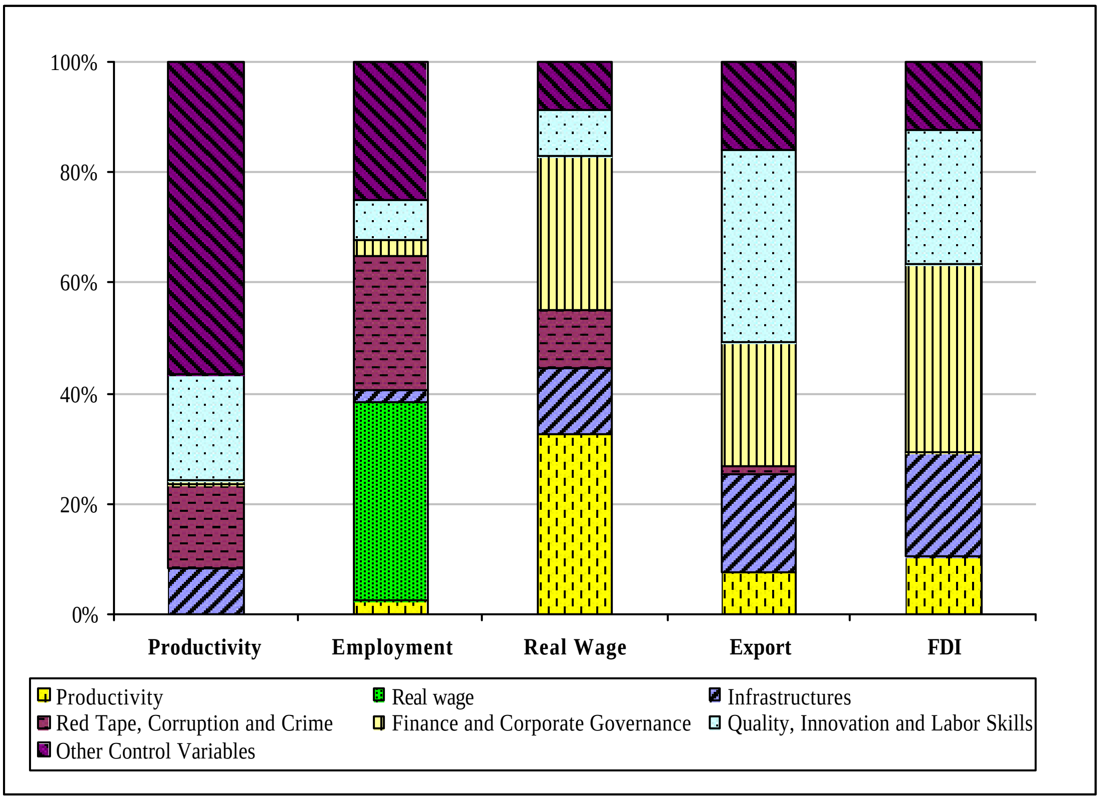
1.1 Days to clear customs to exports. (20% decrs.)
1.2 Average duration of power outages.(20% decrs.)
1.3 Shipment losses.(20% decrs.)
1.4 Internet page. (20% incrs.)
2.1 Security.(20% decrs.)
2.2 Number of inspections.(20% decrs.)

2.3 Cost of entry. (20% decrs.)
2.4 Absenteeism. (20% decrs.)
3.1 Financing Line Program. (20% incrs.)
4.1 R + D. (20% incrs.)
4.2 Internal training. (20% incrs.)
4.3 University staff. (20% incrs.)
4.4 Experience of the manager. (20% incrs.)

5.1 Incorporated company. (20% incrs.)
5.2 Foreign direct investment. (20% incrs.)
5.3 Exporter. (20% incrs.)
5.4 Capacity utilization. (20% incrs.)
5.5 Rent land. (20% decrs.)
5.6 Trade union. (20% decrs.)

Aggregate Productivity | Average Productivity | Efficiency Term

Figure 13
ICA Percentage Absolute Contribution on Economic Performance Variables.



Data					
	Productivity	Employment	Real Wage	Export	FDI
Productivity	-	2.38	32.51	7.76	10.24
Real wage	-	35.81	-	-	-
Infrastructures	8.38	2.41	12.10	17.57	18.78
Red Tape, Corruption and Crime	14.83	24.28	10.68	1.50	-
Finance and Corporate Governance	0.90	3.12	27.43	22.02	34.34
Quality, Innovation and Labor Skills	19.36	6.99	8.57	35.18	24.38
Other Control Variables	56.54	25.01	8.69	15.96	12.25
Total	100	100	100	100	100

NOTES:
* The percentages of Figure 13 are computed by taking the average contributions presented in table H.3. Each number is computed as the sum of the absolute values of the percentages contributions across groups of IC variables (infrastructures, red tape, etc) divided by the cumulated sum of all IC and C variables. For instance, the 8.38 percentage contribution of infrastructures to average log-productivity (first column) is computed as the sum of the absolute values of the four infrastructure variables divided by the cumulative sum of the absolute values of all IC and C variables (including infrastructures), all multiplied by 100.

Figure 14

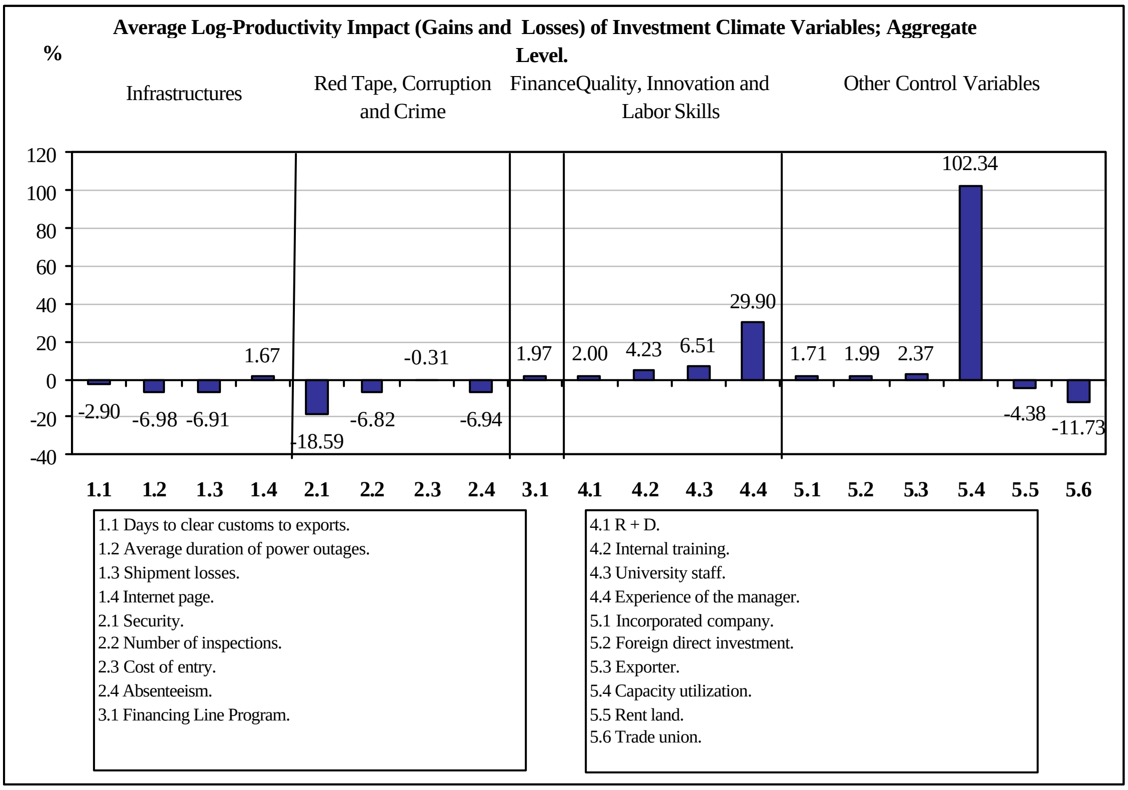


Figure 15

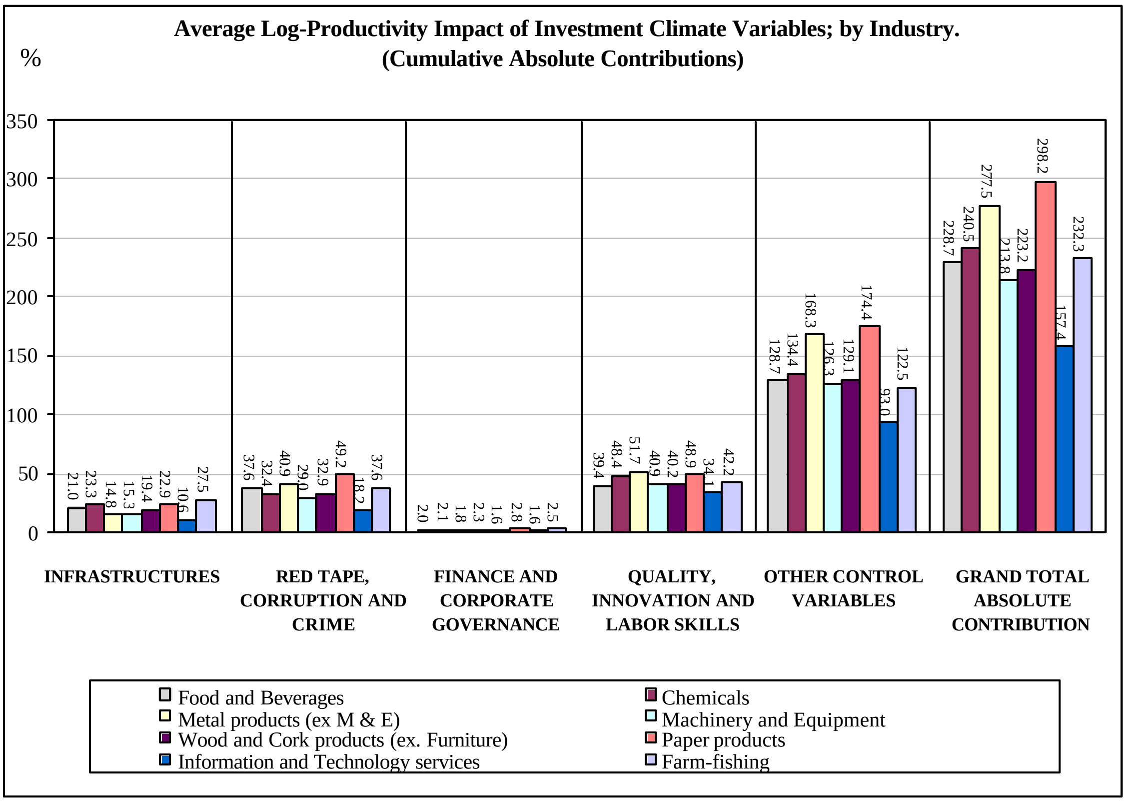


Figure 16

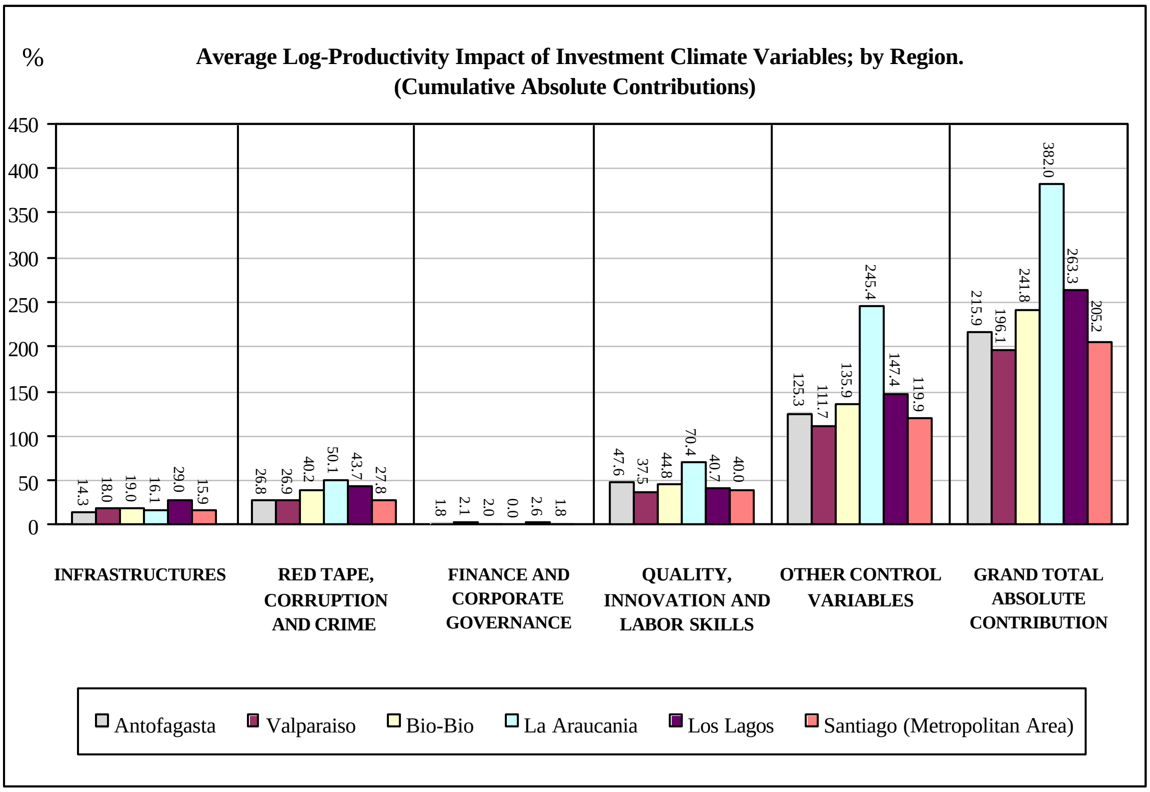


Figure 17

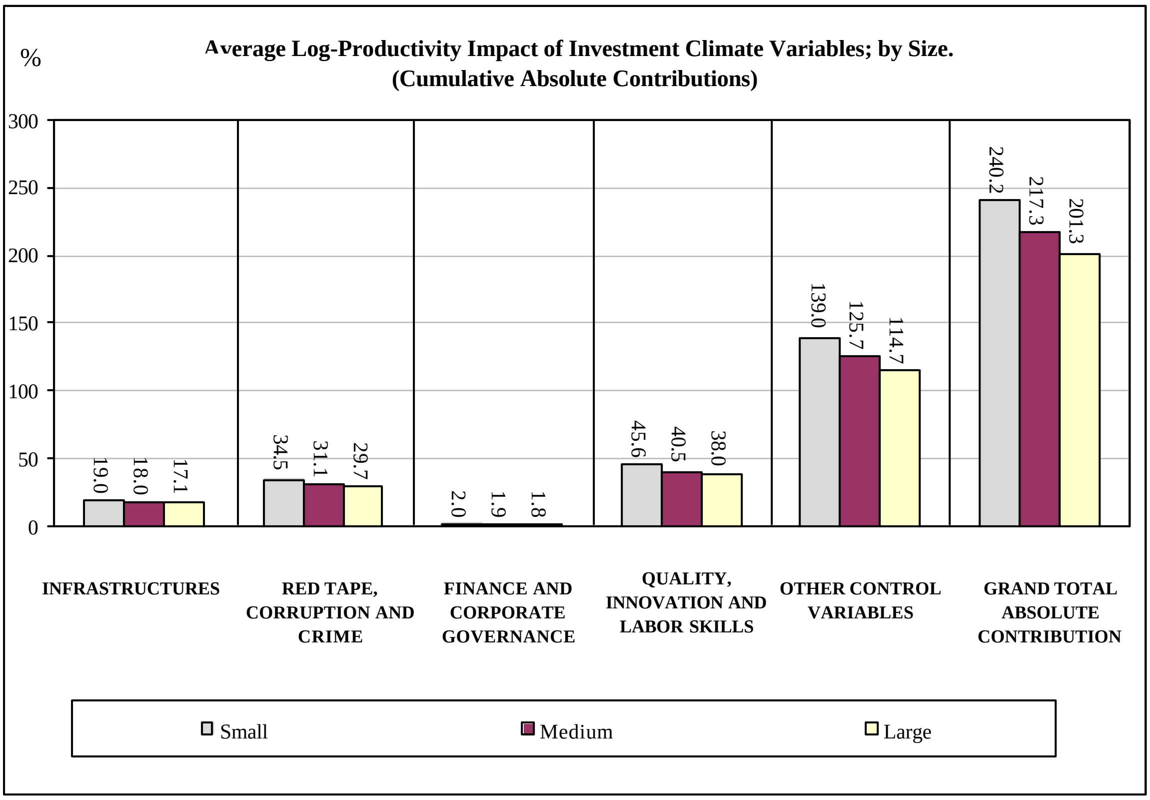
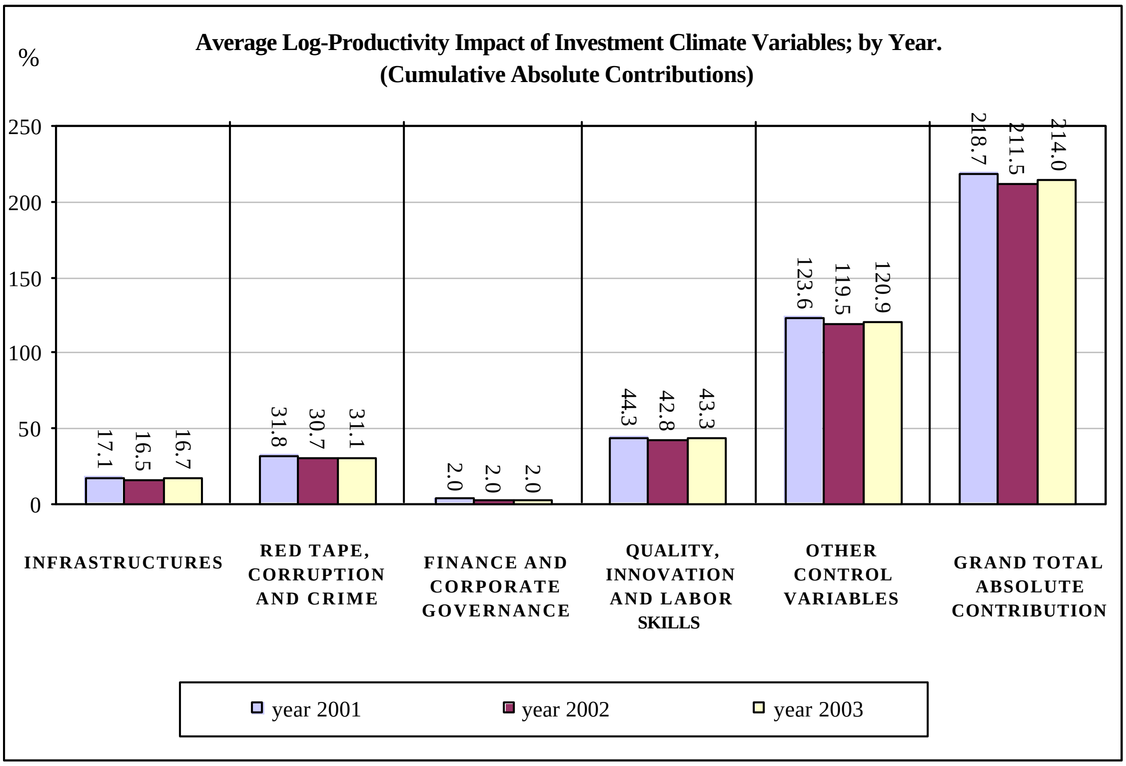


Figure 18



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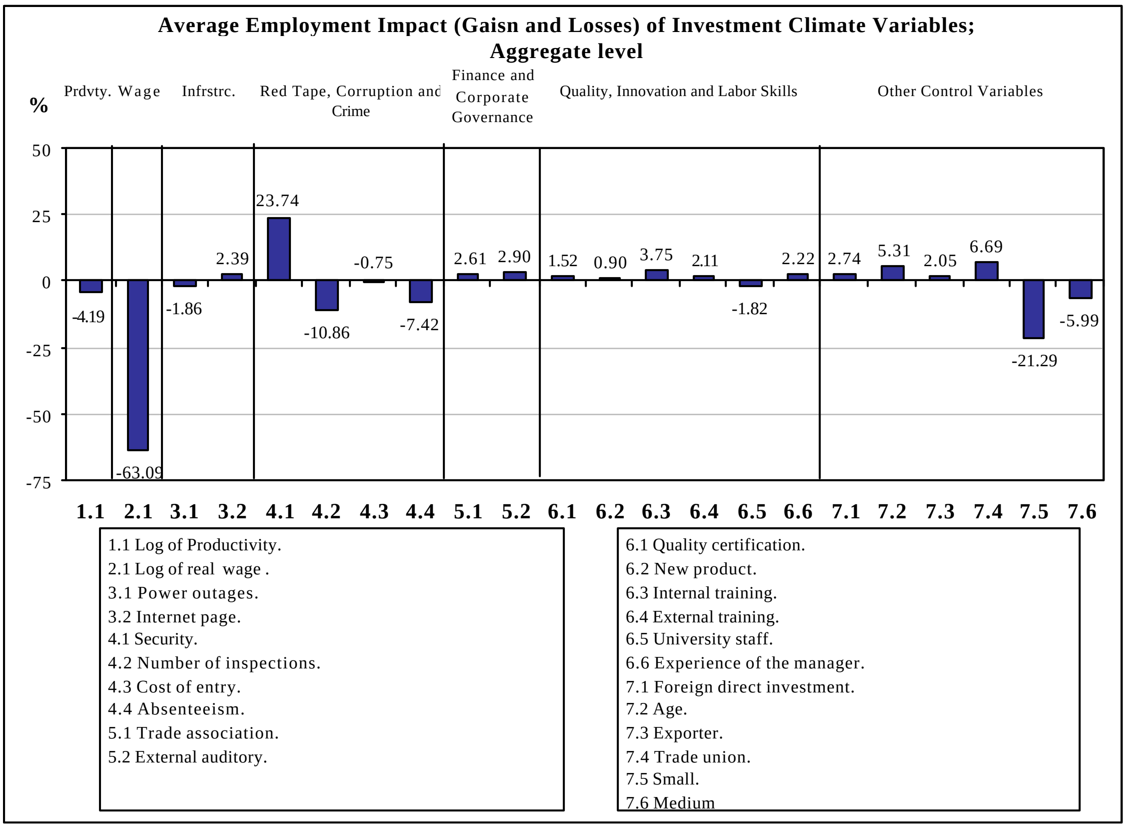

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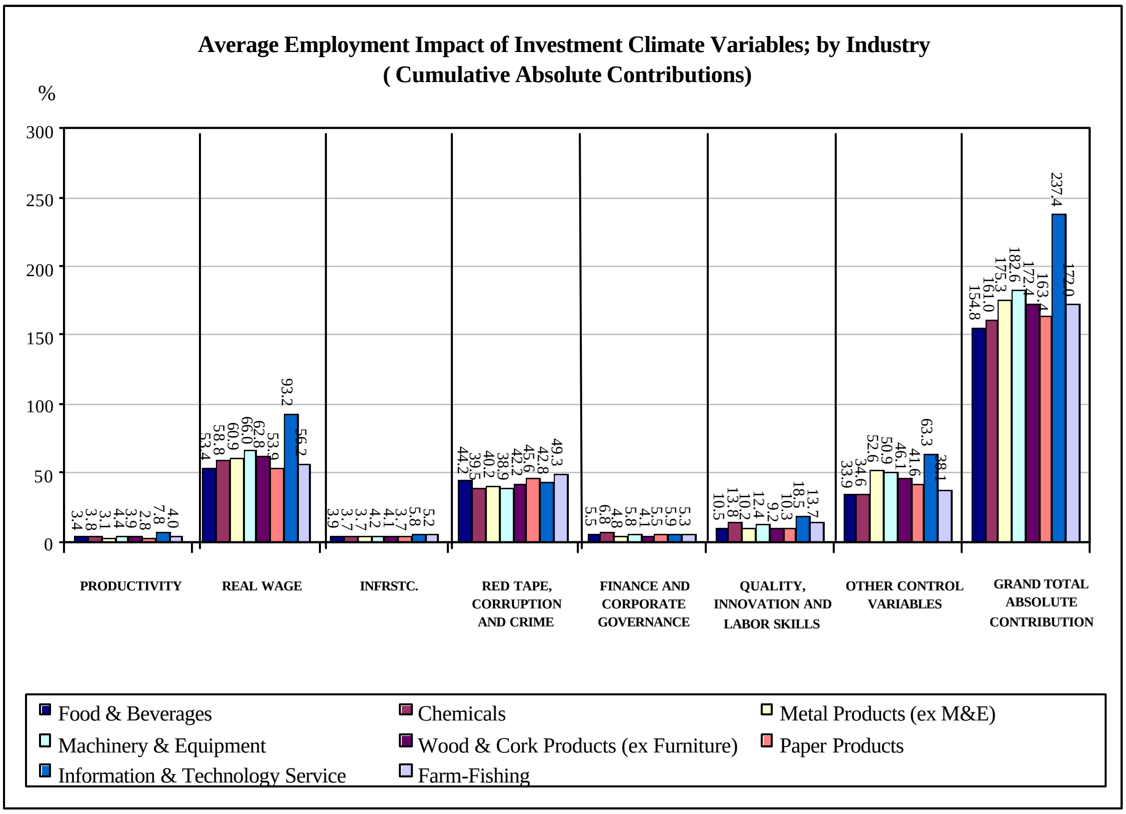

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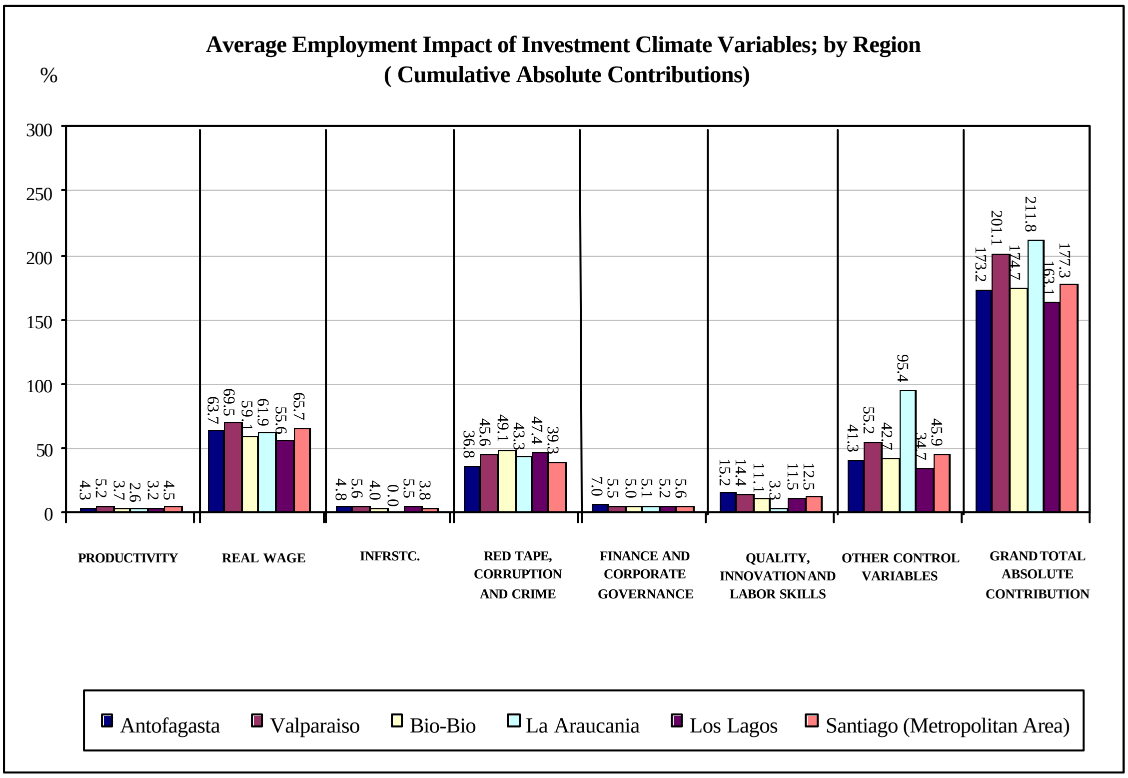

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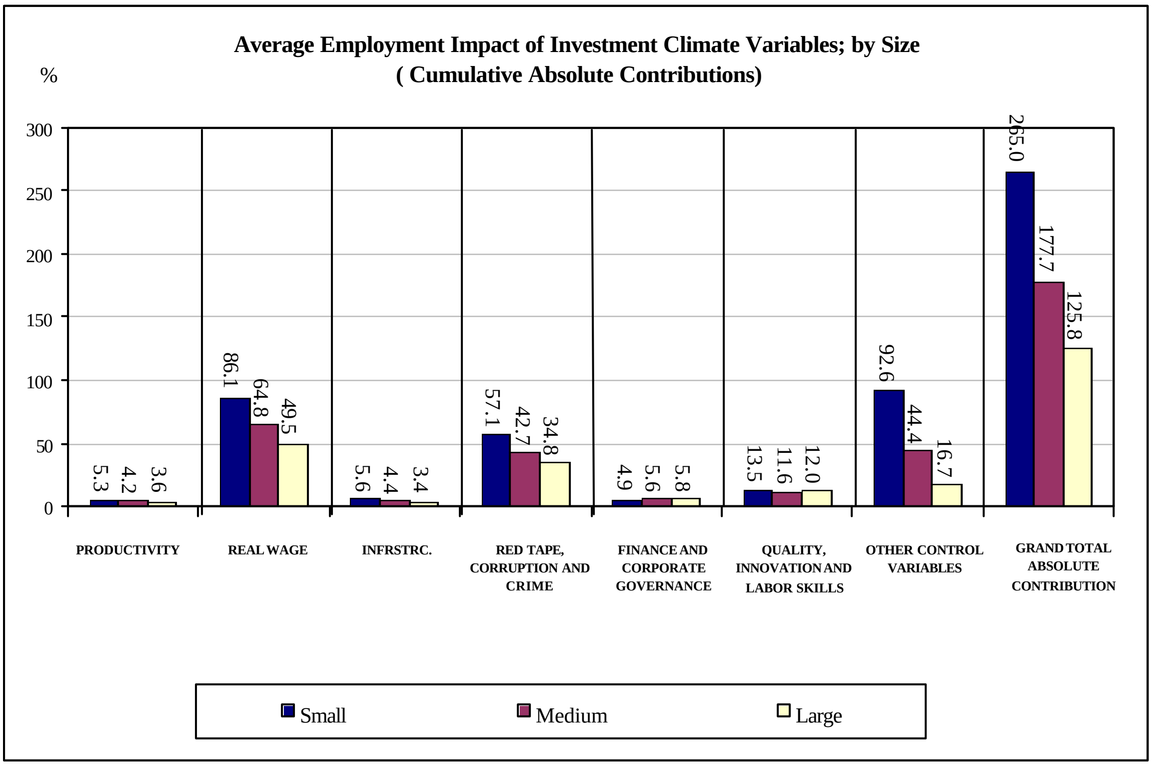

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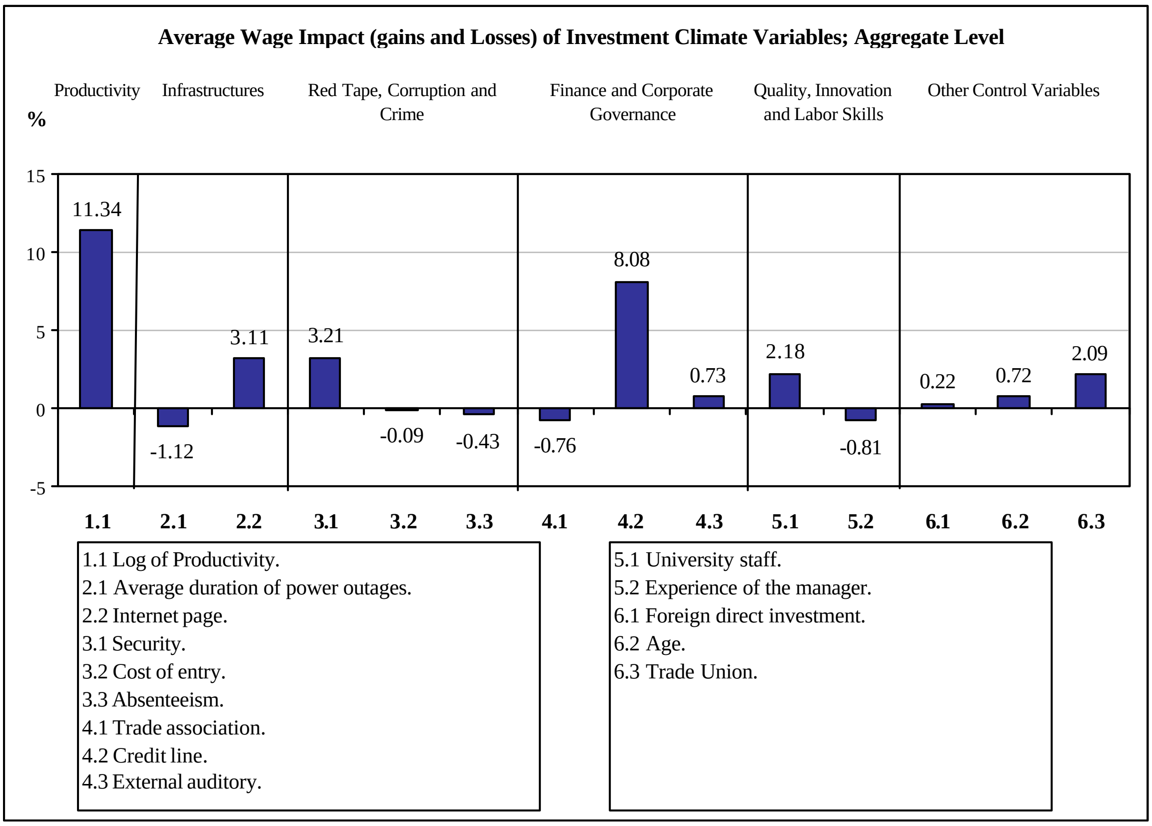
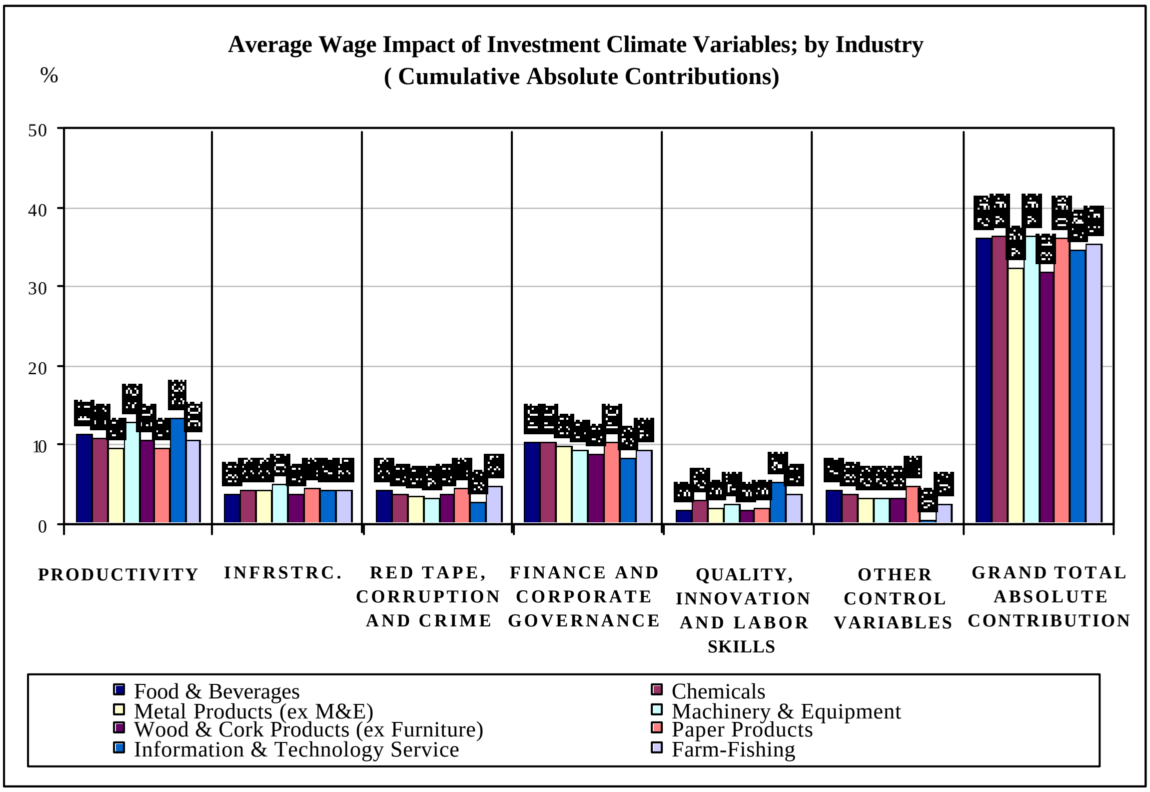


Figure 24



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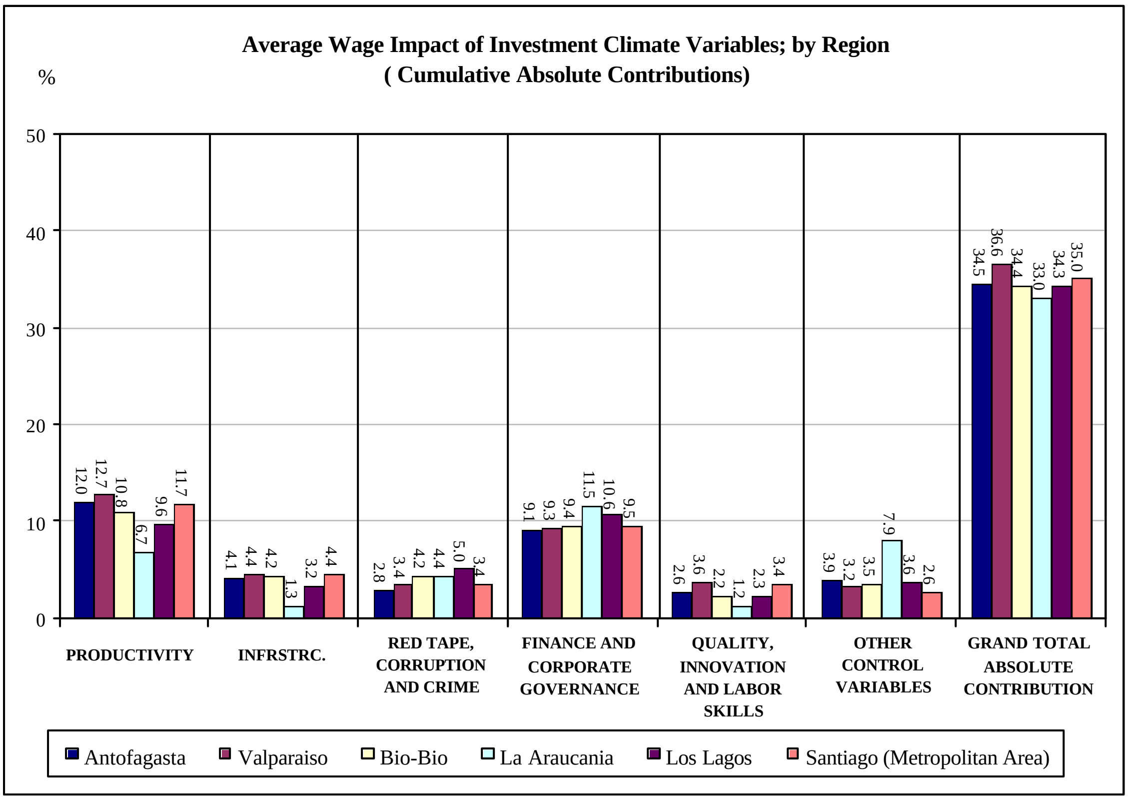


Figure 26

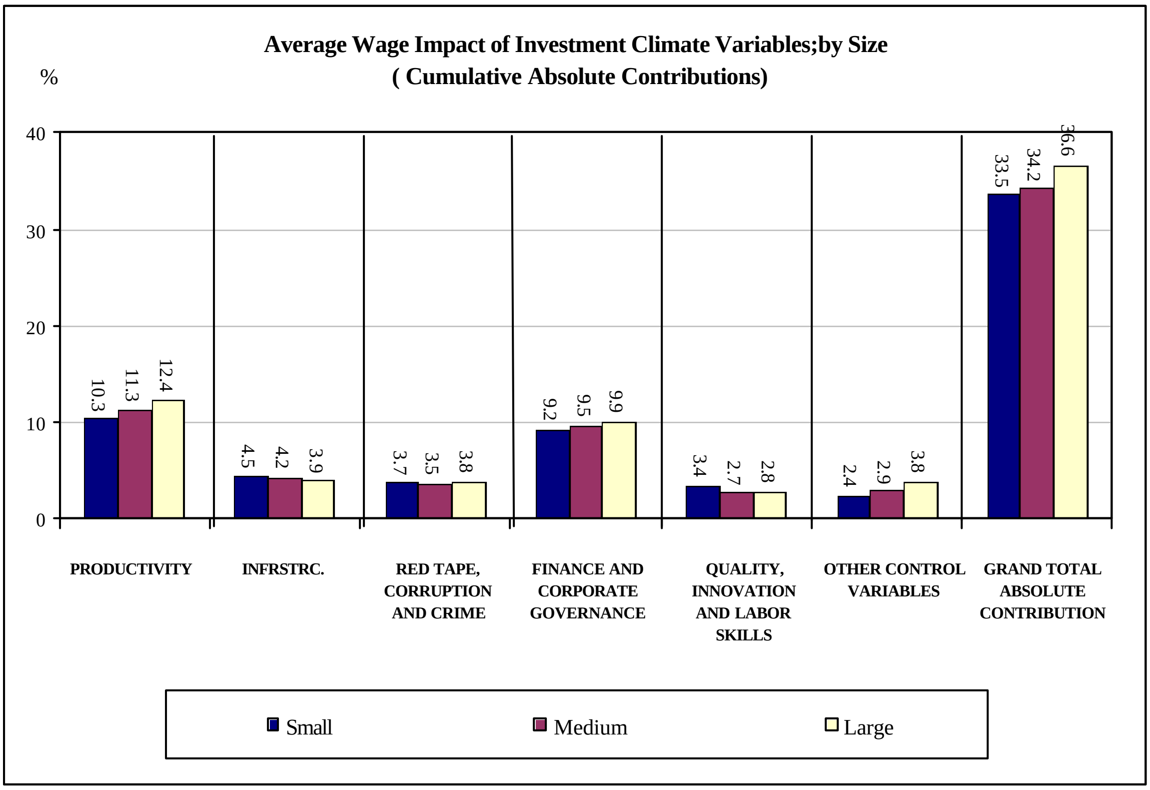
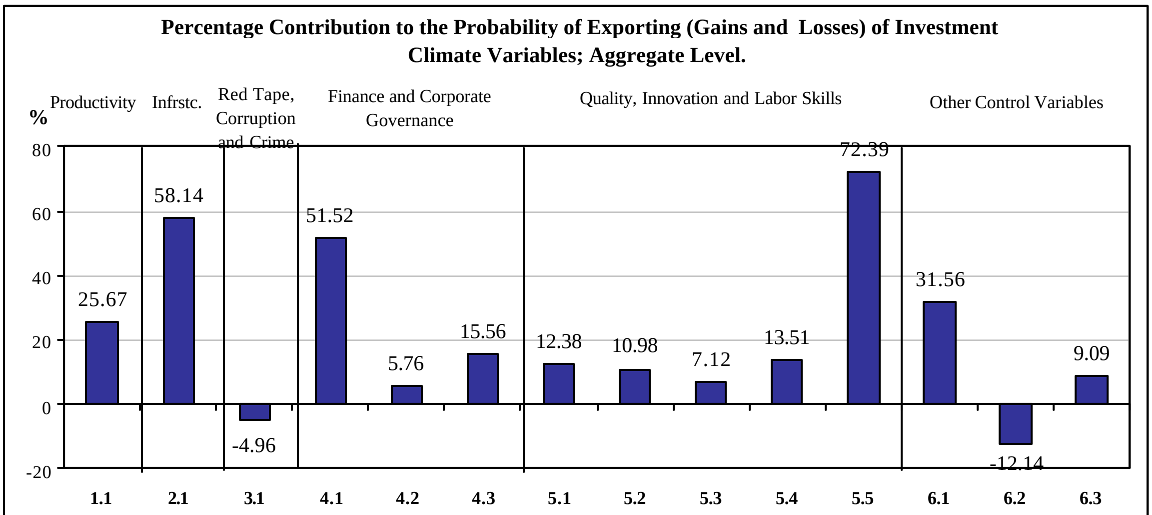


Figure 27



1.1 Log of Productivity.
2.1 Email.
3.1 Illegal payments for protection .
4.1 Trade association.
4.2 Derivatives.
4.3 External auditory.

5.1 Quality certification.
5.2 R+D.
5.3 New technology purchased.
5.4 Internal training.
5.5 Experience of the manager.
6.1 Incorporated company.
6.2 Age.
6.3 Rent buildings.

Figure 28

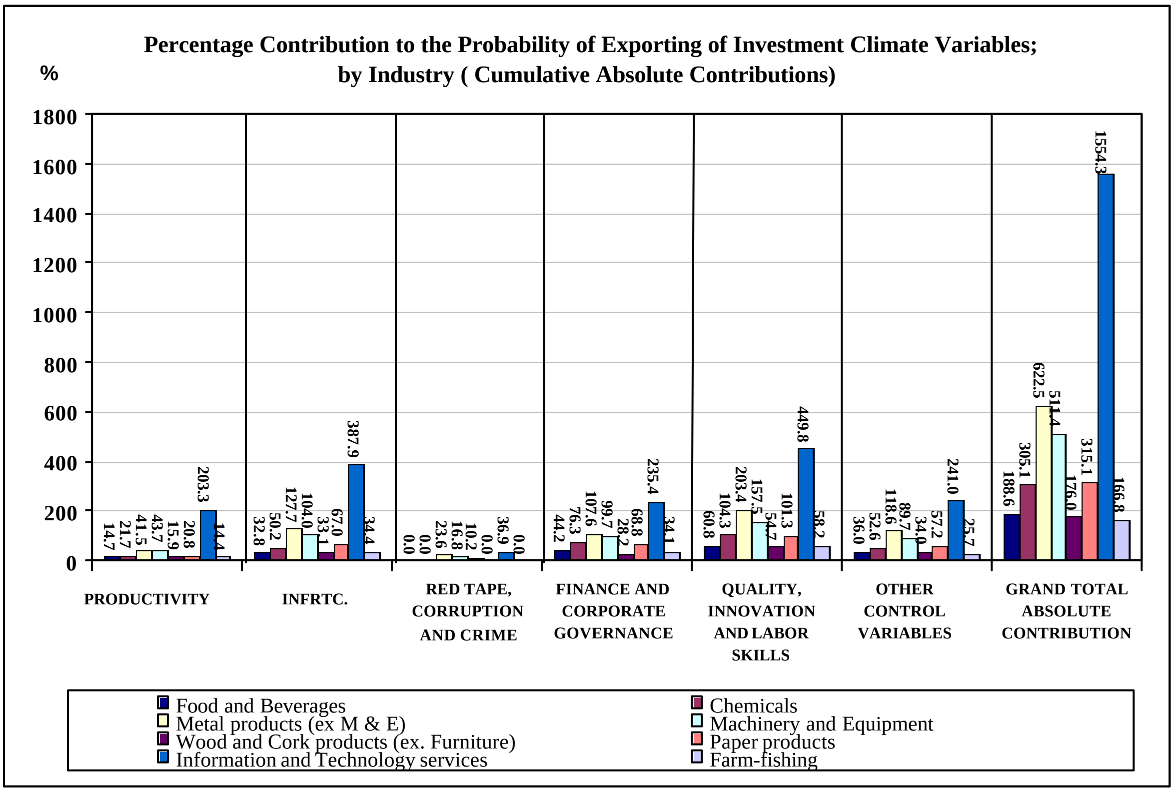


Figure 29

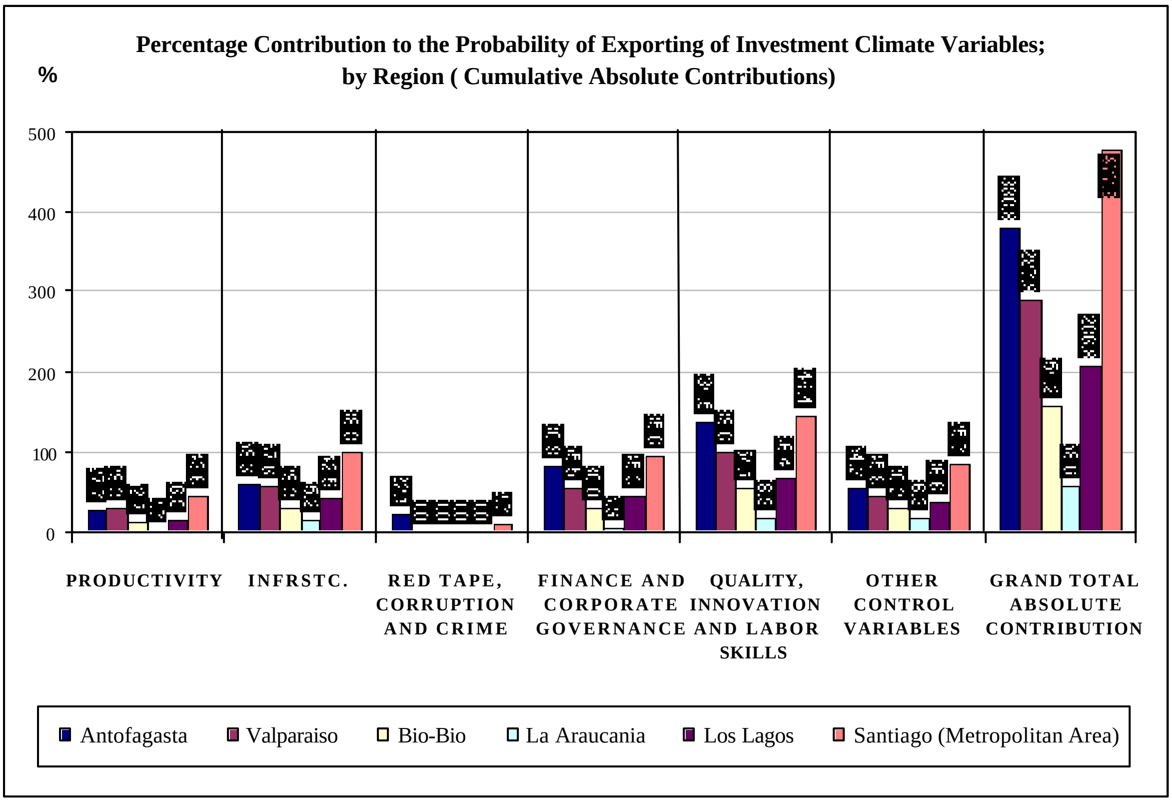


Figure 30

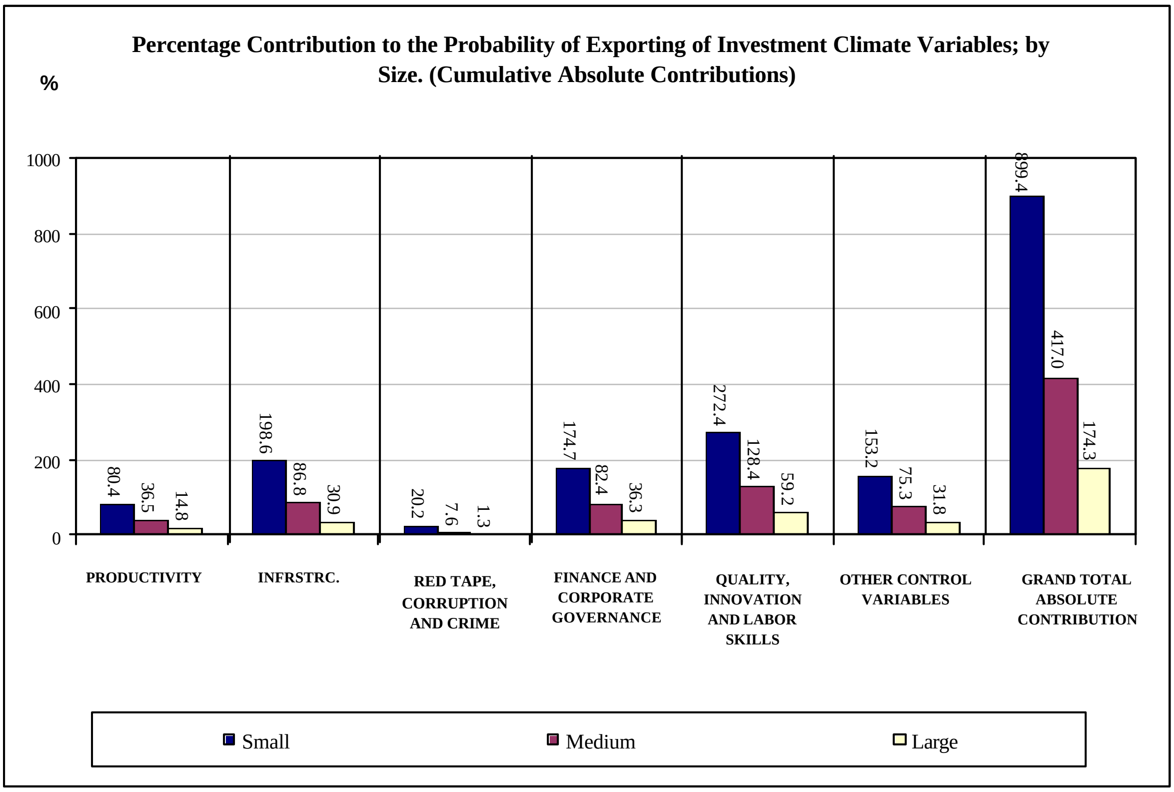


Figure 31

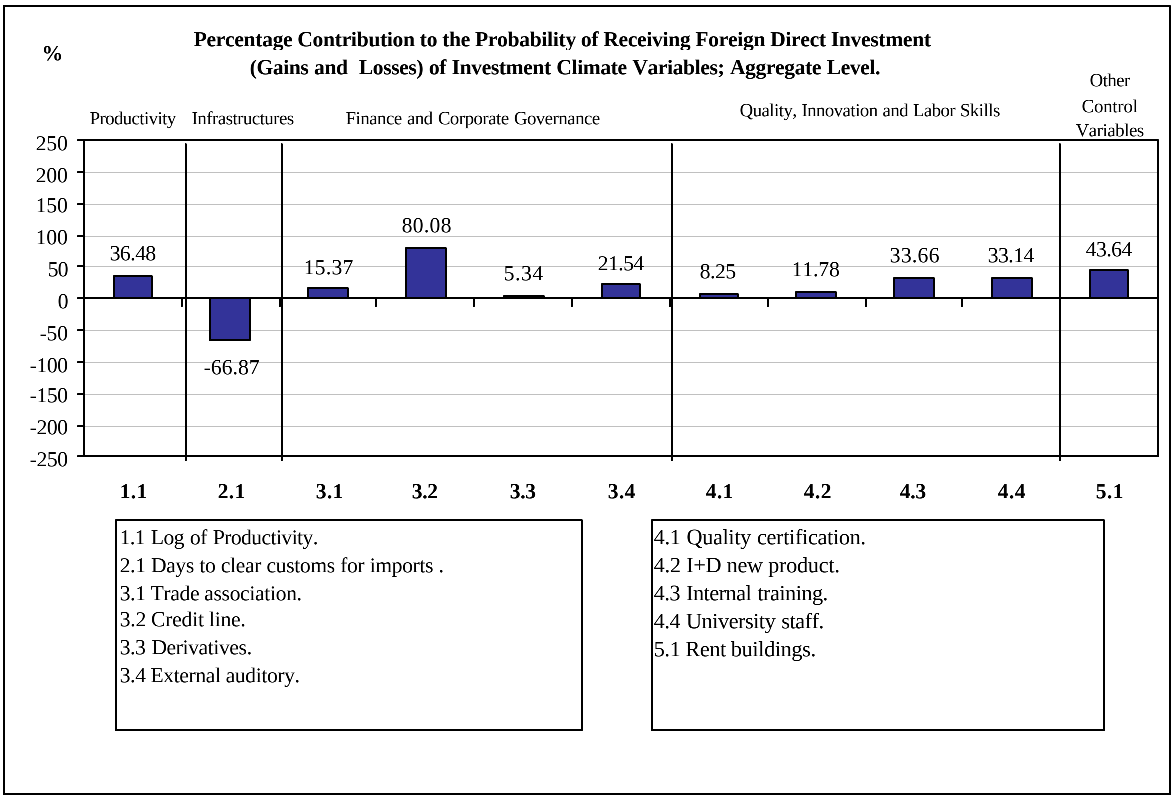


Figure 32

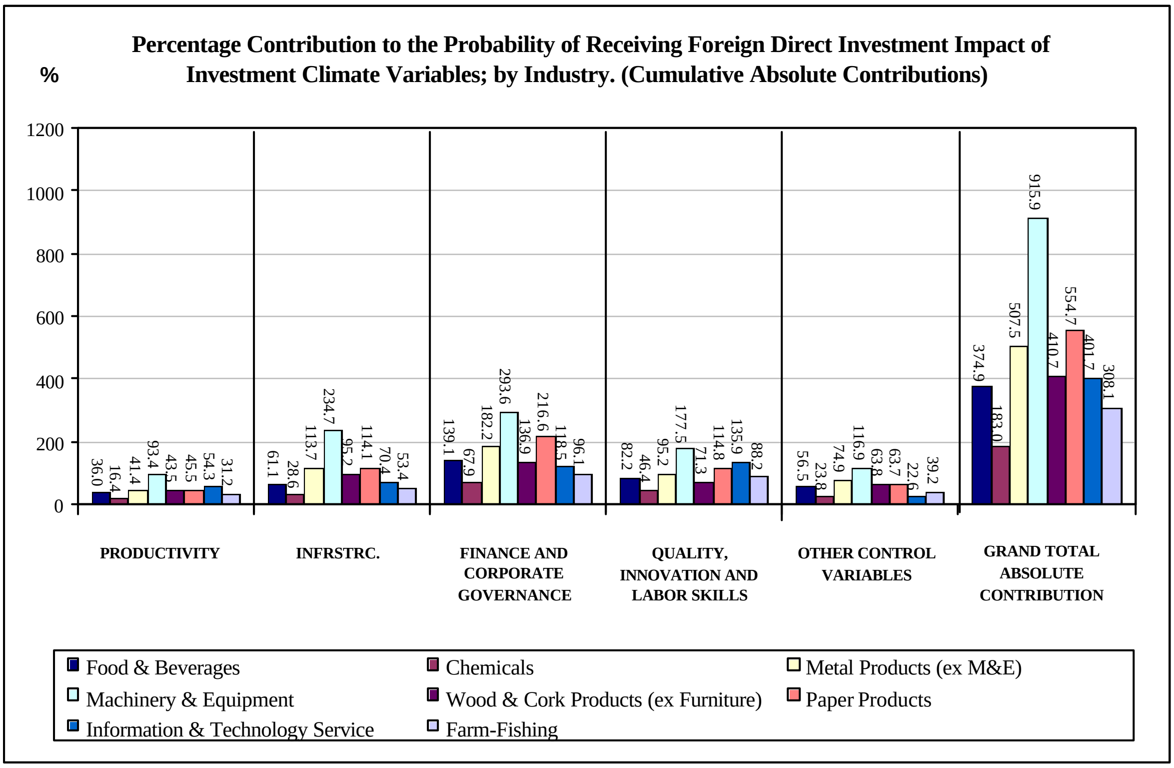


Figure 33

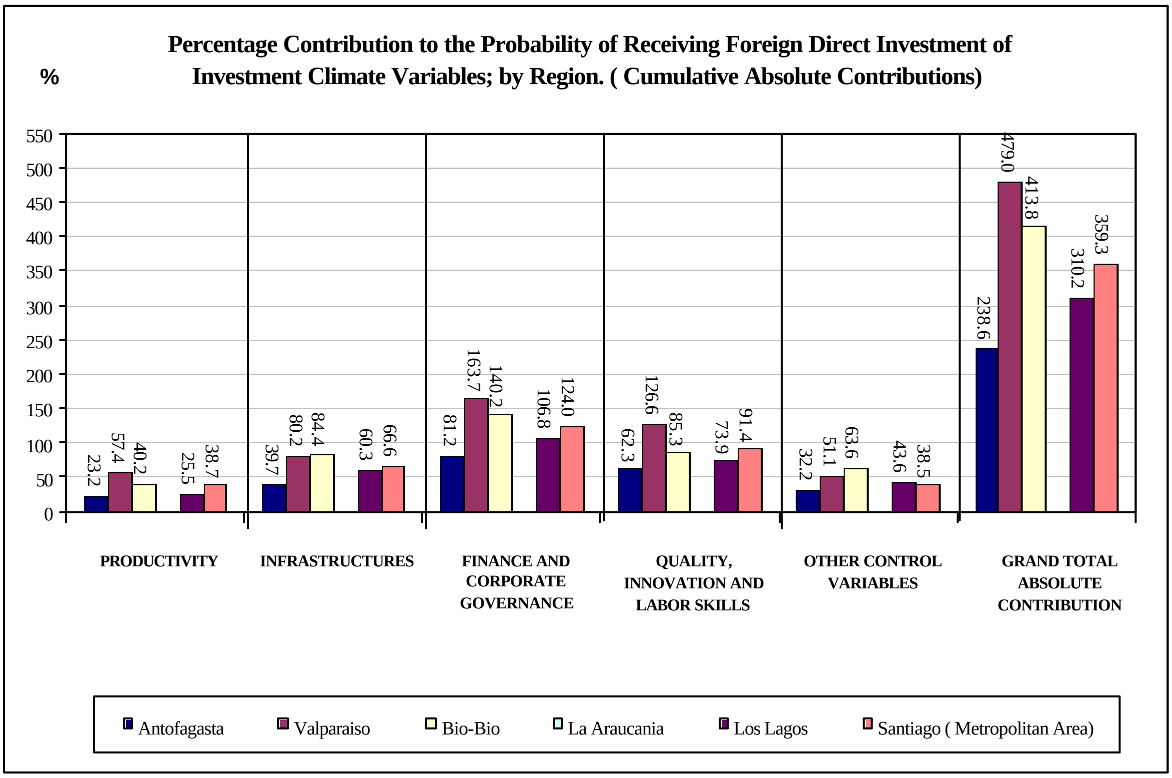


Figure 34

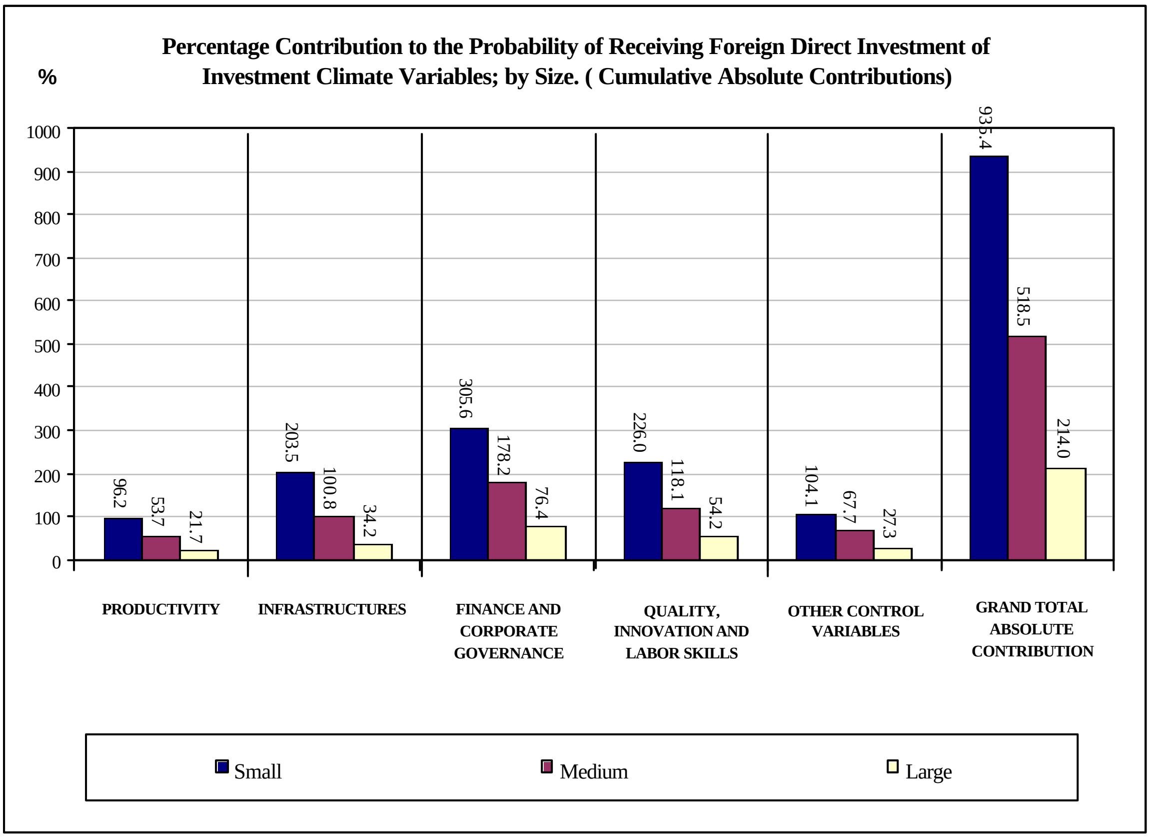

Percentage Contribution to the Probability of Receiving Foreign Direct Investment of Investment Climate Variables; by Size. (Cumulative Absolute Contributions)
%
1000
900
800
700
600
500
400
300
200
100
0
96.2
53.7
21.7
203.5
100.8
34.2
305.6
178.2
76.4
226.0
118.1
54.2
104.1
67.7
27.3
935.4
518.5
214.0
PRODUCTIVITY
INFRASTRUCTURES
FINANCE AND CORPORATE GOVERNANCE
QUALITY, INNOVATION AND LABOR SKILLS
OTHER CONTROL VARIABLES
GRAND TOTAL ABSOLUTE CONTRIBUTION
Small
Medium
Large

Figure 35
Histograms of Restricted Solow Residual Productivity in Logs and Levels; Whole Sample versus Without Outliers.

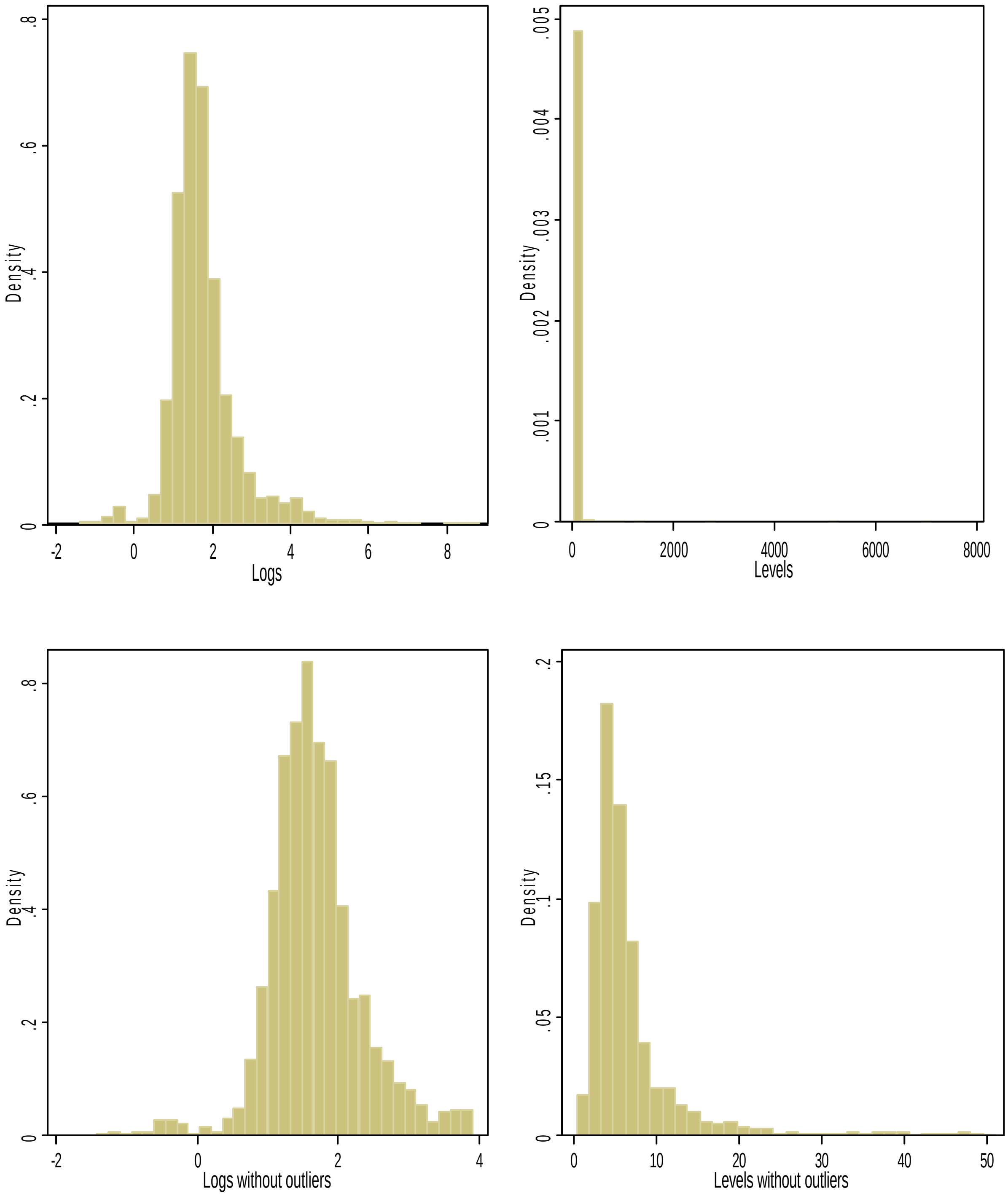
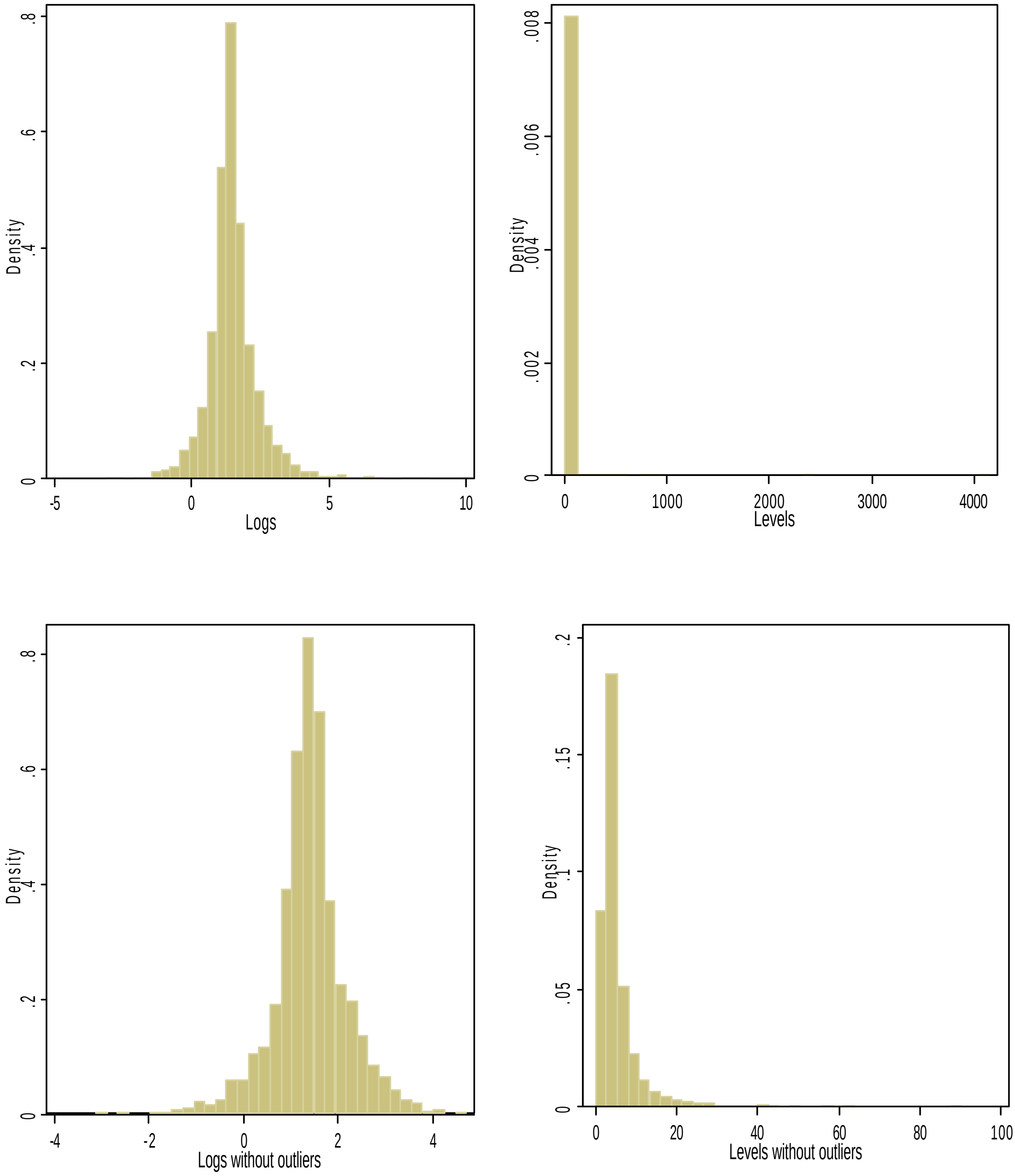


Figure 36
Histograms of Unrestricted Cobb-Douglas OLS Productivity in Logs and Levels; Whole Sample versus Without Outliers.



Appendix A: Data Transformations.

Due to the large amount of zeros and missing values observed in the production function variables (see table B.3) and in order to keep as many observations as possible to benefit us of the law of the large numbers (notice that the most of this observations kept the value of the IC variables), we decided to replace the missing data by values that were obtained directly from the observations available. It must be pointed out here that in the essence of the process applied was always present the idea of maintain as much representativeness as possible of the sample we had. The data transforming process is described in what follows:

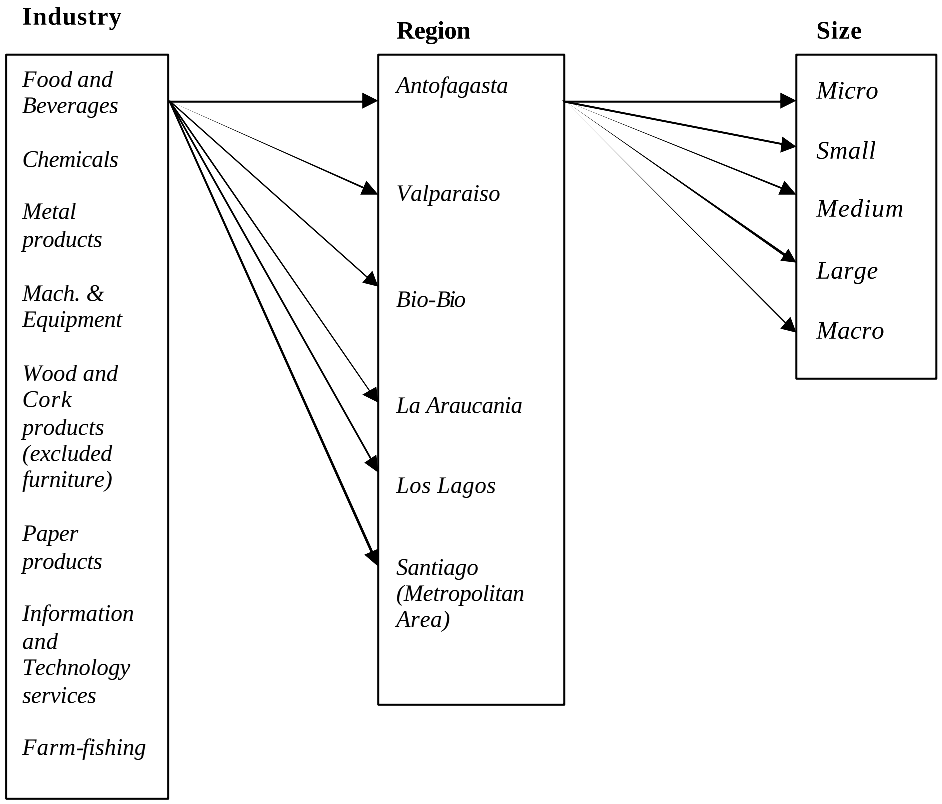
Step 1: *Previous transformations*. Firstly, we dropped those cross sections with either zeros or missing values in all production function variables, in addition we dropped all cross sections with either zeros or missing values in sales, materials and capital stock. Secondly, we replace zeros in production function variables and outliers observations by missing values in order to begin the transformation of the original sample.

Step 2: *Data transformation.* We began by stratifying original sample into sub-groups in order to compute the median of production function variables for each group, the missing values would be then replaced by these medians. Notice that the small the sub-groups we create the more accurate will be the sample for the IC regressions, nevertheless, there is a trade-off between accuracy and number of observations available, thus for some sub-groups we could not compute the median because of there were no observations (the number of observation available decreases as the amplitude of the sub-groups decreases). For such cases the only solution was to use larger groups. If the problem keeps we proceed to create another sub-group, finally to fill all missing values we had to repeat this stratification process three times:

A. *By Industry, region and size of the firms*: eight industries, six regions and five sizes, 240 sub-groups.
B. *By industry and region*: 48 sub-groups.
C. *By industry*: 8 sub-groups.

Step 3: *Final transformations*. Final step slightly modify the sample we obtained in step 2; it simply consists in excluding the outliers which were defined as those observations with ratios of materials to sales or labor cost to sales greater than one.

Figure Ap.1: Stratification Process:



* Variable "Size" used here is based in the number of employees, not in the amount of sales, as the variable used in regressions. *Micro* firms are those with less than 10 employees; *small* firms are in between 10 and 50 employees; *medium* firms are within 50 and 150 employees; *large* firms are in between 150 and 250 employees; finally, *macro* firms are those with more than 250 employees.

Appendix B: Identification restrictions

The restricted variables and the equations in which their coefficients are restricted to take value 0 are listed in what follows, in brackets are the substitutive variables:

a) *Productivity equation*: E-mail (b_{E-mail}) (Web page) and R+D New Product ($b_{R+Dnewp}$) (R+D). With the restrictions applied on productivity equation matrix D becomes (see sub-section 2.6.1)

$$\mathbf{D} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & a_{L,W} & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & b_{Exp,E-mail} & 0 \\ 0 & 0 & 0 & b_{FDI,R+Dnewp} \end{bmatrix}$$

b) *Employment demand equation*: Days to clear customs for exports ($b_{DsCstmExp}$) (Days to clear customs for imports), E-mail (b_{E-mail}) (Web page), R+D New product ($b_{R+Dnewp}$) (R+D) and Average duration of power outages (b_{durpo}) (Number of power outages). Matrix D for employment demand equation is

$$\mathbf{D} = \begin{bmatrix} b_{P,DsCstmExp} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & b_{W,durpo} & 0 & 0 \\ 0 & 0 & b_{Exp,E-mail} & 0 \\ 0 & 0 & 0 & b_{FDI,R+Dnewp} \end{bmatrix}$$

c) *Real Wages equation*: Days to clear customs for exports ($b_{DsCstmExp}$) (Days to clear customs for imports), E-mail (b_{E-mail}) (Web page) and R+D New product ($b_{R+Dnewp}$) (R+D). Matrix D for real wages equation becomes

$$\mathbf{D} = \begin{bmatrix} 0 & b_{P,DsCstmExp} & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & b_{Exp,E-mail} & 0 \\ 0 & 0 & 0 & b_{FDI,R+Dnewp} \end{bmatrix}$$

d) *Probability of exporting equation*: Average duration of power outages (b_{durpo}) (Number of power outages) and R+D New products ($b_{R+Dnewp}$) (R+D). Matrix D is in this case

$$\mathbf{D} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 1 & a_{L,W} & 0 & 0 \\ 0 & 1 & b_{W,durpo} & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{FDI,\,R+Dnewp} \end{bmatrix}$$

e) *Probability of receiving FDI equation*: Days to clear customs for exports ($b_{DsCstmExp}$) (Days to clear customs for imports) and E-mail (b_{E-mail}) (Web page). Being matrix D for this equation

$$\mathbf{D} = \begin{bmatrix} 0 & 0 & b_{P,DsCstmExp} & 0 \\ 1 & a_{L,W} & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & b_{Exp,E-mail} \\ 0 & 0 & 0 & 0 \end{bmatrix}$$