UNIVERSIDAD CARLOS III DE MADRID working papers

Working Paper 08-20
Economic Series (12)
June 2008

Departamento de Economía
Universidad Carlos III de Madrid
Calle Madrid, 126
28903 Getafe (Spain)
Fax (34) 916249875

Investment Climate Assessment Based on Demean Olley and Pakes Decompositions: Methodology and Application to Turkey's Investment Climate Survey[1]

Alvaro Escribano* J. Luis Guasch** Manuel de Orte*** Jorge Pena****

Abstract

Most empirical studies show strong detrimental evidence that regulatory, and administrative, barriers to entry have on productivity and on firm growth. In this paper we evaluate and measure the total factor productivity (TFP) impacts of having; low quality physical infrastructures (electricity, telecommunications, transport, customs, etc.) and bad social infrastructures (rules of law, informality, corruption, etc.). We suggest evaluating the impact on average productivity (TFP) and on the allocative efficiency of production among firms based on several versions of the Olley and Pakes (O&P) decompositions. We evaluate the advantages and disadvantages of each the O&P decomposition in terms of their IC explanatory power. Once we have measured those IC impacts, we compare them with other sources of empirical information obtained from firm's perceptions on main bottlenecks for firm growth and from doing business reports of the World Bank (2007). For the econometric analysis, we use firm level data bases from Turkey's manufacturing sector based on Investment Climate surveys (ICs) done by the World Bank. These ICs are done in many other developing countries and therefore we propose to make cross-country comparisons based on a new demean concept of TFP that also reduces the heterogeneity if using several robust productivity measures within each country.

JEL Clasification: D61, L60, O57, C01.
Keywords: Total factor productivity, investment climate, firm level determinats of allocative efficiency, robust productivity impacts, cross country comparisons of demean TFP.

---

[1] We have benefited from the suggestions and questions from Paulo Correa, Klaus Desmet, Eduardo Ley, Marialisa Motta, Jose Guillherme Reis, Isabel Sanchez, Rodolfo Stucchi and from participants at tepav´s seminar, Ankara, Turkey and at World Bank seminars, Washington DC.
* Telefónica-UC3M Chair on Economics of Telecommunication. Departamento de Economía, Universidad Carlos III de Madrid, Madrid 126, 28903 Getafe, Spain. Email: alvaroe@eco.uc3m.es. http://www.eco.uc3m.es/
** World Bank and University of California, San Diego
*** Laboratorio de Economía de las Telecomunicaciones, Universidad Carlos III de Madrid, Madrid 126, 28903 Getafe, Spain. Email: morte@eco.uc3m.es.
**** Laboratorio de Economía de las Telecomunicaciones, Universidad Carlos III de Madrid, Madrid 126, 28903 Getafe, Spain. Email: jpizquie@eco.uc3m.es.

Contents

1 Introduction

Developing countries are increasingly concern about improving country competitiveness and a significant factor for that is to have a good investment climate or business environment. By investment climate (IC) we mean: a) the set of location-specific factors shaping the opportunities and incentives for firms to invest productively, create jobs and expand and b) the institutional, policy and regulatory environment in which firms operate.

In this paper we extend the recent econometric methodology developed for the World Bank by Escribano and Guasch (2005, 2008) for the analysis of Investment Climate surveys (ICs) of firms from Turkey. Our goal is to use quantitative techniques to estimate the effects on average productivity and on allocative efficiency of restrictive business practices coming from a bad investment climate. Informality, corruption and bad social institutions are at core of the competitiveness problem in most developing countries.

We believe that these types of quantitative analyses are a good complement to the usual empirical indicators used for market investigations of competitive problems affecting consumer welfare, see the report of the Office of Fair Trading (2004). A basic reference of empirical methods in antitrust litigation is Baker and Rubinfeld (1999). Recent and more sophisticated econometric approaches to study the behavior of imperfectly competitive markets are discussed in Pakes (2008) but only some of these recent techniques are applicable for the analysis of investment climate surveys of developing countries given the low quality of the data that create unbalance panels or are just simple cross-section data. Aghion and Griffith (2005) discus the weight that policy makers should place on rewarding successful innovation through granting monopoly power versus enhancing competitive pressure markets puts on firms to push forward the production frontier.

The goal of this paper is to evaluate and measure the impacts on Turkey's firms of having low quality physical infrastructures (electricity, telecommunications, transport, customs, etc.) and of having bad social infrastructures (rules of law, informality, corruption, etc.) on: average total factor productivity (TFP), on the allocative efficiency of production among firms. Once we have measured those impacts, we will compare them with other sources of empirical information like firm's perceptions on main bottlenecks for firm growth and with the results of the doing business report of the World Bank (2006).

Most empirical studies show that productivity (TFP) gains are beneficial for consumers and their quantitative impact is contingent of the degree of competition in the market and competition for the market, see the reports of the Office of Fair Trading (1999 and 2007). Those reports mention the strong detrimental evidence that regulatory and administrative barriers to entry have on productivity. As we will see in the empirical results of this paper, this is a key policy issue in Turkey especially for the attraction of FDI that would make young and small local firms more productive and efficient.

The results of the doing business report of the World Bank (2006) found that Turkey firms are middle rank position (65 out of 178 countries). The weakest areas are related to dealing with licenses, employing workers, closing a business, paying taxes (informality) and trading across borders.

The World Bank (2007) report of Turkey found that firm entry and exit rates are higher in Turkey than in comparator countries. Entering firms in Turkey are small and go through a vigorous post-entry selection process and only 50% of them survive after fours years. Firms that survive do not grow as much as firms in other countries. Is this dynamic inefficient allocation of resources due to investment climate constraints or is it due to the use of anticompetitive business practices that create institutional and physical barriers for firm growth in Turkey? In this paper we measure those investment climate effects on economic performance (TFP, employment, etc.) and on allocative efficiency.

After the past decades with often short-lived economic booms followed by sharp downturns or recessions, Turkey's economic recovery since the 2001 crisis has been notable: Output increased by a third and annual inflation fell steadily. Nevertheless, Figure 1a shows that when compared the evolution with other middle income countries the evolution of the GDP per capita in Turkey remains almost constant with the lowest per capita income. Figure 1b shows that this is due mainly to the evolution of labor productivity. Figure 1c illustrates another basic attribute of Turkish economy: the ratio of labor force to total population is lower than in the comparator countries what is also translated to high unemployment rates.

The World Bank's *Turkey Investment Climate Assessment* (2007) takes stock of the basic characteristics of the Turkish economy: low productivity, low capital per worker, low skills and low participation rates in the job market are the main economic challenges that Turkish politicians have to face in order to accelerate growth and to use the prosperity of the last years as a springboard which may serve to reduce the Turkish GDP gap with respect to more developed economies.

The lack of convergence in terms of per capita income with respect to U.S and E.U during the last twenty-five years shown in Figure 1 reveals the striking weakness of the Turkish economy in terms of competitiveness. In particular, out of the total GDP gap between Turkey and European Union countries 80% is explained by labor productivity and large differences in output per worker between rich and poor countries have been attributed to differences in Total Factor Productivity (TFP), see Caselli (2005), Hall and Jones (1999), and Klenow and Rodríguez-Clare (1997) among others. Thus, once Turkey has secured a reasonable level of macroeconomic stability, in order to get the objectives of increasing productivity and reduce unemployment, the main objective of Turkish's economic authorities is seeking ways to stimulate country competitiveness.[2]

Our goal is to identify competitive restrictions in terms of the investment climate variables with statistically significant and robust effects on several measures of TFP of Turkish firms. For that we follow the systematic and robust econometric methodology presented in Escribano and Guasch (2005 and 2008).[3]

However, a deep evaluation of firms' TFP requires an analysis at the level of individual industries, such as textiles, garments, equipment, automotive, steel, banking, or retailing. A reliable measure of firm performance at the sector level is their corresponding measure of aggregate productivity[4] or aggregate *total factor productivity* (TFP). In a seminal paper, Olley and Pakes (1996) propose to decompose aggregate country, sector, regional TFP into the average TFP of the establishments or and the allocative efficiency term, or sample covariance between TFP and the share of sales.

[2] There is a growing body of literature affirming that large differences on income per capita among countries may be in the greatest extent explained by differences in labor productivity, which in turn may be explained by TFP gaps among countries. We may decompose output per adult (Y/N) into two components: output per worker (Y/L), and the number of workers relative to the adult population (L/N), Y/N=(Y/L)*(L/N). Under a Cobb–Douglas production function framework with constant returns to scale, differences in labor productivity between country A and country B are due to differences in the capital to labor ratio and TFP differences.

[3] The work presented here has been used as background paper for the comprehensive analysis of the Turkish investment climate assessment; see World Bank (2007).

[4] The aggregate TFP of a given sector is computed as simply the weighted average of the TFP at the firm level, where the weights are firms' share of sales.

For Turkish's manufacturing firms the Olley and Pakes (O&P) decomposition of TFP based on the restricted Solow's residual is presented in Figure 2.1 by industry, in Figure 2.2 by region, in Figure 2.3 by size and age of the firm and in Figure 2.4 by year. The first two figures reveal great heterogeneity by industry and by region. A*verage TFP* term varies enormously sector by sector and their corresponding *allocative efficiency* term reveals that the electrical machinery sector inefficiently reallocates resources –output is going from more productive to less productive firms– since this term is negative. However, Figures 2.3 and 2.4 show a large homogeneity by age and through time.

The natural question that arises now is: what are the causes of the large TFP differences observed, across industries within the same country and second across different countries? Investigation on this question has largely focused on differences in technology within representative firms (or average TFP differences). These are models of within-firm inefficiency, with the inefficiency varying across countries, see for example Howitt (2000), Keller (2004), Parente and Prescott (2000) and Klenow and Rodríguez-Clare (2005).

Nevertheless, the more recent literature on productivity dynamics has documented a high dispersion of productivities within industries, providing a considerable margin for reallocation of resources among heterogeneous establishments. Thus, the misallocation of resources among firms can potentially have important effects on aggregate TFP, for instance Baily, Hulten, and Campbell (1992) document that about half of overall productivity growth in U.S. manufacturing in the 80's can be attributed to factor reallocation from low productivity to high productivity plants. Within this recent body of literature the working hypotheses is that not only the level of productivity among heterogeneous plants what matters, but also how the resources are allocated among heterogeneous plants even within narrowly defined industries, see Bartelsman, Haltiwanger, and Scarpetta (2004), Foster, Haltiwanger, and Krizan (2006), Olley and Pakes (1996), Alfaro et al. (2007), Bartelsman, Haltiwanger and Scarpetta (2006), Hsieh and Klenow (2006) and Restuccia and Rogerson (2007)) among others.

In a frictionless economy the allocative efficiency term of the O&P decomposition should be equal to zero, since the natural development of markets makes the more productive establishments to gain market share from the less successful ones; nonetheless, the existence of frictions in the markets may prevent resources to be naturally reallocated among establishments. These frictions may arise from a variety of causes; a non-exhaustive list may include adjustment costs of entry and exit, market structures or technological factors among others. However, these frictions can also be driven by government policies and institutions that affect market competition through their impact on costs, risks and barriers to competition. While these factors are hardly resolved in developed countries, they assume an even more important role in emerging and transition economies like Turkey, where they make the cost of doing business inefficiently high. These factors include corruption, taxes, the regulatory burden and extent of red tape in general, regulation of factor markets (labor, intermediate materials and capital), the quality of infrastructure, technological and innovation support, and the availability and cost of finance. All these factors deteriorate the investment climate for doing business and affect the performance of private firms, reducing the overall efficiency of the firms in a given country (average TFP) and decelerating the allocative efficiency process.[5]

A significant component of country competitiveness is therefore 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 (Bosworth and Collins, 2003; 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

[5] 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, Erosa and Cabrillana (2007) point out that the ability to enforce contracts affects resource allocation across entrepreneurs of different productivities, and across industries with different needs for external financing

turn are conditioned by the institutional and policy arrangements a society employs (investment climate variables for us). 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 for us) as the promising channels for understanding the low productivity observed in Latin American countries.

We show that all those institutional factors worsening the investment climate dramatically reduce the competitive conditions and harm the average productivity and the allocative efficiency process in Turkey. In addition, these results are fully consistent with managers' perceptions, signaling that among all the investment climate factors those regarding red tape, informalities, taxes and corruption play a key role in the determination of the aggregate productivity.

The structure of the paper is the following; Section 2 presents the information on the IC survey of Turkey, the econometric models for robust TFP estimation and the new concept of demean productivity that will be useful for cross-country comparisons. Section 3, introduces several O&P types' decompositions for TFP and logTFP. Section 4, presents the main empirical results and makes an international comparison. Finally, section 5 concludes.

2 Econometric methods

The econometric methodology used in this paper to compute the effect of the investment climate on TFP follows Escribano and Guasch (2005, 2008). We concentrate here on several extensions evaluating the impact of IC and average TFP and on allocative efficiency and their corresponding cross-country comparisons.

2.1 The Data

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 set priorities for intervention and reform. The most common instrument used has been firm-level surveys, know as Investment Climate Surveys (ICs) from which both subjective evaluations of obstacles and objective hard-data numbers with direct links to costs and productivity are elicited and imputed.

The Investment Climate Surveys capture firms' experience in a range of areas related with the economic performance: financing, governance, corruption, crime, regulation, tax policy, labor relations, conflict resolution, infrastructures, supplies and marketing, quality, technology, and training among others. For that purpose, we classify investment climate factors in five categories to evaluate the impact of each group on the economic performance. In the first group, says infrastructures, we include all the variables related with customs clearance, power and water supply, telecommunications (including phone connection and information technologies) and transportation. In the second group, red tape, corruption and crime, are included all the IC factors regarding tax rates, conflicts resolution, crime, bureaucracy, informalities, corruption and regulations. The next group is finance and corporate governance which contains factors related with governance, investments, informalities in payments of sales and purchases, access and cost of finance and accountability (or auditing). The last group of IC variables is quality, innovation and labor skills; this group includes the quality certifications, technology usage, product and process innovation, research and development, quality of the labor, training and managers' experience and education. The last group –other control variables– is not properly a group of investment climate factors but a group of other firms' control characteristics, we classify into this group all the factors that we consider may have an important impact on the economic performance but not considered as IC factor: exports and imports, age, FDI, number of competitors, size of the firm, etc.

The ICs provides information on the productivity (or production function) variables, says, output (sales), employment, intermediate materials, capital stock and labor cost. The ICs does not provide information on prices at the firm level, so the production function variables were deflated by using the World Bank's country specific Consumer Price Index, base 2000. An appendix with the definition of the variables used is included at the end of the paper.

The data are from a survey of 1323 manufacturing establishments conducted in the summer of 2005. The panel is short in the time dimension, since includes only 2 years of productivity data, and has 1 year of investment climate (IC) variables. The cleaned dataset leaves a panel with 836 observations for each of the two years.

In this paper we focus on the manufacturing sector and by classifying the establishments by their ISIC code we end up with establishments from the next eight sectors: a) Food and beverages; b)

Textiles and apparels; c) Chemicals; d) Non-metallic mineral products; e) Metallic products; f) Machinery and equipment; g) Electrical machinery; h) Transport equipment.

2. 2 Alternative Productivity Measures of the Impacts of IC Variables

Escribano and Guasch (2005, 2008) model relates infrastructure and other IC and C variables with firm-level productivity (TFP) according to the following observable fixed-effects system of equations:

$$\log Y_{it} = \alpha_L \log L_{it} + \alpha_M \log M_{it} + \alpha_K \log K_{it} + \log P_{it} \tag{2.1a}$$

$$\log P_{j,it} = a_i + \alpha'_{Ds} D_j + \alpha'_{DT} D_t + \alpha_P + w_{it} \tag{2.1b}$$

$$a_i = \alpha'_{IC} IC_{P,i} + \alpha'_C C_{P,i} \ + \varepsilon_i \tag{2.1c}$$

where, *Y* is firms' output (sales), *L* is employment, *M* denotes intermediate materials, *K* is the capital stock, *INF* is a time-fixed vector of observable infrastructure variables, *IC* and *C* are time-fixed effect vectors of other investment climate and control time-fixed effects, and D_j and D_t are the vectors of industry and year dummies.

The usually unobserved time fixed effects (a_i) of the TFP equation (2.1b) is here proxy by the set of observed time fixed components IC and C variables of (2.1c) and a remaining unobserved random effects (ε_i). The two random error terms of the system, ε_i and w_{it}, are assumed to be conditionally uncorrelated with the explanatory L, M, K, IC and C variables[6] of equation (2.2),

$$\log Y_{it} = \alpha_L \log L_{it} + \alpha_M \log M_{it} + \alpha_K \log K_{it} + \alpha'_{IC} IC_{P,i} + \alpha'_C C_{P,i} \ + \alpha'_{Ds} D_j + \alpha'_{DT} D_t + \alpha_P + u_{it} \,. \tag{2.2}$$

Therefore, the regression equation (2.2) is representing the *conditional expectation* plus a composite random-effect error term equal to $u_{it} = \varepsilon_i + v_{it}$ that should satisfy *standard assumptions* of random effects (RE) conditional models. That is;

[6] Under this formulation (and other standard conditions) the OLS estimator of the productivity equation (2.2) with robust standard errors is consistent, although a more efficient estimator (GLS) is given by the random effects (RE) estimator that takes into consideration the particular covariance structure of the error term, $\varepsilon_i + w_{it}$, which introduces certain type of heteroskedasticity in the regression errors of (2.2).

$$E\left[v_{it} / \log L_{it}, \log M_{it}, \log K_{it}, IC_{P,i}, C_{P,i}, D_j, D_t, \varepsilon_i \right] = 0$$

$$E\left[\varepsilon_i / \log L_{it}, \log M_{it}, \log K_{it}, IC_{P,i}, C_{P,i}, D_j, D_t \right] = 0$$

$$and \quad Var\left[\varepsilon_i / \log L_{it}, \log M_{it}, \log K_{it}, IC_{P,i}, C_{P,i}, D_j, D_t \right] = \sigma_\varepsilon^2 .$$

Notice that we need to condition on the observable fixed effects (IC) to get the orthogonally condition of the inputs L, M and K.

Providing reliable and robust estimates of the impact of IC on productivity are not a straightforward task. First, because the functional form of the PF is not observed, and there is no available single salient TFP measure. Second, there is an identification issue separating TFP from PF; when any PF inputs is influenced by unobserved common causes affecting productivity—such as a firm's fixed effects—there is a simultaneous equation problem in equation (2.1a). Third, we could expect that several IC variables have at least some degree of endogeneity, questioning therefore the conditional uncorrelation condition of (2.2). In what follows of this section, we briefly review the solutions to these questions suggested in Escribano and Guasch (2005, 2008).

Productivity (TFP), or multifactor productivity, refers to the effects of any variable different from the inputs—labor (L), intermediate materials (M), and capital (K)—affecting the production (Y) process. Since there is no single salient measure of productivity (or $logP_i$), any empirical evaluation of the productivity impact of IC might critically depend on the particular productivity measure used. Escribano and Guasch (2005, 2008) suggested -following the literature on *sensitivity analysis* see for example Magnus and Vasnew (2006)- to look for empirical results (elasticities) that are *robust to several productivity measures*. This is also the approach we follow in this paper.

In particular, we want the elasticities of IC on productivity (TFP) to be robust (with equal signs and similar magnitudes) for the 10 different productivity measures used. The alternative productivity measures used come from considering:

(a) Different functional forms of the production functions (Cobb-Douglas and Translog)

(b) Different sets of assumptions (technology and market conditions) to get consistent estimators based on Solow's residuals, ordinary least squares (OLS), or random effects (RE), and so on

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

Table 2.1 summarizes the productivity measures used for the IC evaluation. The two-step estimation starts from the nonparametric approach based on cost shares from Hall (1990) to obtain Solow's residuals in logs under two different assumptions:[7] (a) the cost shares are constant for all plants located in the same country (restricted Solow residual), and (v) the cost shares vary among industries in the same country (unrestricted by industry Solow residual). Once we have estimated the Solow residuals ($logP_i$) in the first step, in the second step we can estimate equation (2.3) by pooling OLS with robust standard errors. We also estimate (2.3) by RE to obtain the corresponding IC elasticities and semi-elasticities,

Table 2.1 Summary of productivity measures and estimated investment climate (IC) elasticities

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

Source: authors estimations

Note: Restricted coefficient = equal input-output elasticities in all industries.

Unrestricted coefficient = different input output elasticities by industry.

[7] The advantage of the Solow residuals is that they require neither the inputs (L, M, K) to be exogenous nor the input-output elasticities to be constant or homogeneous (Escribano and Guasch, 2005 and 2008). The drawback is that they require having constant returns to scale (CRS) and, at least, competitive input markets.

$$\log P_{it} = \alpha'_{IC} IC_{P,i} + \alpha'_{C} C_{P,i} + \alpha'_{Ds} D_j + \alpha'_{DT} D_t + \alpha_P + \varepsilon_i + w_{it} \qquad (2.3a)$$

where *IC* and *C* are, respectively, the observable fixed effects vectors of investment climate and control variables listed in Table A.2 of the Appendix. In all the panel data regressions, we always control for several sector-industry dummies (D_j, j = 1, 2, ..., q_D), and in the cases having more than one year of observations we also include a set of time (D_t, t = 1, 2,..., q_T) dummy variables and always a constant term (α_P).

For cross-country comparisons based on TFP we use the following *demean TFP*[8] concept that gets rid of the constant term as well as the constant effects by industry and by year, concentrating therefore on the part of TFP that is influenced by IC and the other plant level control C variables,

$$Demean \log P_{it} = \alpha'_{IC} IC_{P,i} + \alpha'_{C} C_{P,i} \ . \qquad (2.3b)$$

In the single-step estimation approach, we consider the parametric estimation by OLS and RE of the extended production function (2.2). To address the well-known problem of the endogeneity of inputs (L, M, and K) , we follow the approach proposed by Escribano and Guasch (2005, 2008). That is, we proxy the usually unobserved firm-specific fixed effects (which are the main cause of inputs' endogeneity) by a long list of observed firm-specific fixed effects coming from the investment climate surveys. Controlling for the largest set of IC variables and plant C characteristics, we can get—under standard regularity conditions—consistent and unbiased least squares estimators of the parameters of the PF and the IC elasticities. Furthermore, we use two different functional forms of the PF—Cobb-Douglas and Translog—under two different assumptions on the input-output elasticities: equal input-

[8] Notice that the demean TFP concept of equation (2.3b) corresponds to the observable part of the time fixed effects equation (2.1c).

output elasticities in all industries (restricted case) and different input-output elasticities by industries (unrestricted case).

Another econometric problem we have to face when estimating the parameters of the IC and C variables—either from the two-step or single-step procedure—is the possible endogeneity of some of these IC variables. That is, many IC variables are likely to be determined simultaneously along with any TFP measure. With these productivity equations, the traditional instrumental variable (IV) approach is difficult to implement, given that we only have information for one year, and therefore we cannot use the natural instruments for inputs, such as those provided by their own lags or it is difficult to find good instruments from the list of IC variables. As a simple alternative correction for the endogeneity of the IC variables, we use the region-industry-size average of firm-plant-level IC variables instead of the crude IC variables,[9] which is a common solution in panel data studies at the firm level[10] (see, for instance, Veeramani and Goldar, 2004, for the use of the industry-region averages with IC variables).

Using industry-region-size averages also mitigates the effect of having certain missing individual IC observations at the plant level, which—as mentioned in Section 3—represent one of the most important difficulties using ICs. As an alternative, we also follow a second strategy to deal with the missing values of some IC, and C variables. In order to keep as many observations in the regressions as possible to avoid losing efficiency, when the response rate of the variables is large enough, we decided to replace those missing observations with the corresponding industry-region-size average.[11] Thus, we gain observations, efficiency, and representativity at the cost of introducing measurement errors into some variables.[12]

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

[9] Because of the low number of available regions in most of the countries, we had to use the industry-region-size variables instead of the region-industry averages. For the creation of cells a minimum number of firms are imposed—there must be at least 15 to 20 firms in each industry-region-size cell to create the average, otherwise we apply the region-industry averages. If the problem persists, we apply the industry-size or the region-size average.
[10] This two-step estimation approach is a simplified version of an instrumental variable estimator (two-stage least squares, 2SLS).
[11] Notice that this replacement strategy has a straightforward weighted least squares interpretation since we are giving a greater weight to those observations with more variance.
[12] The measurement error introduces a downward bias in the parameters that depends on the ratio between the variances of the variables and the measurement error. Since those explanatory variables are constant within regions, sizes, and industries we expect their variances will be small.

too-simple model—generates biased and inconsistent parameter estimates. We start the selection of variables with a wide set compounded by up to 95 IC variables, see Table A.2 of the appendix . We avoid simultaneously using time variables that provide the same information and are likely to be correlated, mitigating the problem of multicollinearity that could otherwise arise. We then start removing from the regressions—the less significant variables—one by one, until we obtain the final set of variables, all significant in at least one of the regressions and with parameters varying within a reasonable range of values. Once we have selected a preliminary model we test for omitted IC variables.

The robust coefficients of the IC, and C variables in productivity, along with their level of significance, are detailed in Table C.1 of the country-specific annexes included at the end of the report. Indications on the form the variables are entering the regression—industry-region-size average or missing values replaced by the industry-region-size average—are also included.

Table B.1 of the appendix shows the correlation matrix between all the possible pair wise combinations of productivity measures. The correlations range from very high and positive values (0.99) to very low and negative values (-0.001). However, the IC estimated elasticities on the 10 alternative (see Table 2.1) productivity measures given in Tables C.1a and Table C.1b of the appendix, show very robust results. All the IC elasticities and semi-elasticities estimated never change the signs and the numerical values obtained are reasonable. The main reason for getting these robust results is obtained by controlling for IC variables from all the IC blocks (Infrastructures, Red tape, corruption and crime, Finance and corporate governance, Quality, innovation and labor skills and the other Control variables) to avoid having omitted variables biases, see Escribano and Guasch (2005, 2008).

3 The Olley and Pakes decompositions: IC Productivity contributions to the sample mean and to allocative efficiency

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 or to do country by country analysis when we were forced to pool observations from different countries to be able to do regression analysis. In those cases, we cannot give much credibility to the country by country, or sector by sector, regression estimates of the impact of IC variables on productivity since they are based on very small samples. Furthermore, this decomposition provides additional information on aggregate productivity and efficiency allocation analysis within each country or sector.

The Olley and Pakes (1996) type TFP decomposition, (O&P) from now on, has two elements; the sample average productivity and the covariance term.

Let $P_{jt} = \sum_{i=1}^{N_{jt}} s_{j,it}^{Y} P_{j,it}$ be the aggregate (or weighted) 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 ($s_{j,it}^{Y}$) indicate the share of sales of firm i in year t over the total sales (Y) of sector j of that year ($s_{j,it}^{Y} = \frac{Y_{j,it}}{\sum_{i=1}^{N_{j,t}} Y_{j,it}}$). Let $\bar{P}_{jt} = \frac{1}{T}\sum_{i=1}^{N_{jt}} P_{j,it}$ 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 where[13] $\tilde{s}_{j,it}^{Y} = (s_{j,it}^{Y} - \bar{s}_{j,t}^{Y})$ and $\tilde{P}_{j,it} = (P_{j,it} - \bar{P}_{j,t})$ are in deviations to the mean. The Olley and Pakes (1996) decomposition (O&P) in levels is:

$$P_{jt} = \bar{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{Y} \tilde{P}_{j,it} \,. \tag{3.1}$$

The first term ($\bar{P}_{jt}$) is the *average productivity* of industry j in year t and the second term ($\sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{Y} \tilde{P}_{j,it}$) = $N_{jt}\,\text{co}\hat{\text{v}}(s_{j,t}^{Y}, P_{j,t})$, measures the *allocative efficiency* or covariance between the share of sales and productivity, $\text{co}\hat{\text{v}}(s_{j,t}^{Y}, P_{j,t})$, 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 covariance, the higher will be the share of sales that goes to more productive firms. Therefore, allocation efficiency is increased and sector j aggregate productivity is enhanced. However, if the covariance is negative, there are allocation

[13] Notice that $\bar{s}_{j,t}^{Y} = \frac{1}{N_{jt}}$ in the Olley and Pakes (1996) decomposition.

inefficiencies since the more negative the covariance is, the higher will be the share of output that goes to less productive firms, reducing aggregate sector j productivity.

Similarly we can compute the aggregate productivity of sector j but for TFP in logs. Let $\log P_{jt} = \sum_{i=1}^{N_{jt}} s^{Y}_{j,it} \log P_{j,it}$ 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 ($s^{Y}_{j,it}$) are the same of the normal case of decomposition in levels. Let $\log \overline{P}_{jt} = \frac{1}{T}\sum_{i=1}^{N_{jt}} \log P_{j,it}$ 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 (3.1) where $\tilde{s}^{Y}_{j,it} = (s^{Y}_{j,it} - \overline{s}^{Y}_{j,t})$ and $\log \tilde{P}_{j,it} = (\log P_{j,it} - \log \overline{P}_{j,t})$ are in deviations to the mean. Then the Mixed O&P decomposition becomes,

$$\log P_{jt} = \log \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}^{Y}_{j,it} \log \tilde{P}_{j,it} \ . \qquad (3.2)$$

The first term ($\log \overline{P}_{jt}$) is the *average log productivity* of industry j in year t and the second term ($\sum_{i=1}^{N_{jt}} \tilde{s}_{Y,j,it} \log \tilde{P}_{j,it}$)= $N_{jt}\, \hat{\text{cov}}(s_{Y,j,t}, \log P_{j,t})$, measures the *allocative efficiency* between variables.

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 (3.1)-(3.2) to the Solow residuals, at five different levels of aggregation; aggregate level, by sector, by region, by size of the firms, by age of the firms, etc.

Figures 2.1 to 2.5 report the results of the O&P decomposition in levels at industry, region, size and age, year and city aggregation levels. By industry "Textiles & apparels" has the largest aggregate productivity followed by "Food and beverages". Efficiency term becomes more relevant in "Non-metallic mineral products", whereas in "Transport equipment" and "Machinery & equipment" its role is marginal. By regions Ic Anadolu is the more productive region, having the efficiency term a key role. By size, the small and large have similar aggregate productivity, however the efficiency term is less important in large firms, whereas this term is almost a half of aggregate productivity of small firms. There are no significant differences among age and years. By cities we found the largest aggregate productivity in Erzurum, Konya and Kahramanmaras.

Figures 3.1 to 3.5 show the results of the Mixed O&P decomposition at different aggregation levels.

3.1 IC variables assessment based on Olley and Pakes decompositions

Aggregate log-productivity, say (log P), is equal to the sum of the sample average log productivity of the establishments, and the covariance between the share of sales (s^Y) and log productivity. The index q could also indicate a particular industry, region, size, and so on. The useful additive property of equation (2.2) in logarithms, allow us to obtain an exact closed form solution of the decomposition of aggregate log productivity according to equation (3.3). We can express aggregate log productivity as a weighted sum of the average values of the IC, C, dummy D variables, the intercept and the productivity average residuals ($\hat{u}$) from (2.2); and, the sum of the *covariances* between the share of sales and investment climate variables IC, C, dummies D and the productivity residuals ($\hat{u}$).

$$\begin{aligned}\log P \ &= \hat{\alpha}'_{IC}\overline{IC}_P + \hat{\alpha}'_C\overline{C}_P + \hat{\alpha}'_{Ds}\overline{D} \ + \hat{\alpha}_p + \overline{\hat{u}}_t \ + N_{jt}\hat{\alpha}'_{IC}\,\hat{\text{c}}\text{ov}(s_t^Y, IC_P) + \\ & N_{jt}\hat{\alpha}'_C\,\hat{\text{c}}\text{ov}(s_t^Y, C_P) + N_{jt}\hat{\alpha}'_{Ds}\,\hat{\text{c}}\text{ov}(s_t^Y, D_j) + N_{jt}\hat{\alpha}'_{DT}\,\hat{\text{c}}\text{ov}(s_t^Y, D_t) + N_t\,\hat{\text{c}}\text{ov}(s_t^Y, \hat{u}_t\,)\end{aligned} \qquad (3.3)$$

where the set of estimated parameters used comes from the two-step TFP estimation, having the restricted Solow’s residual as dependent variable in (2.2).

From equation (3.3) each IC, and C variable may affect the aggregate log productivity through both its average and covariance (with respect to the share of sales). This complements the information provided by the marginal effects (IC elasticities). Suppose that an IC variable with a low impact, in terms of marginal effects (elasticities), affect most of the firms in a given country, then the impact of such a IC variable in terms of average productivity could be very high. Therefore, it is very important for policy analysis to combine the empirical evidence from the estimated IC elasticities, on productivity, with their corresponding IC impact on the two components of O&P decompositions; average productivity and allocative efficiency.

A variable with a negative marginal effect on average productivity (or log P) may have either a positive or a negative effect on allocative efficiency. If the covariance of that IC variable and the market share is positive, then the greater proportion of sales is in the hands of establishments with high levels of that variable the larger will be the negative impact on aggregate productivity, therefore decreasing the allocative efficiency. In contrast, a negative covariance means that those establishments with the highest levels of the IC variable have the lowest market shares, and, therefore, the negative effect of the IC variable on average productivity is somehow compensated through the effect on the reallocation of resources among firms.

By operating in (3.3) obtain the next expression that allows us obtain a direct decomposition of the impacts of each INF, IC, and C variables on aggregate productivity (log P),

$$100 = \frac{100}{logP}[\hat{\alpha}'_{IC}\overline{IC}_P + \hat{\alpha}'_C\overline{C}_P + \hat{\alpha}'_{Ds}\overline{D}_j + \hat{\alpha}'_{DT}\overline{D}_t + \hat{\alpha}_p + \overline{\hat{u}}_t + N_{jt}\hat{\alpha}'_{IC}\hat{c}ov(s_t^Y, IC_P) + N_{jt}\hat{\alpha}'_C\hat{c}ov(s_t^Y, C_{P,}) + N_{jt}\hat{\alpha}'_{Ds}\hat{c}ov(s_t^Y, D_j) + N_{jt}\hat{\alpha}'_{DT}\hat{c}ov(s_t^Y, D_t) + N_{jt}\hat{c}ov(s_t^Y, \hat{u}_t)]. \tag{3.4}$$

There are several advantages of using equation (3.4). First, we can compare net contributions by isolating the impact of INF and other IC variables from the impact of industry dummies, the intercept, and the residuals. Second, we can express what portion of aggregate productivity is explained by IC, and C variables (demean logTFP), and what proportion is due to the constant term, industry dummies and so on. To make cross-country comparisons based on IC impacts on TFP, to avoid the problem of comparing apples and oranges, it is desirable create an index (*demean TFP*). After subtracting the mean (that is, the constant term, time effects, industry effects and country-specific effects) from aggregate productivity we can concentrate on the contributions of IC variables to the demean TFP.

Similarly, we can construct the demeaned counterparts of expressions (3.3) and (3.4) and compute the percentage contribution of each IC variable or by blocks of IC variables -see equations (3.5) and (3.6) respectively- obtaining the following *demean mixed O&P decomposition*,

$$Demean \log P \ = \hat{\alpha}'_{IC}\overline{IC}_P + \hat{\alpha}'_C\overline{C}_P + N\ \hat{\alpha}'_{IC}\hat{\text{cov}}(s_t^Y, IC_P) + N\hat{\alpha}'_C\hat{\text{cov}}(s_t^Y, C_P) \qquad (3.5)$$

$$100 = \frac{100}{DemeanlogP}[\hat{\alpha}'_{IC}\overline{IC}_P + \hat{\alpha}'_C\overline{C}_P + N\ \hat{\alpha}'_{INF}\hat{cov}(s_i^Y, INF_{P,i}) + N\ \hat{\alpha}'_{IC}\hat{cov}(s_i^Y, IC_{P,i}) + N\ \hat{\alpha}'_C\hat{cov}(s_i^Y, C_{P,i})]. \qquad (3.6)$$

So far, we have exploited the linear properties of the logarithm form of the mixed O&P decomposition of TFP. However, the original O&P decomposition is based on TFP and the share of sales (in levels) and therefore is capturing also nonlinear relations between market shares and IC variables coming from (2.3a). To know to what extent these nonlinear terms are affecting this relation, we perform simulation experiments[14] on IC and C variables, and evaluate the consistency of the results with the ones obtained from the previous mixed O&P decomposition- see (2.4b). The IC simulations are done variable by variable (one at a time) keeping the rest of the variables constant; that is, we propose a scenario in which one of the IC variables experiment a 20 percent improvement in all establishments. We compute the corresponding rate of change of aggregate productivity, average productivity and allocative efficiency caused by such a 20% improvement. We repeat the same experiment for the rest IC and C variables, and, for comparative purposes, we also evaluate the relative by group of IC variables.

3.2 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 (3.1),

$$P_{jt} = \sum_{i=1}^{N_{jt}} s_{j,it}^{\log Y} \log P_{j,it} = \log \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y} \log \tilde{P}_{j,it} \qquad (3.7)$$

[14] We are indebted to Ariel Pakes for this suggestion.

where $s_{j,it}^{\log Y} = \log Y_{j,it} \left(\sum_{i=1}^{N_{jt}} \log Y_{j,it} \right)^{-1}$.

In general, the original O&P decomposition (3.1) has several advantages over (3.3) in terms of explanatory power of the investment climate (IC) variables because we are interested in TFP and not on log TFP. However, there is one important algebraic simplification when we using (3.3) that allow us to obtain an exact decomposition of the IC effects in term of the inputs (L, M and K) of the production function that serves as a measure of the *degree of endogeneity of the inputs.*

Writing the Solow´s residuals from equation (2.2), or the productivity term of the Cobb-Douglas production function (2.1a), with variables in deviation to their means we have,

$$
\begin{aligned}
(\log Y_{j,it} - \log \overline{Y}_{jt}) &= \alpha_L(\log L_{j,it} - \log \overline{L}_{jt}) + \alpha_M(\log M_{j,it} - \log \overline{M}_{jt}) + \alpha_K(\log K_{j,it} - \log \overline{K}_{jt}) \\
&\quad + (\log P_{j,it} - \log \overline{P}_{jt}).
\end{aligned}
\tag{3.8}
$$

Multiplying by $(\log P_{j,it} - \log \overline{P}_{jt})$ 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, [15]

$$
\begin{aligned}
\hat{cov}(s_{j,t}^{\log Y}, \log P_{j,t}) &= \alpha^*_L \hat{cov}(\log L_{j,t}, \log P_{j,t}) + \alpha^*_M \hat{cov}(\log M_{j,t}, \log P_{j,t}) + \alpha^*_K \hat{cov}(\log K_{j,t}, \log P_{j,t}) + \\
&\quad + \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{j,it}} \hat{var}(\log P_{j,t}).
\end{aligned}
\tag{3.9}
$$

where $\alpha^*_L = \alpha_L \left(\sum_{i=1}^{N_{jt}} \log Y_{j,it} \right)^{-1}$, $\alpha^*_M = \alpha_M \left(\sum_{i=1}^{N_{jt}} \log Y_{j,it} \right)^{-1}$ and $\alpha^*_K = \alpha_K \left(\sum_{i=1}^{N_{jt}} \log Y_{j,it} \right)^{-1}$. [16]

[15] 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 $\hat{cov}(s_{j,t}^{\log Y}, \log P_t) = \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{it}} \hat{cov}(\log Y_t, \log P_t) = \frac{1}{\sum_{i=1}^{N_{jt}} \log Y_{it}} \hat{var}(\log P_t)$ and the O&P decomposition (3.7) in logs is reduced to, $\log P_{jt} = \sum_{i=1}^{N_{jt}} s_{j,it}^{\log Y} \log P_{it} = \log \overline{P}_{jt} + \sum_{i=1}^{N_{jt}} (\log P_{j,it} - \log \overline{P}_{jt})^2$. 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.

[16] The estimation of the input-output elasticities, α_L, α_M and α_K can be obtained from equation (1) or from their corresponding cost shares, see equation (3).

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 (2.3a) in deviations to the mean, this leads to

$$(\log P_{j,it} - \log \overline{P}_{jt}) = \hat{\alpha}'_{IC}(IC_{j,i} - \overline{IC}_j) + \hat{\alpha}'_C(C_{j,i} - \overline{C}_j) + \hat{\alpha}'_{Ds}(D_j - \overline{D}_j) + \hat{\alpha}'_{DT}(D_t - \overline{D}_t) + \hat{u}_{j,it} \quad (3.10)$$

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 (3.10) in the O&P efficiency term of equation (3.3) 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 ($\hat{u}_{it}$),

$$\begin{aligned}\sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y} \log \tilde{P}_{j,it} &= \hat{\alpha}_{IC} \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y}(IC_{j,i} - \overline{IC}_j) + \hat{\alpha}_C \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y}(C_{j,i} - \overline{C}_j) + \\ &+ \hat{\alpha}_{Ds} \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y}(D_j - \overline{D}_j) + \hat{\alpha}_{DT} \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y}(D_t - \overline{D}_t) + \sum_{i=1}^{N_{jt}} \tilde{s}_{j,it}^{\log Y} \hat{u}_{j,it}\end{aligned} \quad (3.11)$$

Substituting (3.11) in (3.7) and taking into account that

$$\log P_{j,it} = \hat{\alpha}_{IC} IC_{j,i} + \hat{\alpha}_C C_{j,i} + \hat{\alpha}_{Ds} D_j + \hat{\alpha}_{DT} D_t + \hat{\alpha}_P + \hat{u}_{j,it} \quad (3.12)$$

and therefore

$$\log \overline{P}_{jt} = \hat{\alpha}_{IC} \overline{IC}_j + \hat{\alpha}_C \overline{C}_j + \hat{\alpha}_{Ds} \overline{D}_j + \hat{\alpha}_{DT} \overline{D}_t + \hat{\alpha}_P + \overline{\hat{u}}_{j,it} \quad (3.13)$$

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

$$\begin{aligned}P_{j,t} &= \hat{\alpha}'_{IC}\overline{IC}_j + \hat{\alpha}'_C \overline{C}_j + \hat{\alpha}'_{Ds}\overline{D}_j + \hat{\alpha}'_{DT}\overline{D}_t + \hat{\alpha}_P + \overline{u}_{j,t} + \hat{\alpha}'_{IC}\,\hat{\text{cov}}(s_{j,t}^{\log Y}, IC_j) + \hat{\alpha}'_C\,\hat{\text{cov}}(s_{j,t}^{\log Y}, C_j) \\ &+ \hat{\alpha}'_{Ds}\,\hat{\text{cov}}(s_{j,t}^{\log Y}, D_j) + \hat{\alpha}'_{DT}\,\hat{\text{cov}}(s_{j,t}^{\log Y}, D_T) + \hat{\text{cov}}(s_{j,t}^{\log Y}, \hat{u}_{j,t})\end{aligned} \quad (3.14)$$

Equation (3.14) relative to aggregate productivity becomes,

$$100=\frac{\hat{\alpha}'_{IC}\overline{IC}_j}{P_{jt}}100+\frac{\hat{\alpha}'_{C}\overline{C}_j}{P_{jt}}100+\frac{\hat{\alpha}'_{Ds}\overline{D}_j}{P_{jt}}100+\frac{\hat{\alpha}'_{DT}\overline{D}_t}{P_{jt}}100+\frac{\hat{\alpha}_{P}}{P_{jt}}100+\frac{\overline{u}_{j,t}}{P_{jt}}100+\frac{\hat{\alpha}'_{IC}N_{jt}\ \hat{\text{c}}\text{ov}(s_{j,t}^{\log Y},IC_j)}{P_{jt}}100$$
$$+\frac{\hat{\alpha}'_{C}N_{jt}\ \hat{\text{c}}\text{ov}(s_{j,t}^{\log Y},C_j)}{P_{jt}}100+\frac{\hat{\alpha}'_{Ds}N_{jt}\ \hat{\text{c}}\text{ov}(s_{j,t}^{\log Y},D_j)}{P_{jt}}100+\frac{\hat{\alpha}'_{DT}N_{jt}\ \hat{\text{c}}\text{ov}(s_{j,t}^{\log Y},D_T)}{P_{jt}}100+\frac{N_{jt}\ \hat{\text{c}}\text{ov}(s_{j,it}^{\log Y},\hat{u}_{j,t})}{P_{jt}}100 \quad (3.15)$$

A similar expression could be obtain in terms of the ratio of covariances.[17]

Let R be a input where $R=L, M, K$, substituting the expression for log-productivity of equation (3.13) in (3.10) we have the next general decomposition for each input R in terms of IC, C and D variables and the residual term $\hat{u}_{j,it}$ is given by,

$$\begin{aligned}\alpha^*{}_R\hat{cov}(\log R_{j,t},\log P_{j,t})&=\alpha^*{}_R\hat{cov}(\log R_{j,t},\hat{\alpha}_{IC}IC_j)+\alpha^*{}_R\hat{cov}(\log R_{j,t},\hat{\alpha}_C C_j)+\\&+\alpha^*{}_R\hat{cov}(\log R_{j,t},\hat{\alpha}_{Ds}D_j)+\alpha^*{}_R\hat{cov}(\log R_{j,t},\hat{\alpha}_{DT}D_t)+\alpha^*{}_R\hat{cov}(\log R_{j,t},\hat{u}_{j,t})\\&+\left(\sum_{i=1}^{N_{jt}}\log Y_{j,it}\right)^{-1}\hat{\text{v}}\text{ar}\left(\hat{\alpha}_{IC,r}IC_j+\hat{\alpha}_C C_j+\hat{\alpha}_{Ds}D_j+\hat{\alpha}_{DT}D_t+\hat{u}_{j,t}\right)\end{aligned} \quad (3.16)$$

Substituting (3.16) in equation (3.11), we get an equivalent expression of equation (3.14) which is an O&P type decomposition,

[17] Notice that it is interesting to express (3.9) as

$$100=\frac{\alpha^*{}_L\hat{cov}(\log L_{j,it},\log P_{j,it})}{\hat{cov}(s_{j,it}^{\log Y},\log P_{j,it})}100+\frac{\alpha^*{}_M\hat{cov}(\log M_{j,it},\log P_{j,it})}{\hat{cov}(s_{j,it}^{\log Y},\log P_{j,it})}100+\frac{\alpha^*{}_K\hat{cov}(\log K_{j,it},\log P_{j,it})}{\hat{cov}(s_{j,it}^{\log Y},\log P_{j,it})}100+\frac{\hat{var}(\log P_{j,it})}{\hat{cov}(s_{j,it}^{\log Y},\log P_{j,it})\sum_{i=1}^{N_{jt}}\log Y_{j,it}}100$$

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.

$$P_{jt} = \hat{\alpha}'_{IC}\overline{IC}_j + \hat{\alpha}'_C\overline{C}_j + \hat{\alpha}'_{Ds}\overline{D}_j + \hat{\alpha}'_{DT}\overline{D}_t + \hat{\alpha}_P + \overline{u}_{j,t} + \sum_{R=L,M,K} \{\alpha^*{}_R N_{jt}\hat{c}ov(\log R_{j,t}, \hat{\alpha}'_{IC} IC_j)$$

$$+ \alpha^*{}_R N_{jt}\hat{c}ov(\log R_{j,t}, \hat{\alpha}'_C C_j) + \alpha^*{}_R N_{jt}\hat{c}ov(\log R_{j,t}, \hat{\alpha}'_{Ds} D_j) + \alpha^*{}_R N_{jt}\hat{c}ov(\log R_{j,t}, \hat{\alpha}'_{DT} D_t)$$

$$+ \alpha^*{}_R N_{jt}\hat{c}ov(\log R_{j,t}, \hat{u}_{j,t})\} + \left(\sum_{i=1}^{N_{jt}} \log Y_{j,it}\right)^{-1} \hat{\text{v}}\text{ar}\left(\hat{\alpha}'_{IC,r} IC_j + \hat{\alpha}'_C C_j + \hat{\alpha}'_{Ds} D_j + \hat{\alpha}'_{DT} D_{rt} + \hat{u}_{j,t}\right).$$

(3.17)

The empirical results of equations (3.15) and (3.17) relating the IC variables with inputs are reported in Table C2.b.

3.2 Simulation impacts: Changes of IC variables on the O&P decomposition of TFP in levels

Our aim now is to get a measure of the impact of a 20% improvements in the IC and C variables on the aggregate productivity in levels, to do that we start from the next O&P decomposition of the aggregate productivity measured by the restricted Solow residual in levels at moment cero (0) prior to the improvement in one of the IC variables.

Let the O&P decomposition in levels (see equation (3.1)) at moment 0 prior to the change in the IC variable and let IC_i, C_i, D_j and D_t represent scalars instead of vectors for simplicity

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

where

$$P^0_{j,it} = \exp(\hat{\alpha}_{IC} IC^0_{j,i} + \hat{\alpha}_C C^0_{j,i} + \hat{\alpha}_{Ds} D^0_i + \hat{\alpha}_{DT} D^0_t + \hat{\alpha}_P + \hat{u}_{j,it}), \quad (3.18)$$

being the expression for the share of sales at moment 0

$$s^{Y0}_{j,it} = \frac{Y^0_{j,it}}{\sum_{i=1}^{N_{jt}} Y^0_{j,it}}, \text{ with } \quad Y^0_{j,it} = \exp(\alpha^L \log L_{j,it} + \alpha^M \log M_{j,it} + \alpha^K \log K_{j,it} + \log P^0_{j,it})$$

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

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

with

$$P^{1}_{j,it} = \exp(\alpha_{IC} IC^{1}_{j,i} + \alpha_{C} C^{0}_{j,i} + \alpha_{Ds} D^{0}_{i} + \alpha_{DT} D^{0}_{t} + \alpha_{P} + u_{j,it}) \qquad (3.19)$$

Similarly for the share of sales

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

Being the rate of change of the aggregate productivity in levels caused by an improvement in one of the variables

$$\frac{P^{1}_{jt} - P^{0}_{jt}}{P^{0}_{jt}} 100 = \frac{\overline{P}^{1}_{jt} - \overline{P}^{0}_{jt}}{P^{0}_{jt}} 100 + \frac{N_{jt} \operatorname{cov}(s^{Y0}_{j,it}, P^{0}_{j,it}) - N_{jt} \operatorname{cov}(s^{Y1}_{j,it}, P^{1}_{j,it})}{P^{0}_{jt}} 100 \quad . \qquad (3.20)$$

4 IC Estimated Elasticities and Semi-Elasticities on Productivity

The econometric analysis based on the 10 different productivity (P) measures is explained in the rest of this section. 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*[18]. While the constant productivity-IC 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.1a and C.1b have the expected signs and the estimated elasticities or semi-elasticities are within a reasonable range of values for the 10 productivity measures

[18] 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.

considered. The empirical results are robust since the signs of all of the ICA variables are equal and the range of values of the elasticities is reasonable.

4.1 IC-Evaluation on the O&P Decomposition

In section 3 by following Olley and Pakes (1996) we have decomposed aggregate productivity both in levels and mixed decomposition 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 mixed decomposition of productivity. In addition, we also evaluate the effect of IC and C variables on productivity by simulating changes in those variables.

The absolute percentage contributions given so far were based in groups of IC variables, so we cannot say much about the impact of the individual IC factors. For the case of Turkey, Figures 4.2-4.4 breaks down the absolute percentage impact of Figure 4.1 by key IC variables.

The largest contributions to the average TFP and allocative efficiency come from the red tape, corruption and crime variables: sales declared to taxes and losses due to criminal activity in the case of the average TFP and dummy for lawsuit and sales declared to taxes for the case of the allocative efficiency.

4.3 International comparisons of TFP

From the demeaned productivity at the firm level we can obtain the O&P decomposition either in levels or in logs (mixed), and this new set of country by country comparable results are presented in Figures 9 and 10. Panel A, Figure 10 shows the decomposition of the demean productivity in levels; it is interpreted as the productivity that comes from the investment climate conditions. The results are not surprising at all since they are basically consistent with the ones provided by the per capita income and by the 2007 Doing Business Report; the ranking based on the demean productivity is leaded by Chile followed at a lower level by Brazil and Mexico. At the end of the ranking are the countries with the most anti-productive investment climate, or in other words the countries for which the investment climate conditions poses more difficulties to the economic development; these countries are India and Turkey. Symmetrically, as for the regular O&P decomposition, the contribution of the investment climate to the aggregate demean productivity is decomposed into the contribution to the average *demean* productivity and the contribution to the allocative *demean* efficiency term, the effect of the allocative efficiency is always lower than the effect of the average productivity.

Alternatively, this demean productivity may be also interpreted as a sum of pro-productive and anti-productive IC variables, examples of pro-productive IC factors are the use of the e-mail or the labor skills, negative or anti-productive factors are the number of inspections, the informal competition etc. As a consequence the productivity will decrease as the importance of the anti-productive factors becomes larger and larger; this picture becomes even clearer in the panel B of the Figure 10. The demean O&P decomposition in logs of the panel B shows how the aggregate productivity may be negative—Turkey—when the negative aspects of the investment climate gain importance, or positive when the pro-productive IC factors weight more than the negative ones, which is the case of Chile, Brazil, Mexico and India.

So far we know that the investment climate as a whole has an effect on the aggregate productivity of the manufacturing industry, and also that this effect may be positive or negative depending on which IC aspects matter more, the pro-productive or the anti-productive. The aim now is to know at what extent this decreases or increases of the productivity are due to the infrastructures, the red tape, corruption and crime or to other IC groups. Panels B of Figures 9 and 10 provides the demean decomposition by groups of IC and C variables. Notice that the demean decomposition in levels lacks the additive properties of the decomposition in logs and therefore to decompose the demean productivity in levels we use simulations of improvements of the IC variables. Panel B of Figure 9 shows the results obtained for the simulations, the interpretation of these results is straightforward, if all the IC factors would improve by a 20% (this implies decreases in the negative factors and vice versa in the positive ones) one by one—a 20% more firms using e-mail, a 20% less inspections, etc— the aggregate productivity could increase in Turkey by 55%, in India by 120% and so on. From Figure 9, panel B it is clear that there are some economies more likely to be affected by the investment climate and therefore are more sensitive to changes in the IC conditions, this is the case of Turkey and Mexico, the opposite case are India and Brazil. Lastly, the improvements of the aggregate productivity come in almost all the countries via improvements in the average productivity and in a lower extent by improvements in the allocative efficiency, with the exception of Chile.

The simulations are interpreted as a dynamic change from the initial situation to the simulated scenario, at this respect panel B of the Figure 10 shows a more static interpretation by using the O&P decomposition in logs (mixed) by groups of variables; in particular, panel B offers information on how is the actual and current situation of the investment climate and what is its effect on the aggregate TFP. From this panel we see that the effect of the infrastructures is negative in all the countries, implying this that the pro-productive factors never compensate the negative effects of the anti-competitive ones. The effect of the red tape, corruption and crime group in turkey is the largest and negative.

It is interesting to study the relative weight of the different IC groups of variables in the relative contributions to the average demean log-productivity and to the demean efficiency term in logs. Thus, by forcing the contribution of the investment climate to the average productivity and to the allocative efficiency to be 100% we find that the relative contribution of the red tape, corruption and crime group in Turkey reaches 62%, in Mexico is 40% or in India 30%, as Figure 11, panel A shows. The same holds for the allocative efficiency where once again Turkey presents the largest contributions of the red tape corruption and crime group.

The results of the percentage relative contributions are fully consistent with the managers' perceptions presented in Figure 12. The red tape, corruption and crime group ranks first in terms of managers' perception in Turkey.

5 Conclusions

The lack of convergence in terms of per capita income with respect to the U.S and E.U during the last twenty-five years, reveals the striking weakness of the Turkish economy in terms of competitiveness. In particular, out of the total GDP gap between Turkey and European Union countries, 80% is explained by labor productivity. Comparing the decompositions of per capita income of Turkey with eastern European countries, we observe that Turkey is doing worse in term of the three elements; per capita GDP, labor productivity and labor force participation.

Large differences in output per worker between rich and poor countries are usually attributed to differences in Total Factor Productivity (TFP). Thus, once Turkey has secured a reasonable level of macroeconomic stability, in order to get the objectives of increasing productivity and reduce unemployment, the main objective of Turkish's economic authorities is seeking ways to stimulate country competitiveness and TFP is usually its main driver.

In this paper we have extended the robust productivity (TFP) approach of Escribano and Guasch (2005, 2008) to alternative Olley and Pakes (1996) decompositions of TFP, logTFP and the mixed case. Each of them has certain advantages and disadvantage over the others. First, the O&P decomposition of TFP has the advantage that is the natural measure of productivity, measures linear and nonlinear relationships between TFP and IC variables, but has the draw back that it is difficult to get closed form relationships between TFP and IC and we have to obtain it by simulation methods. Second, the O&P decomposition in logs provides exact decompositions relating IC with logs TFP in terms of average productivity as well as with the allocative efficiency term. It also allows us to obtain an explicit decomposition relating the inputs (L, M and K) with the IC variables. It has the disadvantage, that they only provide approximate results since we are not interested in the IC effects on log TFP but on the effects on TFP. Finally, the mixed decompositions provide a nice compromise between the two. It gives us an explicit relationship between IC and Log TFP but also one in terms of efficiency. Furthermore, the allocative efficiency term is measured in terms of the share of sales and not the share of log sales, which is not invariant to changes on the units of measurements on sales. The empirical results in terms of the O&P are very similar to those in terms of the mixed TFP. However, with the O&P in logs the allocative efficiency effect on aggregate productivity is much lower in absolute terms.

We have proposed to use a *demean O&P decomposition* for the evaluation of the IC effects by blocks and proposed to compare those proportions with the ones obtained from firm's perception on bottlenecks for economic performance of firms. In fact, we obtain empirical results that are consistent with firm's perceptions. The most important block of IC variable in Turkey is red tape, corruption and crime with the main individual IC constraints being; are taxes and tax administration and security. The second group of IC variables is infrastructures and the most important single elements within this block is the number of days to clear custom to import. Those results are also consistent with the ones obtained in term of ease of doing business of DBR (2007).

This new measure of TFP allows us to make interesting cross country comparisons. We found that Turkey has the lowest demean productivity level of the five countries considered (India, Mexico, Brazil and Chile). The explanation is simple the positive IC effects (like having e-mail, internet, internal training at the firms, etc.) dominates in all these countries, over the negative IC effects (losses due to power outages, managers time spent in bureaucratic issues, etc.) but the net effect is the smallest of the five countries. The corresponding ranking of countries in term of demean O&P decompositions are highly correlated with per-capita income rankings and with firm perceptions or the rankings base on the ease of doing business.

References

Alfaro, L., A. Charlton and F. Kanczuk (2007), “Firm-size Distribution and Cross-Country Income Differences”. Unpublished manuscript.

Aw, B., Chung, S y M. Roberts (1998). “Productivity and the Decision to Export: Micro Evidence from Taiwan and South Korea”. NBER Working Paper 6558.

Baily, M. N., C. Hulten, D. Campbell, (1992), "Productivity Dynamics in Manufacturing Establishments," Brookings Papers on Economic Activity, 187-249.

Bartelsman, E, J. Haltiwanger and S. Scarpetta, (2006) “Cross-Country Differences in Productivity: The Role of Allocative Efficiency,” Unpublished manuscript.

Benfratello, L. and L. Sembenelli 2006. "Foreign ownership and productivity: Is the direction of causality so obvious?," International Journal of Industrial Organization, Elsevier, vol. 24(4), pages 733-751, July.

Bernard, A. B. and J. B. Jensen. (1995). “Exporters, Jobs, and Wages in U.S. Manufacturing, 1976-1987.” Brookings Papers on Economic Activity, Microeconomics. Washington DC.

Bernard, A. B. and J. B. Jensen. (1999). “Exceptional Exporter Performance: Cause, Effect, or Both?” Journal of International Economics, Vol. 47, pp. 1-25.

Bosworth B., and S. Collins (2003). “The Empirics of Growth: An Update”. The Brookings Institution. Washington, D.C. Processed.

Caselli, F., (2005) “Accounting for Income Differences Across Countries,” chapter 9 in the Handbook of Economic Growth Vol. 1A, P. Aghion and S. Durlauf, eds., North Holland.

Clarides, S. Lach and J. Tybout, Is learning by exporting important?. The Quarterly Journal of Economics 454 (1998), pp. 903–947

Cole, H. L., L. E. Ohanian, A. Riascos and J. A. Schmitz Jr. (2004). "Latin America in the Rearview Mirror". National Bureau of Economic Research WP #11008, December.

Conyon, M. J, (2002) "The Productivity and Wage Effects of Foreign Acquisition in the United Kingdom," Journal of Industrial Economics, Blackwell Publishing, vol. 50(1), pages 85-102, March.

Djankov, S, R. La Porta, F. Lopez-de-Silanis and A. Shleifer (2002). “The Regulation of Entry”. Quarterly Journal of Economics 117, February 2002. 1-37.

Escribano A. and J. L. Guasch (2005). “Assessing the Impact of Investment Climate on Productivity using Firm Level Data: Methodology and the Cases of Guatemala, Honduras and Nicaragua”. *Policy Research Working Paper* # 3621. The World Bank, June.

Escribano A. and J. L. Guasch (2008). “Robust Methodology for Investment Climate Assessment on Productivity: Application to Investment Climate Surveys from Central America”. *Working Paper # 08-19 (11)*, Universidad Carlos III de Madrid.

Erosa, A and A. Cabrillana (2007) “On Finance as a Theory of TFP, Cross-Industry Productivity Differences, and Economic Rents.” Working paper. University of Toronto.

Evenett, S.J., Voicu, A., (2002). Picking winners or creating them? Revisiting the benefits of FDI in the Czech Republic?

Foster, L., J. C. Haltiwanger, C. J. Krizan, (2001) "Aggregate Productivity Growth: Lessons from Microeconomic Evidence," Chicago: University of Chicago Press.

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

Haltiwanger, J. (2002). “Understanding Economic Growth. The Need for Micro Evidence”. New Zealand Economic Papers 36 (1), 33-58.

He, K. S., R. Morck and B. Yeung (2003). “Corporate Stability and Economic Growth”.

William Davidson Working Paper No. 553.

Hsieh, C-T and P. J. Klenow, (2007) “Misallocation and Manufacturing TFP in China and India,” Unpublished manuscript.

Howitt, P. (2000) “Endogenous Growth and Cross-Country Income Differences,” American Economic Review 90: 829-846.

Kasper, Wolfgang, (2002), “Losing Sight of the Lodestar of Economic Freedom: A Report Card on New Zeland’s Economic Reform”, NZ Business Roundtable.

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

Kerr, Roger (2002). ”The Quagmire of Regulation” NZ Business Roundtable.

Klenow, P. J. and A. Rodríguez-Clare, (1997) “The Neoclassical Revival in Growth Economics: Has It Gone Too Far?” in B. Bernanke and J. Rotemberg, eds., NBER Macroeconomics Annual (MIT Press, Cambridge) 73-103.

Loayza, N.V., A. M. Oviedo and Luis Serven (2004). “Regulation and Macroeconomic Performance”, World Bank, Washington DC.

McMillan, John, (1998), “Managing Economic Change: Lessons from New Zeland”, The World Economy 21, 827-43.

Olley G. S.and A. Pakes (1996). “The Dynamics of Productivity in the Telecommunications Equipment Industry”. *Econometrica*, Vol. 64, 6, 1263-1297.

Parente, S. L. and E. C. Prescott, (1994) “Barriers to Technology Adoption and Development,” Journal of Political Economy, 102(2): 298-321.

Prescot, Edward C. (1998) "Needed: A Theory of Total Factor Productivity". International Economic Review, 39, 525-552.

Restuccia, D. and R. Rogerson, (2007) “Policy Distortions and Aggregate Productivity with Heterogeneous Plants,” NBER Working Paper No. W13018.

Rodrik, D., and A. Subramanian (2004). "From 'Hindu Growth to Productivity Surge: The Mystery of the Indian Growth Transition". Harvard University, Cambridge, Mass. Processed.

World Bank 2003. "Doing Business in 2004: Understanding Regulation." Washington, D.C. World Bank.

__________ 2004a "Doing Business in 2005: Removing Obstacles to Growth". Washington, D.C. World Bank.

__________ 2004b "2003 Annual Review of Development Effectiveness: The Effectiveness of Bank Support for Policy Reform. Report 28290". Washington, D.C.: World Bank Operations Evaluation Department.

__________ (2006). "Doing Business in 2007: How to Reform." Washington, D.C. World Bank.

Appendix I: Tables and Figures

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

General Information at Plant Level	Industrial classification	a) food and beverages; b) textiles and wearing apparel; c) chemical products, petroleum, coal, rubber and plastics; d) non-metallic metal products; e) fabricated metal products, excluding machinery and equipment; f) machinery and equipment, excluding electrical; g) electrical machinery apparatus, appliances and supplies; h) transport equipment.
	Regional classification	a) Marmara; b) Ege; c) Ic Anadolu; d) Akdeniz; e) Karadeniz (Dogu Anadolu).
Production Function Variables	Sales	Used as the measure of output for the production function estimation. Sales are defined as total annual sales. The series are deflated by using the Producer Price Indexes (PPI), base 2000.
	Employment	Total number of permanent and temporal workers.
	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 the Producer Price Indexes (PPI), base 2000.
	Capital stock	Net book value of machinery and equipment. The series are deflated by using the Producer Price Indexes (PPI), base 2000.
	User cost of capital	The user cost of capital is defined in terms of the opportunity cost of using capital; it is defined as a 15% of the net book value of machinery and equipment.
	Labor cost	Total expenditures on personnel. The series are deflated by using the Producer Price Indexes (PPI), base 2000.
Dependent Variables in Equation Regressions and Linear Probability Models	Exports	Dummy variable that takes value 1 if exports are greater than 10%.
	Foreign Direct Investment	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 Producer Price Indexes (PPI), base 2000.) divided by the total number of permanent and temporal workers.
	Employment	Total number of permanent and temporal workers.

[1] All series were translated to US dollars by using the official exchange rate. Data obtained from the World Bank data base.

Table A.2 (I): Investment climate (IC) and control (C) variables

Blocks of ICAs	Name of the variable	Description of the variable
Infrastructures	Days to clear customs for exports	Average number of days to clear customs to export (log).
	Days to clear customs for imports	Average number of days to clear customs to imports (log).
	Average duration of power outages	Average duration of power outages suffered by the plant in hours (log).
	Losses due to power outages	Value of the losses due to the power outages as a percentage of sales (conditional on the plant reporting power outages).
	Number of power outages	Number of power outages suffered by the plant in 2003 (log).
	Average duration of water outages	Average duration of water outages suffered by the plant in hours (log).
	Number of water outages	Number of water outages suffered by the plant in 2003 (log).
	Losses due to water outages	Value of the losses due to the water outages as a percentage of sales (conditional on the plant reporting water outages).
	Wait for phone	Actual delay to obtain a phone connection in days (log).
	Wait for electricity connection	Actual delay to obtain a electricity connection in days (log).
	Wait for water connection	Actual delay to obtain a water connection in days (log).
	Wait for health certification	Actual delay to obtain a health certification in days (log).
	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.
	Dummy for email	Dummy variable that takes value 1 if the plant uses email.
	Dummy for internet page	Dummy variable that takes value 1 if the plant has a website.
	Dummy for electronic invoice system	Dummy variable that takes value 1 if the plant uses an electronic invoice system.

Table A.2 (II): Investment climate (IC) and control (C) variables

Blocks of ICAs	Name of the variable	Description of the variable
Red Tape, Corruption and Crime	Dummy for criminal activity	Dummy variable that takes value 1 if the plant suffered any criminal attempt during 2003.
	Losses due to criminal activity	Value of losses due to criminal activity (log).
	Security expenses	Cost in security (equipment, staff, etc) (log).
	Illegal payments for protection	Cost due to protection payments e. g. to organized crime to prevent violence (bribery) (log).
	Dummy for consulting	Dummy variable that takes value 1if the firm uses consultants or employments to help deal with bureaucratic issues.
	Dummy for payments to deal with bureaucratic issues	Dummy that takes value 1 if firms in the main sector occasionally need to give gifts or make informal payments to public officers in order to "get things done" with regard to customs, taxes, licenses, legislations, services, etc.
	Manager's time spent in bureaucratic issues	Percentage of managers' time spent in dealing with bureaucratic issues.
	Dummy for informal competition	Dummy variable that takes value 1 if the firm competes with informal (no registered) firms.
	Sales declared to taxes	Percentage of total sales declared to taxes.
	Labor costs declared	Percentage of workforce declared to taxes.
	Number of inspections	In the last year, total number of inspections (log).
	Dummy for 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 with clients	Percentage of conflicts with clients solved in the courts in the last two years.
	Average duration of conflicts	Average weeks that take to resolve a conflict from the moment the case was brought to court until the moment the court decided the case.
	Absenteeism	Days of production lost due to absenteeism (log).
	Wait for a construction related permit	Actual delay to obtain a construction related in days (log).
	Wait for a main operating license	Actual delay to obtain a main operating license in days (log).
	Dummy for new land or building	Dummy variable that takes value 1 if the firm acquired or attempted to acquire new land or buildings to expand operations in the previous 3 years.
	Delay to obtain a land or a building	Total time that took from the moment the firm decided to buy a new land or building to the moment the firm finally got it (Including all the time required for official registration, negotiations with the seller and obtaining all licenses and necessary development permits and excluding the time needed for the construction permits).
	Transaction fees to obtain a land or a building	Total cost related with transaction fees (including registration fees, payments to lawyers, brokers, etc) to obtain a land or a building.
	Payment to government or private parties to obtain a land or a building	Total cost in informal payments to government officials or private parties to obtain a new land or buildings
	Dummy for contract enforcement	Dummy variable that takes value 1 if the conflict of the firm with clients solved in courts were generally enforced.
	Dummy for alternative resolution of conflicts	Dummy variable that takes value 1 if the firm attempted to use alternative ways of resolution of conflicts with clients (e.g. arbitration or mediation).
	Dummy for lawsuit	Dummy variable that takes value 1 if the firm has been involved in a lawsuit in the last three years.
	Delayed payments	Percentage of monthly total sales to private customers that were not paid within the agreed time.
	Sales never repaid	Percentage of monthly total sales to private customers that were never repaid.

Table A.2 (III): Investment climate (IC) and control (C) variables

Blocks of ICAs	Name of the variable	Description of the variable
Finance and Corporate Governance	Dummy for credit line	Dummy variable that takes value 1 if the plant reports that it has a credit line.
	Dummy for loan	Dummy variable that takes value 1 if the plant reports that it has a bank loan.
	Dummy for loan outstanding	Dummy variable that takes value 1 if the firm has a loan outstanding from a financial institution.
	Dummy for loan bank	Dummy variable that takes value 1 if the firm has a loan from a domestic private commercial banks.
	Dummy for loan leasing	Dummy variable that takes value 1 if the firm has a loan from a leasing arrangement.
	Dummy for loan public	Dummy variable that takes value 1 if the firm has a loan from a state owned banks.
	Dummy for loan informal	Dummy variable that takes value 1 if the firm has a loan from Informal sources (e.g. money lender).
	Dummy for loan DOT	Dummy variable that takes value 1 if the firm has a loan from the Small and Medium Sized Industry Development Organization of Turkey (Incentive Credit for Export)
	Dummy for loan Turkish Lira	Dummy variable that takes value 1 if the loan is denominated in Turkish Lira.
	Dummy for loan foreign currency	Dummy variable that takes value 1 if the loan is denominated in a foreign currency.
	Dummy for loan with collateral	Dummy variable that takes value 1 if the loan is on collateral.
	Dummy for loan long term	Dummy variable that takes value 1 if the duration of the loan is more than 12 months.
	Borrows foreign	Percentage of borrows denominated in foreign currency.
	Dummy for rent land	Dummy variable that takes value 1 if the plant rents almost all its lands.
	Dummy for rent buildings	Dummy variable that takes value 1 if the plant rents almost all its buildings.
	Dummy for external auditory	Dummy variable that takes value 1 if the plant uses an external auditory.

Table A.2 (IV): Investment climate (IC) and control (C) variables

Blocks of ICAs	Name of the variable	Description of the variable
Quality, Innovation and Labor Skills	Dummy for quality certification	Dummy variable that takes value 1 if the plant has a quality certification.
	Dummy for new product	Dummy variable that takes value 1 if the plant has developed a new product or product line.
	Dummy for product upgraded	Dummy variable that takes value 1 if the plant upgraded an existing product last year.
	Dummy for new technology purchased	Dummy variable that takes value 1 if the firm purchased any new technology during last year.
	Dummy for licensed technology	Dummy variable that takes value 1 if the firm used a licensed technology of a foreign company in the last year.
	Dummy for education of the manager	Dummy variable that takes value 1 if the manager of the plant has a bachelor or higher education degree.
	Conflicts with employees	Times in the last year the firm was taken to court by its current and former employees
	Duration of conflicts with employees	Average weeks that take to resolve a conflict with an employee from the moment the case was brought to court until the moment the court decided the case.
	Staff-skilled workers	Percentage of skilled workers in firm's staff.
	Staff-unskilled workers	Percentage of unskilled workers in firm's staff.
	Staff-professional workers	Percentage of professional workers in firm's staff.
	Staff-part time workers	Percentage of part time workers in firm's staff.
	Staff-female workers	Percentage of female workers in firm's staff.
	Staff-temporal workers	Percentage of temporal workers in firm's staff.
	Dummy for internal training	Dummy variable that takes value 1 if the plant provides internal training to its employees.
	Dummy for external training	Dummy variable that takes value 1 if the plant provides external training to its employees.
	Training skilled workers	Percentage of skilled workers that received training during last year.
	Training unskilled workers	Percentage of unskilled workers that received training during last year.
	Weeks of training of skilled workers	Number of weeks of training received by the skilled workers during last year.
	Weeks of training of unskilled workers	Number of weeks of training received by the unskilled workers during last year.
	Staff-university	Percentage of staff with at least one year of university.
	Staff-middle education	Percentage of staff with completed high school (11 years) or completed secondary school (8 years).
	Staff-basic education	Percentage of staff with primary school either completed or not.

Table A.2 (V): Investment climate (IC) and control (C) variables

Blocks of ICAs	Name of the variable	Description of the variable
Other Control Variables	Dummy for incorporated company	Dummy variable that takes value 1 if the plant is an incorporated company.
	Dummy for public	Dummy variable that takes value 1 if the firm belongs to the government.
	Dummy for foreign direct investment	Dummy variable that takes value 1 if any part of the capital of the firm is foreign.
	Age of the firm	Difference between the year that the plant started operations and current year.
	Number of competitors	Number of competitors in the main market (log).
	Dummy for exporter	Dummy variable that takes value 1 if exports are greater than 10%.
	Dummy for importer	Dummy variable that takes value 1 if imports are greater than 10%.
	Percentage of capacity utilization	Average percentage of capacity used during last year.
	Dummy for holding company	Dummy variable that takes value 1 if the firm belongs to a holding company.
	Market share	Market share of the firm (percentage).
	Competitive pressure	Categorical variable that takes value 1 if the number of competitors in firm's main market has increased during last year.
	Percentage of workforce unionized	Percentage of workers that belongs to a syndicate.
	Strikes	Days of production lost due to strikes (log).
	Dummy for ownership	Dummy variable that takes value 1 if the firm previously belonged to the government.
	Dummy for industrial zone	Dummy variable that takes value 1 if the firm is located in an industrial zone.
	Dummy for foreign competition	Dummy variable that takes value 1 if the firm competes with foreign firms.
	Small	Dummy variable that takes value 1 if the firm employs 49 workers or less.
	Medium	Dummy variable that takes value 1 if the firm employs more than 49 workers and less or equal than 249.
	Large	Dummy variable that takes value 1 if the firm employs 250 workers or more.
	Young	Dummy variable that takes value 1 if the firm is 5 years old or less.
	Old	Dummy value that takes value 1 if the fir is more than 5 years old.

Table B.1: Correlation matrix among productivity measures

	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
Restricted Solow's residual	1									
Unrestricted Solow's residual	0.993	1								
Cobb Douglas OLS	0.926	0.918	1							
Cobb Douglas RE	0.923	0.915	0.999	1						
Translog OLS	0.915	0.908	0.993	0.993	1					
Translog RE	0.911	0.905	0.993	0.994	0.999	1				
Cobb Douglas OLS	0.596	0.611	0.637	0.638	0.639	0.638	1			
Cobb Douglas RE	0.591	0.609	0.633	0.634	0.635	0.635	0.99	1		
Translog OLS	0.046	0.007	0.052	0.049	0.044	0.043	-0.07	-0.089	1	
Translog RE	-0.001	-0.043	-0.008	-0.011	-0.017	-0.017	-0.127	-0.127	0.968	1

Notes:

a) Solow residuals in logs are obtained as sales (in logarithms or logs) minus a weighted sum 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.

(2) Unrestricted by Industry case: the cost shares are calculated as the averages across plant-level cost shares for each of the eight 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 Productivities in logs are obtained from Cobb-Douglas and Translog production functions of sales with inputs labor, materials, and capital estimated by OLS and by random effects under two different environments:

(1) Restricted: a single set of production function coefficients is obtained using data on plants, for all industries (excluding outliers).

(2) Unrestricted by Industry: a set of production function coefficients is obtained for each one of eight industries using data on all plants (excluding outliers).

Table C.1a: ICA elasticities and semi-elasticities with respect to productivity, restricted estimation.

Blocks of ICA variables	Explanatory ICA variables	Two steps estimation		Single step estimation			
		Solow residual		Cobb-Douglas		Translog	
		OLS	Random Effs.	OLS	Random Effs.	OLS	Random Effs.
Infrastructures	Days to clear customs to imports (a)	-0.171***	-0.171**	-0.199***	-0.198***	-0.198***	-0.202***
	Average duration of power outages (a)	-0.332***	-0.332***	-0.323***	-0.318***	-0.286***	-0.293***
	Delay to obtain a phone connection (a)	-0.005**	-0.005**	-0.005***	-0.005**	-0.004**	-0.004*
	Dummy for e-mail	0.074	0.074	0.160***	0.166**	0.129**	0.134**
Red tape, corruption and crime	Losses due to criminal activity (a)	-0.097***	-0.097***	-0.082***	-0.082***	-0.082***	-0.080***
	Manager's time spent in bur. issues (a)	-0.021***	-0.021**	-0.016**	-0.016*	-0.016**	-0.016*
	Illegal payments for protection	-0.254***	-0.254**	-0.205**	-0.216**	-0.229***	-0.238**
	Sales declared to taxes (a)	0.013***	0.013***	0.010***	0.010***	0.009***	0.009**
	Number of inspections	-0.032	-0.032	-0.027	-0.026	-0.028	-0.026
	Absenteeism (a)	-0.271**	-0.271*	-0.297**	-0.297**	-0.303**	-0.292**
	Dummy for lawsuit	-0.147***	-0.147***	-0.067	-0.069	-0.077*	-0.075
	Dummy for informal competition	-0.100**	-0.100**	-0.130***	-0.130***	-0.117***	-0.117**
Finance and corporate governance	Dummy for external auditory (a)	0.769*	0.769**	1.008***	0.992***	0.800**	0.842**
Quality, innovation and labor skills	Dummy for new technology purchased (a)	0.187	0.187	0.256	0.26	0.295	0.318
	Staff-unskilled workers	-0.182**	-0.182**	-0.087	-0.079	-0.086	-0.081
	Staff-part time workers	-0.005***	-0.005**	-0.004**	-0.004**	-0.003	-0.003
	Weeks of training of skilled workers (a)	0.041***	0.041**	0.014	0.015	0.017	0.016
Other control variables	Age of the firm	-0.0001**	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	Dummy for ownership	0.344**	0.344	0.447***	0.445*	0.453***	0.472**
	Dummy for small firms	-0.243***	-0.243***	-0.769***	-0.817***	-0.875***	-0.933***
	Dummy for medium	-0.289***	-0.289***	-0.435***	-0.467***	-0.546***	-0.585***
	Observations	1516	1516	1516	1516	1516	1516
	R-squared	0.18	0.18	0.77	0.77	0.78	0.78

Notes.
Significance is given by robust standard errors.*significant at 10%; ** significant at 5%; *** significant at 1%
Similar results by robust cluster errors. The more relevant changes are in Dummy for external audit and Weeks of training of skilled workers, both variables are significant at 15% in this case.
Each regression includes a set of industry dummies, year dummies and a constant term.
(a) Variables instrumented with the industry-region-size average.

Table C.1b: ICA elasticities and semi-elasticities with respect to productivity, unrestricted estimation.

Blocks of ICA variables	Explanatory ICA variables	Two steps estimation		Single step estimation			
		Solow residual		Cobb-Douglas		Translog	
		OLS	Random Effs.	OLS	Random Effs.	OLS	Random Effs.
Infrastructures	Days to clear customs to imports (a)	-0.152**	-0.152**	-0.151**	-0.154**	-0.141**	-0.136*
	Average duration of power outages (a)	-0.293***	-0.293***	-0.268***	-0.255***	-0.170*	-0.159*
	Delay to obtain a phone connection (a)	-0.005**	-0.005**	-0.004**	-0.005**	-0.004**	-0.004*
	Dummy for e-mail	0.061	0.061	0.144**	0.151**	0.130**	0.141**
Red tape, corruption and crime	Losses due to criminal activity (a)	-0.095***	-0.095***	-0.076***	-0.074***	-0.069***	-0.068***
	Manager's time spent in bur. issues (a)	-0.020***	-0.020**	-0.021***	-0.020**	-0.022***	-0.022***
	Illegal payments for protection	-0.267***	-0.267**	-0.166*	-0.165	-0.195**	-0.208**
	Sales declared to taxes (a)	0.013***	0.013***	0.011***	0.011***	0.006*	0.006*
	Number of inspections	-0.036*	-0.036	-0.036*	-0.036	-0.022	-0.024
	Absenteeism (a)	-0.260**	-0.260*	-0.241**	-0.254*	-0.271**	-0.293**
	Dummy for lawsuit	-0.141***	-0.141***	-0.072*	-0.071	-0.123***	-0.116**
	Dummy for informal competition	-0.098**	-0.098**	-0.110***	-0.113**	-0.109***	-0.116***
Finance and corporate governance	Dummy for external auditory (a)	0.717*	0.717**	0.695*	0.669**	0.514	0.557*
Quality, innovation and labor skills	Dummy for new technology purchased (a)	0.241	0.241	0.212	0.203	0.526**	0.514**
	Staff-unskilled workers	-0.167**	-0.167**	-0.086	-0.087	-0.044	-0.038
	Staff-part time workers	-0.005***	-0.005**	-0.003*	-0.003	-0.001	-0.001
	Weeks of training of skilled workers (a)	0.043***	0.043**	0.019	0.017	0.006	0.003
Other control variables	Age of the firm	-0.0001***	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	Dummy for ownership	0.350**	0.350**	0.350**	0.350**	0.350**	0.350**
	Dummy for small firms	-0.226***	-0.226***	-0.622***	-0.660***	-0.442***	-0.477***
	Dummy for medium	-0.294***	-0.294***	-0.376***	-0.397***	-0.148	-0.182*
	Observations	1516	1516	1516	1516	1516	1516
	R-squared	0.204	0.204	0.803	0.803	0.845	0.845

Notes.
Significance is given by robust standard errors.*significant at 10%; ** significant at 5%; *** significant at 1%
Similar results by robust cluster errors. The more relevant changes are in Dummy for external audit and Weeks of training of skilled workers, both variables are significant at 15% in this case.
Each regression includes a set of industry dummies, year dummies and a constant term.
(a) Variables instrumented with the industry-region-size average.

Table C.2a: Percentage Contribution of IC and C Variables to the Mixed Olley and Pakes Decomposition of the Productivity; Restricted Solow Residual.

		Aggregate Productivity	Average Productivity	Efficiency Term
Infrastructures	Days to clear customs to imports	-12.29	-12.2	-0.09
	Average duration of power outages	-2.97	-3.38	0.4
	Delay to obtain a phone connection	2.76	2.51	0.26
	Dummy for e-mail	-2.38	-2.04	-0.33
Red tape, corruption and crime	Losses due to criminal activity	-35.4	-35.16	-0.23
	Manager's time spent in bur. issues	-2.64	-2.92	0.27
	Illegal payments for protection	-7.77	-7.95	0.18
	Sales declared to taxes	28.34	29.22	-0.88
	Number of inspections	-1.55	-1.35	-0.2
	Absenteeism	-3.16	-3.57	0.41
	Dummy for lawsuit	-3.9	-2.56	-1.34
	Dummy for informal competition	0.72	0.15	0.56
Finance and corporate governance	Dummy for external auditory	-1.99	-2.05	0.05
Quality, innovation and labor skills	Dummy for new technology purchased	14.16	12.8	1.36
	Staff-unskilled workers	3.44	3.44	0
	Staff-part time workers	-3.36	-3.13	-0.23
	Weeks of training of skilled workers	-0.79	-0.47	-0.31
Other control variables	Age of the firm	5.18	5.46	-0.28
	Dummy for ownership	-0.13	-0.14	0.01
	Dummy for small firms	-1.03	-4.87	3.84
	Dummy for medium	-5.17	-4.61	-0.56
Year Dummies	Year 2004	0.96	1.15	-0.19
Industry Dummies	Textiles and Apparels	0.32	0.36	-0.04
	Chemicals	7.09	5.25	1.84
	Non Metallic Mineral Products	0.2	0.13	0.07
	Metal Products (excl. M&E)	0.63	0.73	-0.1
	Machinery and Equipment	-0.66	-1.3	0.64
	Electrical Machinery	-0.1	-0.15	0.06
	Transport Equipment	-0.26	-0.35	0.09
	Constant	108.01	108.01	0
	Residual	13.74	0	13.74
	Total	100	80.98	19.02

NOTES:

* Results presented are relative to aggregate productivity (in logs).

** The productivity measure used to construct the tables is the restricted Solow residual.

*** Results from equation (3.4).

Table C.2b: IC impact on the inputs of the production function: Evaluation based on the Olley and Pakes decomposition in logs (with log TFP and the shares of log sales).

		Labor term	Materials term	Capital term	Productivity term	Total
Infrastructures	Days to clear customs to imports	-0.25	-0.59	-0.02	0.43	-0.43
	Average duration of power outages	-0.96	-0.22	0.1	1.52	0.45
	Delay to obtain a phone connection	0.82	1.23	0.09	0.26	2.39
	Dummy for e-mail	-0.24	-1.14	-0.13	1.36	-0.14
Red tape, corruption and crime	Losses due to criminal activity	-0.44	0.57	-0.06	-1.59	-1.52
	Manager's time spent in bur. issues	0.21	-0.37	0.1	0.63	0.57
	Illegal payments for protection	0.22	-0.77	0.09	1.81	1.34
	Sales declared to taxes	-2.06	-2.36	-0.05	-3.15	-7.63
	Number of inspections	-0.19	-0.52	-0.07	0.42	-0.36
	Absenteeism	0.05	0.49	0.03	1.49	2.05
	Dummy for lawsuit	-1.62	-3.63	-0.28	0.97	-4.55
	Dummy for informal competition	0.01	-0.02	0.01	0.1	0.1
Finance and corporate governance	Dummy for external auditory	0.18	0.24	0.01	0.69	1.12
Quality, innovation and labor skills	Dummy for new technology purchased	2.66	4.19	0.09	2.34	9.28
	Staff-unskilled workers	-0.14	0.01	0.03	-0.2	-0.29
	Staff-part time workers	-0.73	-1.42	-0.18	1.01	-1.32
	Weeks of training of skilled workers	-0.81	-1.42	-0.07	0.83	-1.48
Other control variables	Age of the firm	-0.09	-1.99	-0.32	1.45	-0.94
	Dummy for ownership	-0.07	0.09	0.03	0.05	0.1
	Dummy for small firms	0.23	0.59	0.06	0.18	1.05
	Dummy for medium	8.15	13.09	0.96	0.78	22.97
Year Dummies	Year 2004	-4.62	-10.21	-0.47	0.92	-14.38
Industry Dummies	Textiles and Apparels	0.03	0.03	0.01	0.01	0.08
	Chemicals	4.86	2.58	0.01	8.3	15.75
	Non Metallic Mineral Products	-0.03	0.11	0	-0.04	0.05
	Metal Products (excl. M&E)	-0.32	-1.88	0.02	-0.19	-2.37
	Machinery and Equipment	0.44	0.11	0.1	2.55	3.2
	Electrical Machinery	0.03	0.07	-0.01	0.08	0.17
	Transport Equipment	0.11	0.09	-0.01	0.15	0.35
	Constant	-0.61	-1.32	-0.04	1.38	-0.59
	Residual	-5.22	-29.3	-1.39	110.89	74.99
	Total	-0.41	-33.68	-1.34	135.43	100

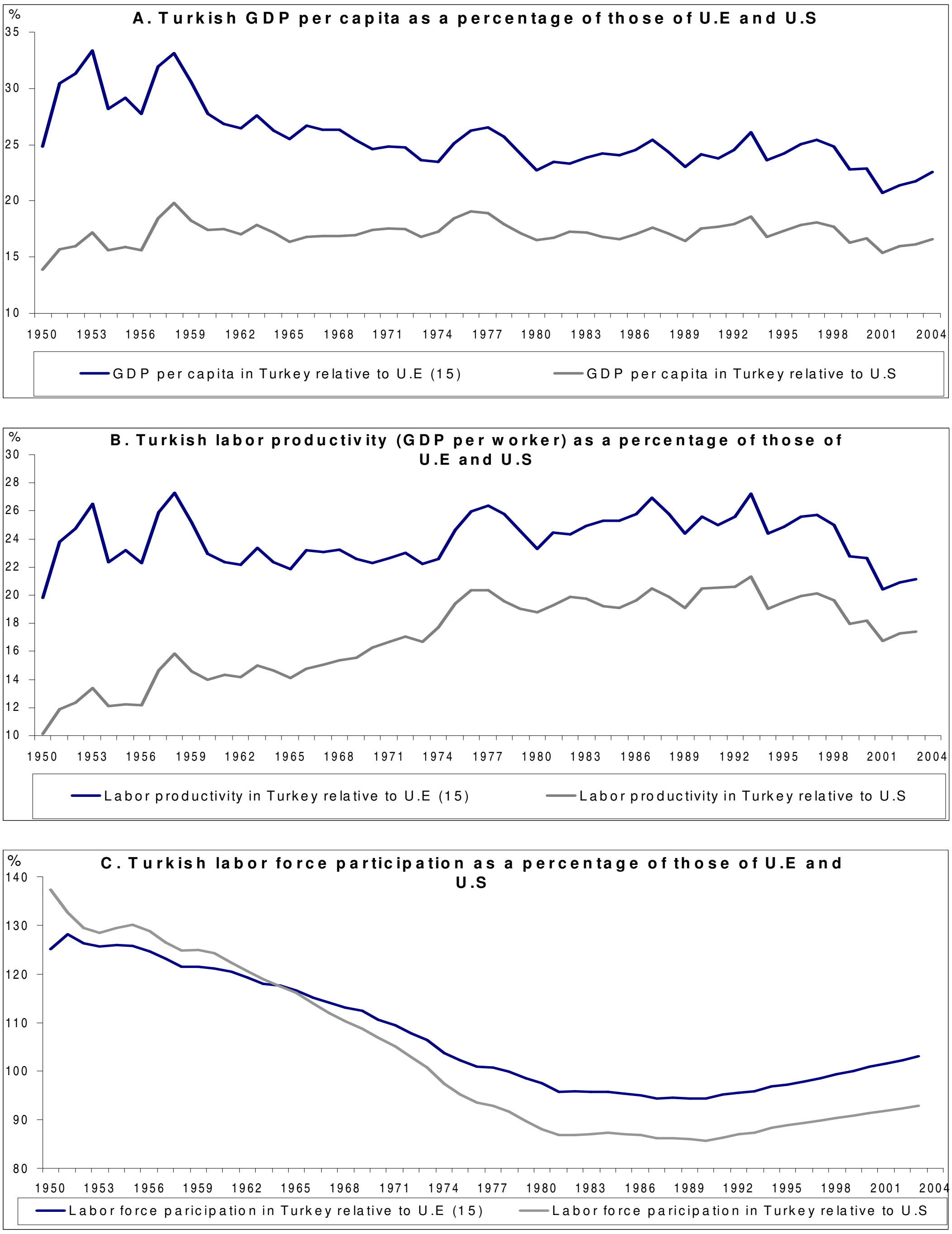
NOTES:

* Results presented are relative to aggregate productivity (in logs).

** The productivity measure used to construct the tables is the restricted Solow residual.

*** Results from equation (3.15)

Figure 1: Decomposition of Turkish GDP per capita with respect to U.S and U.E (15)



Notes:

a) European Union includes: Austria, Belgium, Denmark, Finland, France, Germany, United Kingdom, Greece, Ireland, Italy, Luxemburg, Netherlands, Spain, Sweden and Portugal.

b) 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 expression becomes: $(Y^{US}/P^{US})]= [(Y^{TUR}/L^{TUR})/ (Y^{US}/L^{US})]*[(L^{TUR}/P^{TUR})/ (L^{US}/P^{US})]$

Source: Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Figure 2.1

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

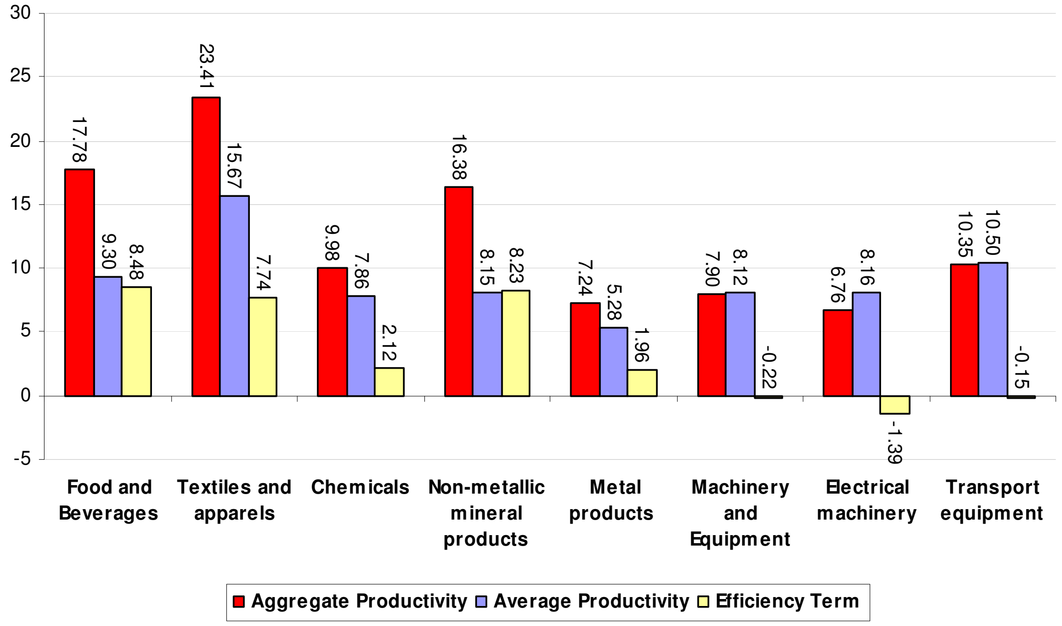


Figure 2.2

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

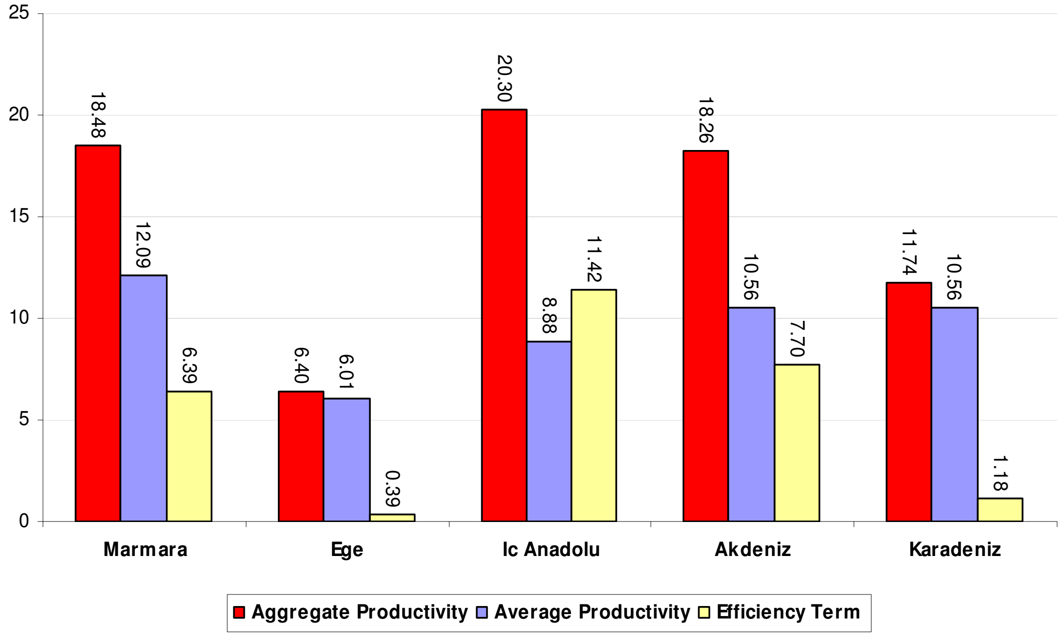


Figure 2.3

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

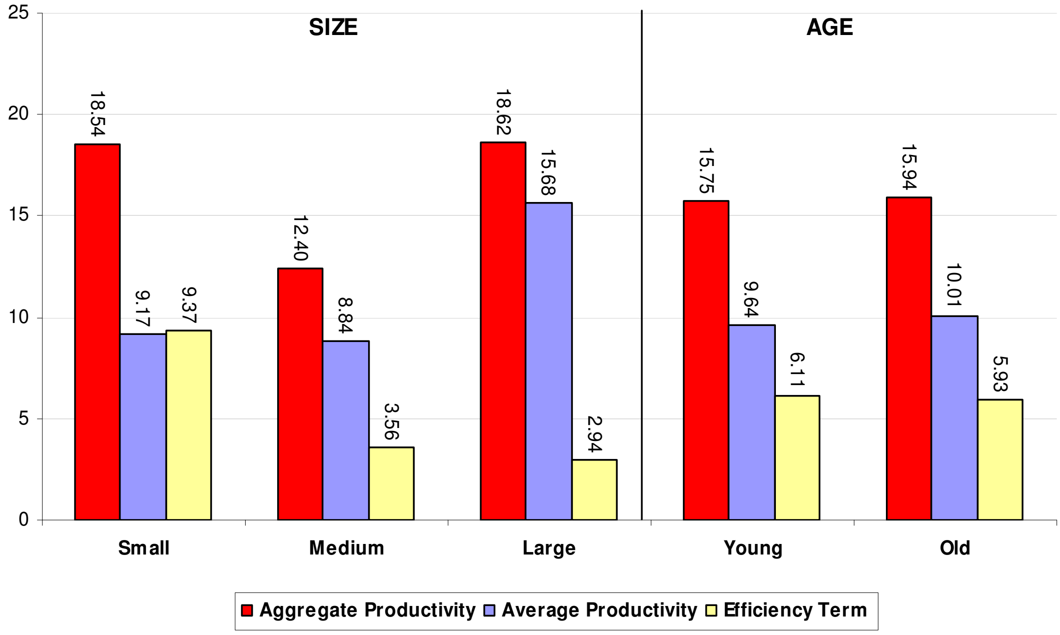


Figure 2.4

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

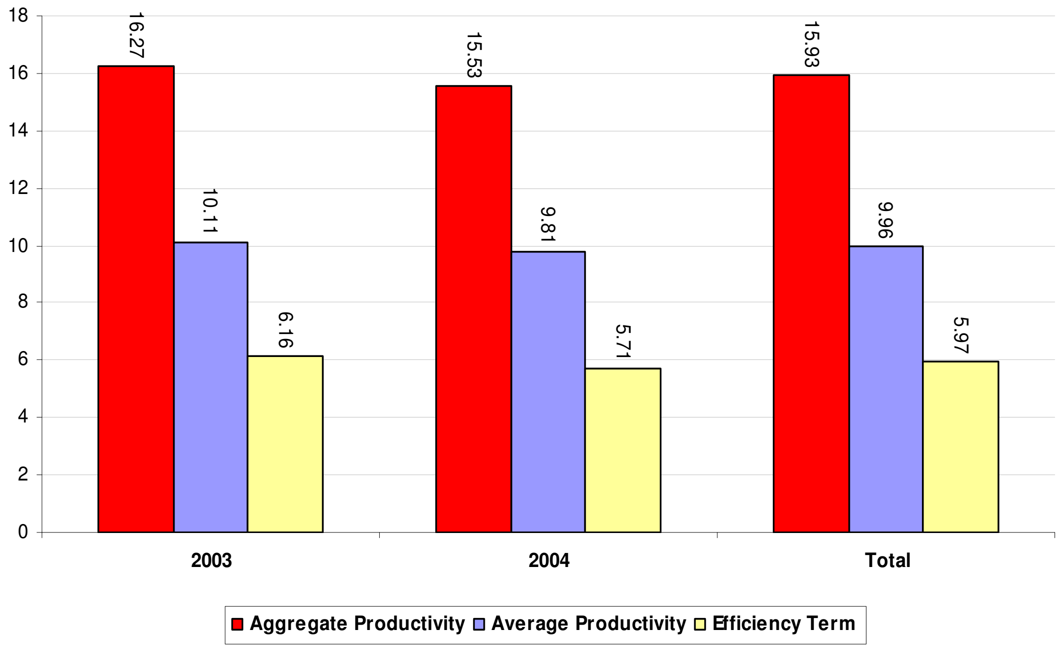


Figure 2.5

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

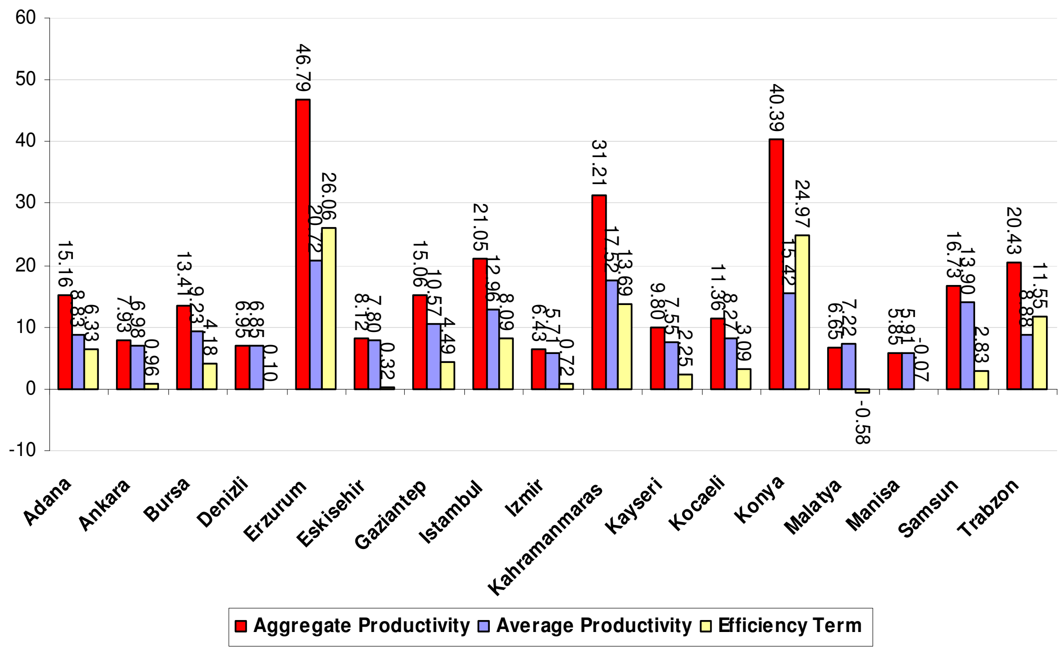


Figure 3.1

Mixed Olley and Pakes Decomposition by Industry of Aggregate Productivity (Restricted Solow Residual)

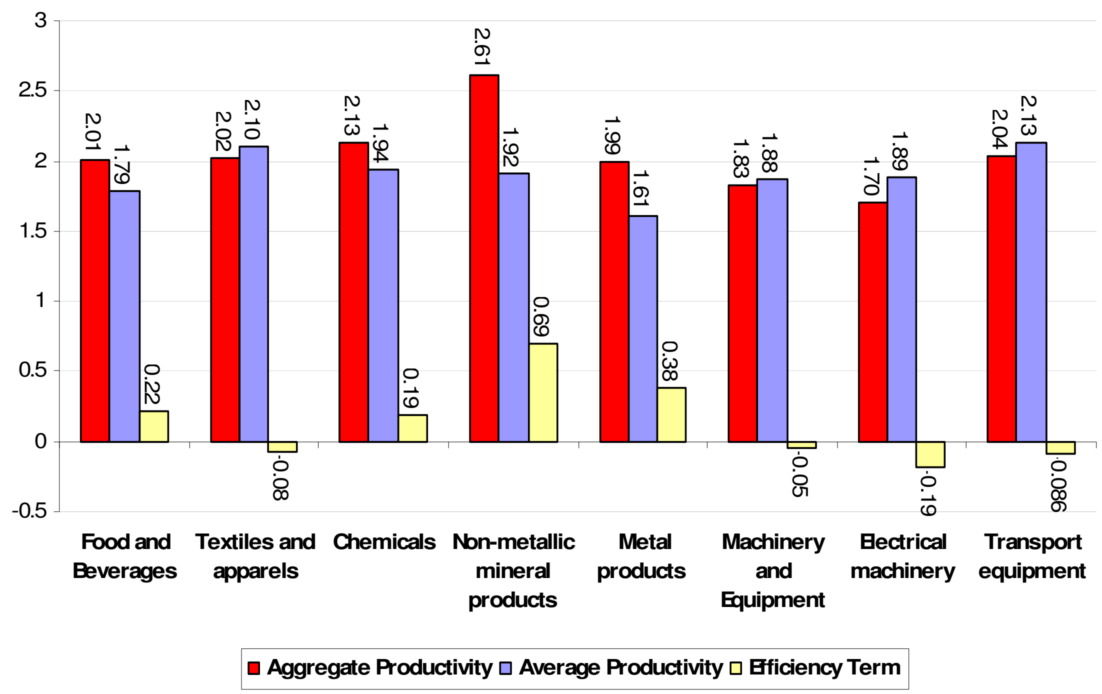


Figure 3.2

Mixed Olley and Pakes Decomposition by Region of Aggregate Productivity (Restricted Solow Residual)

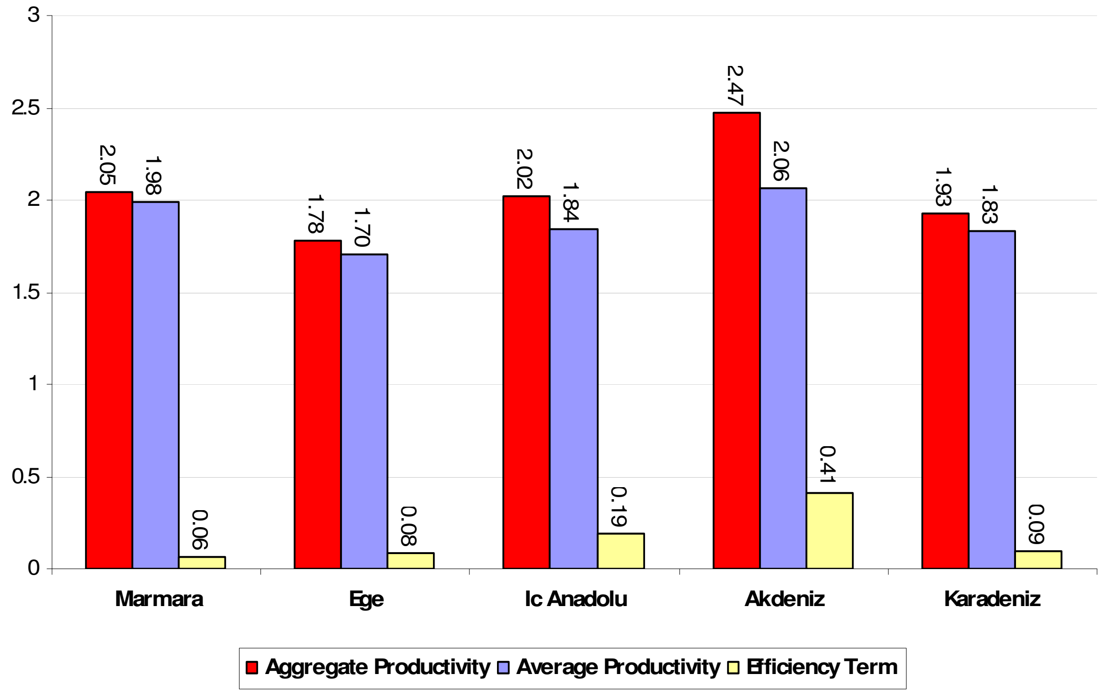


Figure 3.3

Mixed Olley and Pakes Decomposition by Size and Age of Aggregate Productivity (Restricted Solow Residual)

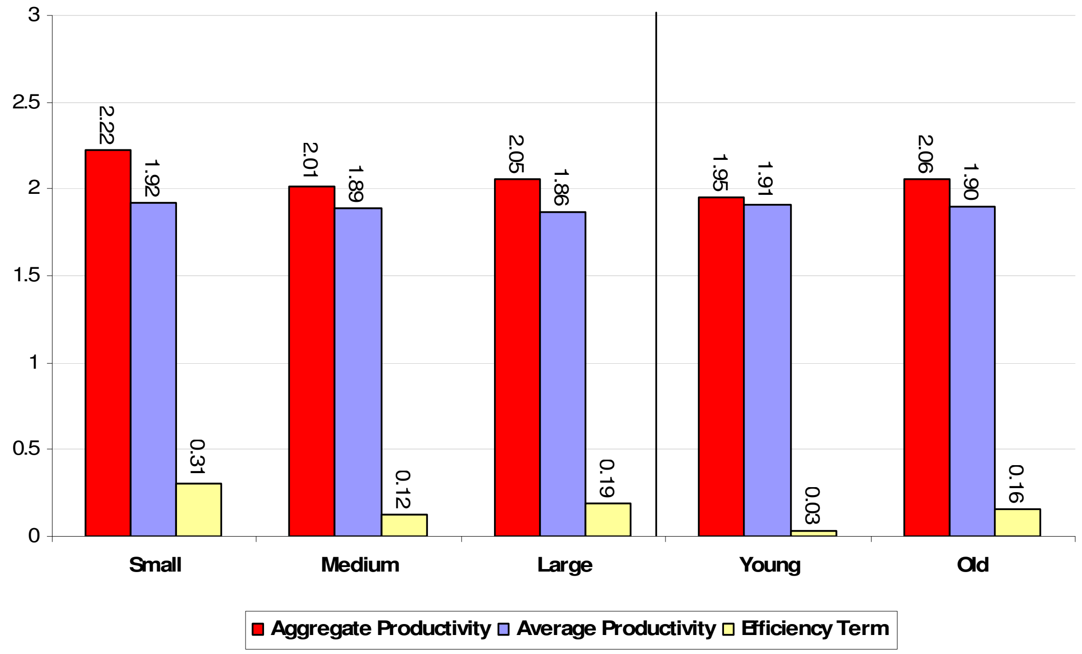


Figure 3.4

Mixed Olley and Pakes Decomposition by Year of Aggregate Productivity (Restricted Solow Residual)

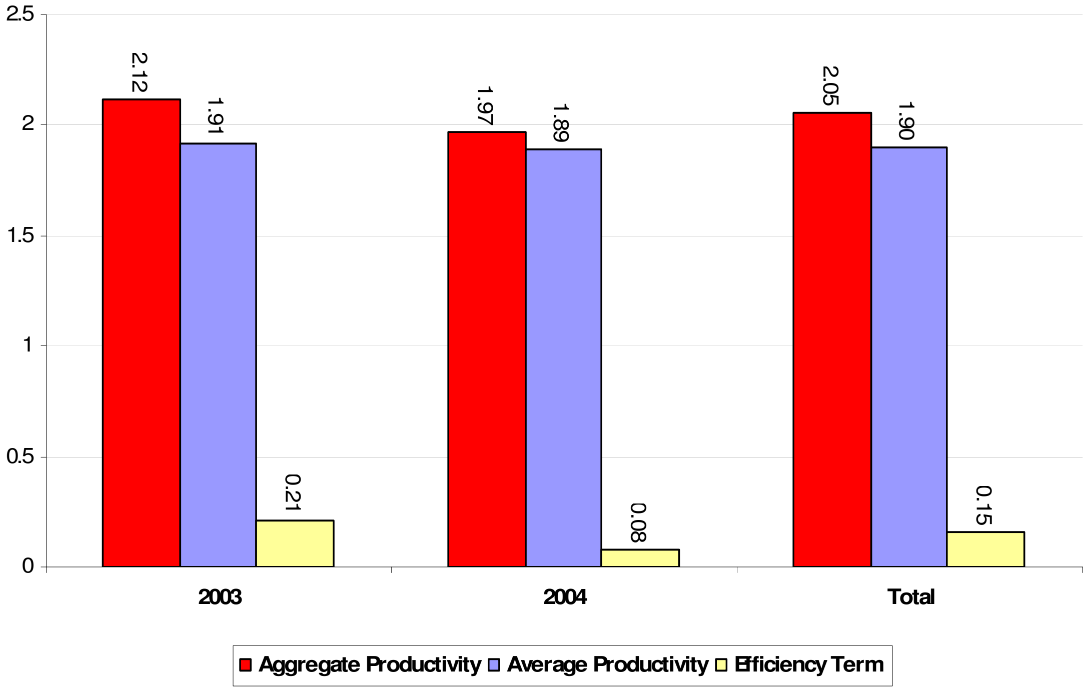


Figure 3.5

Mixed Olley and Pakes Decomposition by City of Aggregate Productivity (Restricted Solow Residual)

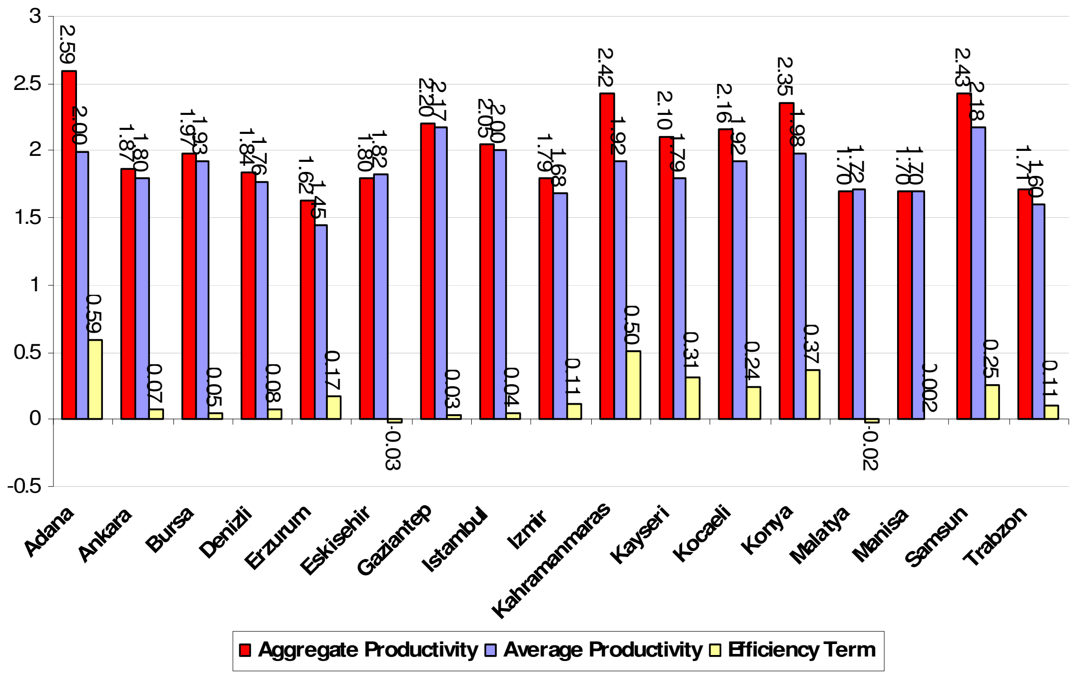
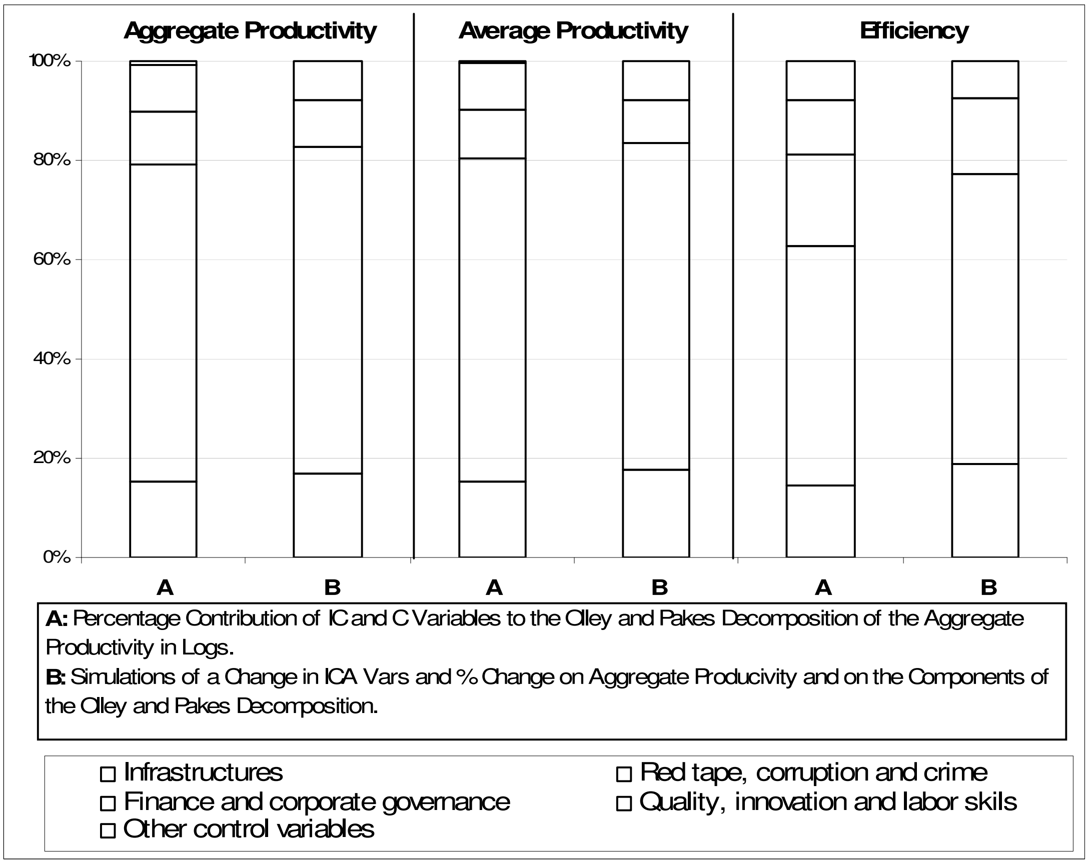


Figure 4.1
Relative ICA effects by groups of variables on aggregate productivity, average productivity and efficiency (covariance term) (mixed decomposition and simulations of a 20% improvement in IC and C variables.



	Aggregate Productivity		Average Productivity		Efficiency Term	
	A	B	A	B	A	B
Infrastructures	15.35	16.86	15.42	17.53	14.62	18.90
Red Tape, Corruption and Crime	63.75	65.92	64.96	66.16	48.18	58.18
Finance and Corporate Governance	10.65	9.48	9.81	8.49	18.32	15.29
Quality, Innovation and Labour Skills	9.61	7.66	9.58	7.75	11.14	7.56
Other Control Variables	0.64	0.07	0.23	0.07	7.74	0.07
Total	100.00	100.00	100.00	100.00	100.00	100.00

Notes:
A: relative contributions computed according to equations (3.4).
B: relative contributions computed according to equations (3.20).

Figure 4.2
Absolute Percentage Contribution of IC Variables on the Aggregate Productivity

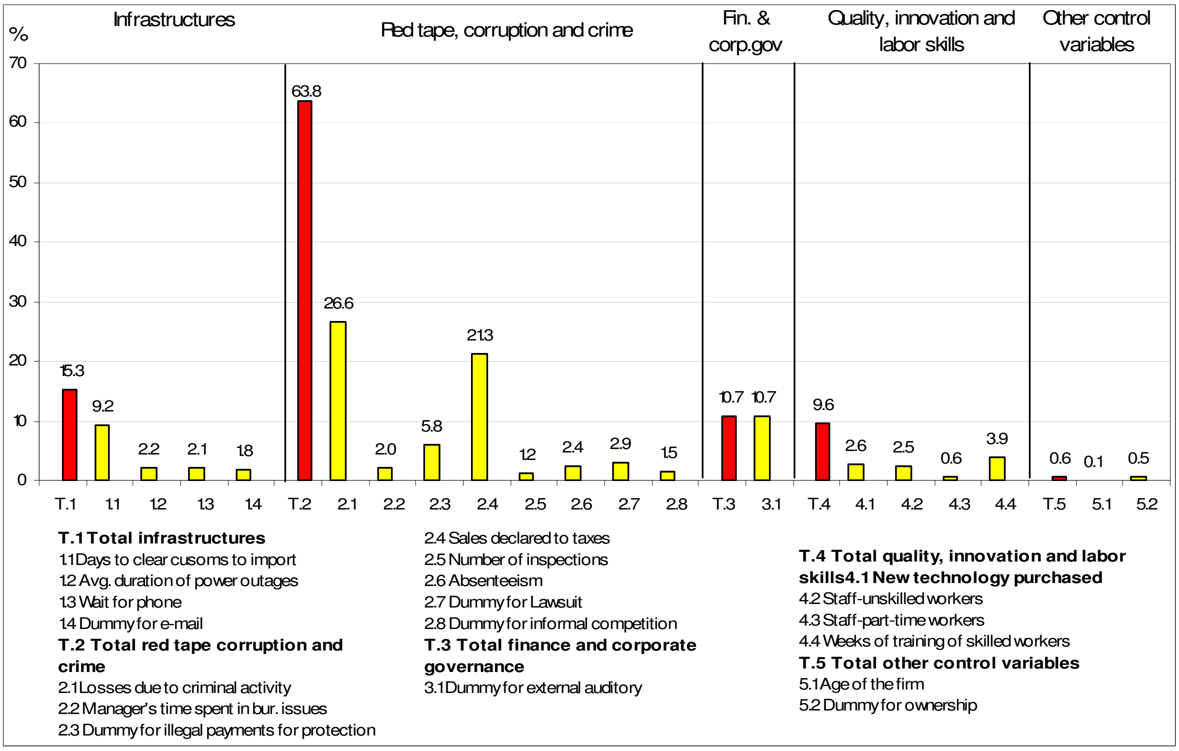


Figure 4.3
Absolute Percentage Contribution of IC Variables on the Average Productivity

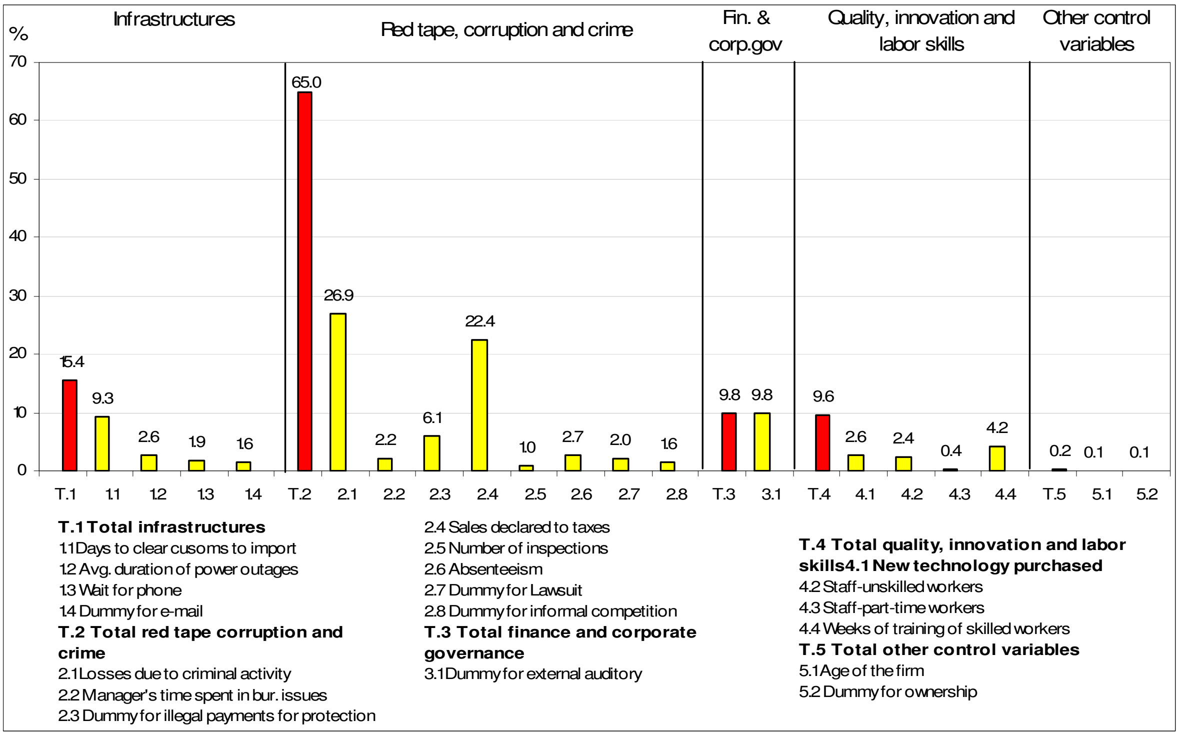


Figure 4.4
Absolute Percentage Contribution of IC Variables on Allocative Efficiency

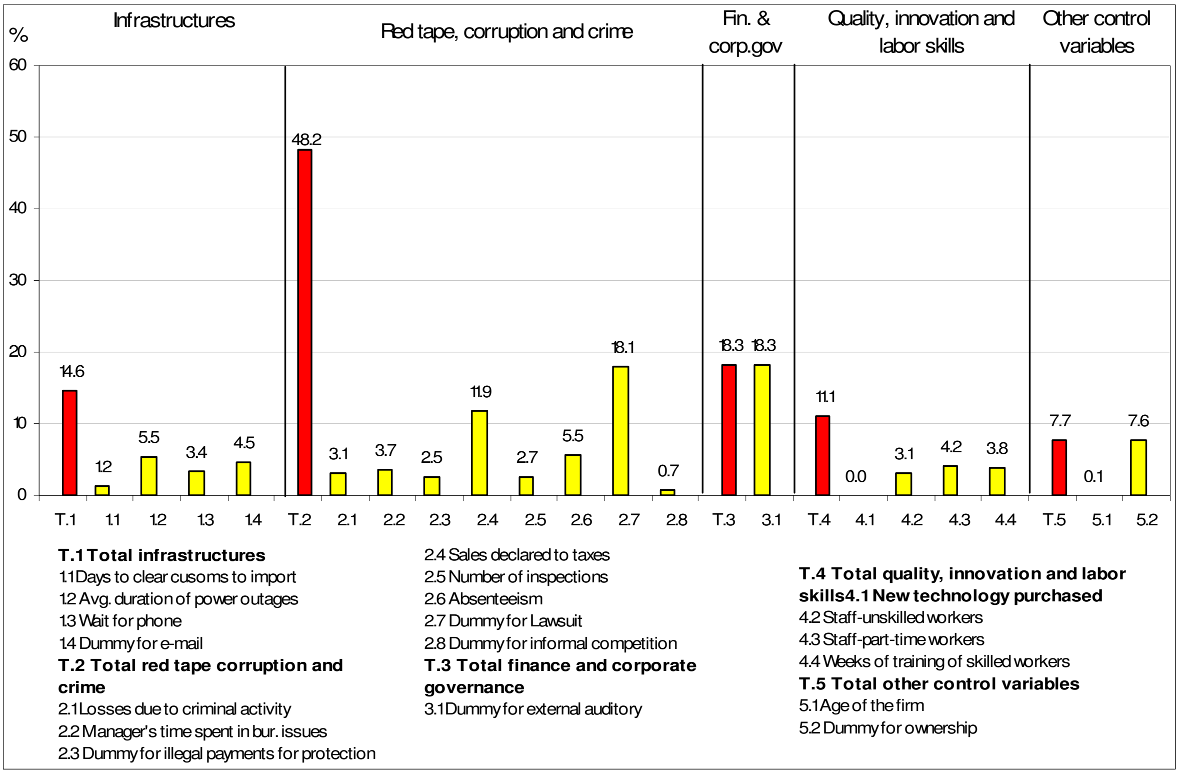


Figure 4.5
Absolute Percentage Contribution of IC Variables on the Aggregate Productivity (Simulation)

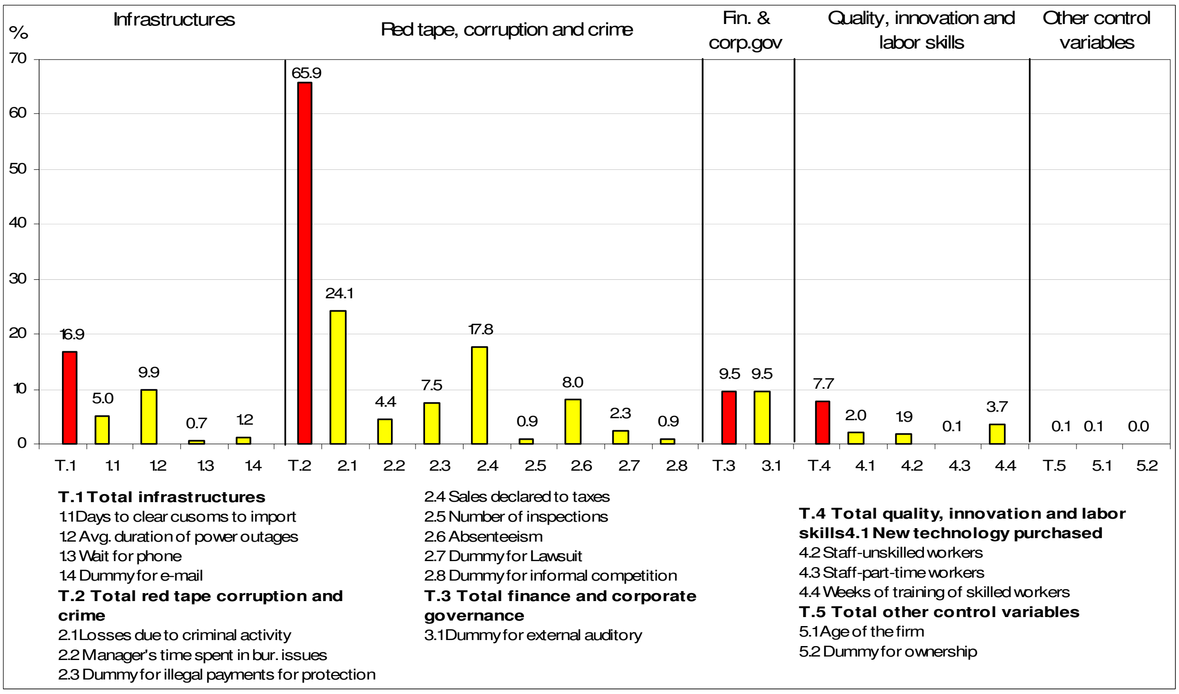


Figure 4.6
Absolute Percentage Contribution of IC Variables on the Average Productivity (Simulation)

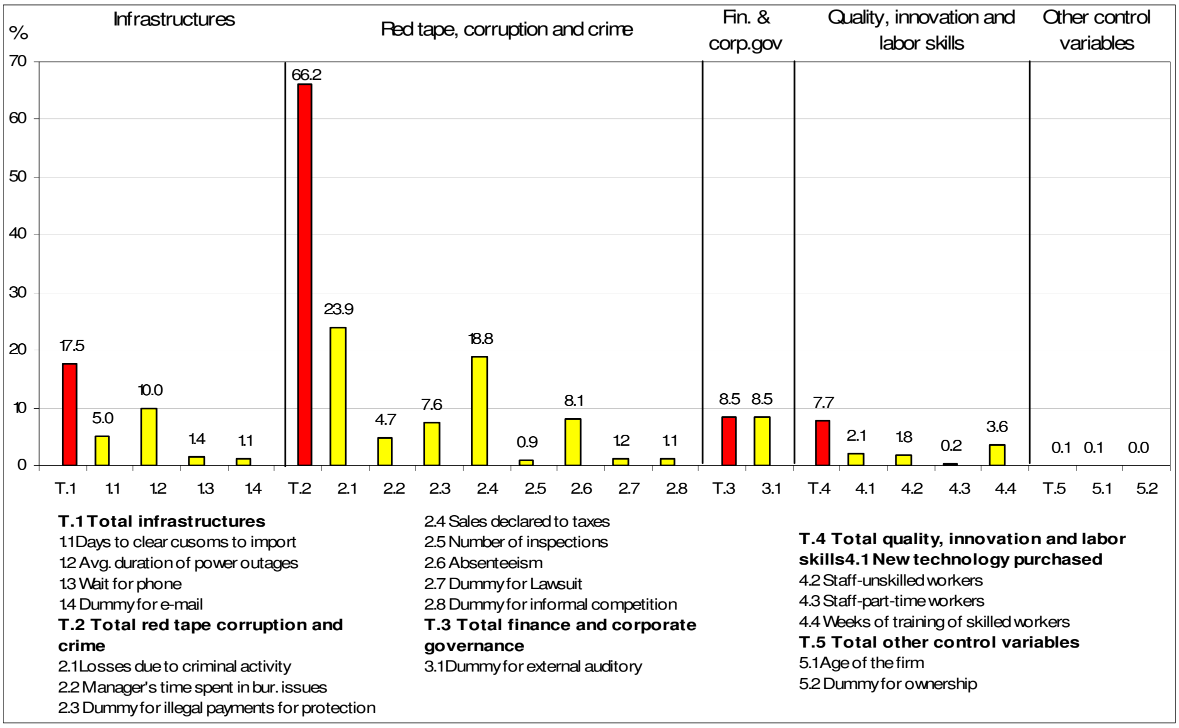


Figure 4.7
Absolute Percentage Contribution of IC Variables on Allocative Efficiency (Simulation)

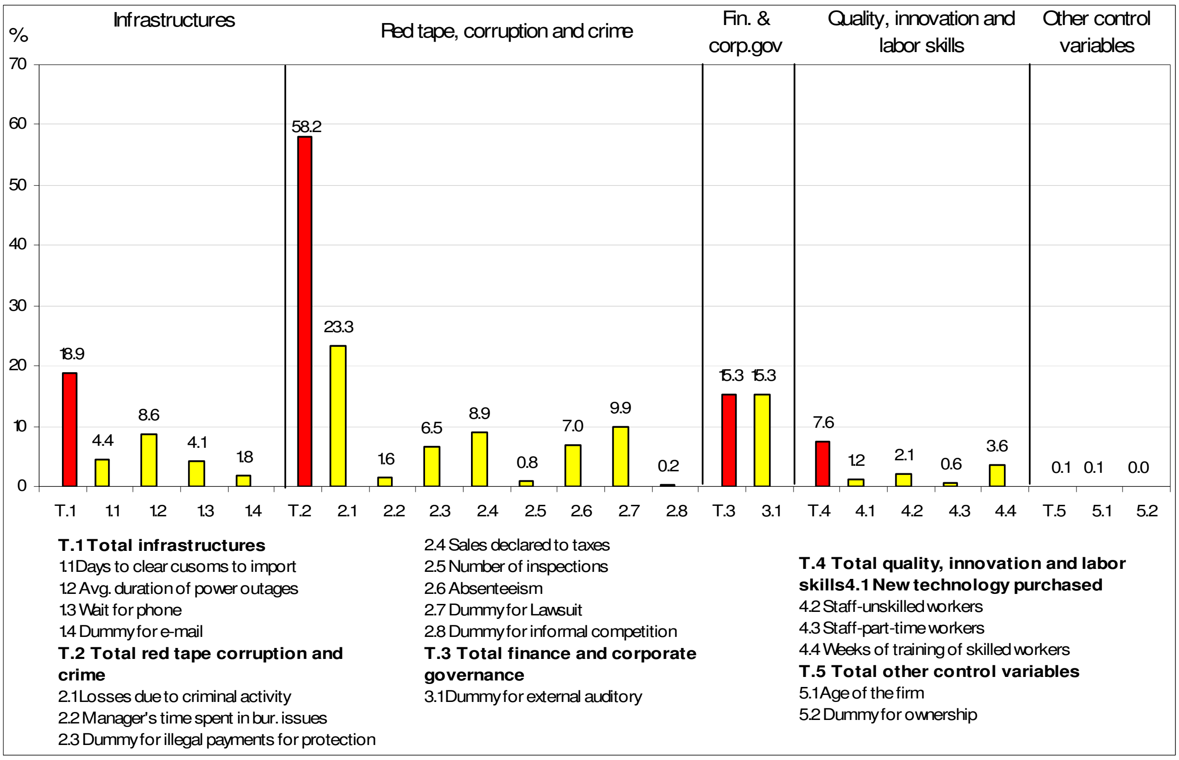


Figure 5
Relative ICA effects by groups of variables on average productivity by size

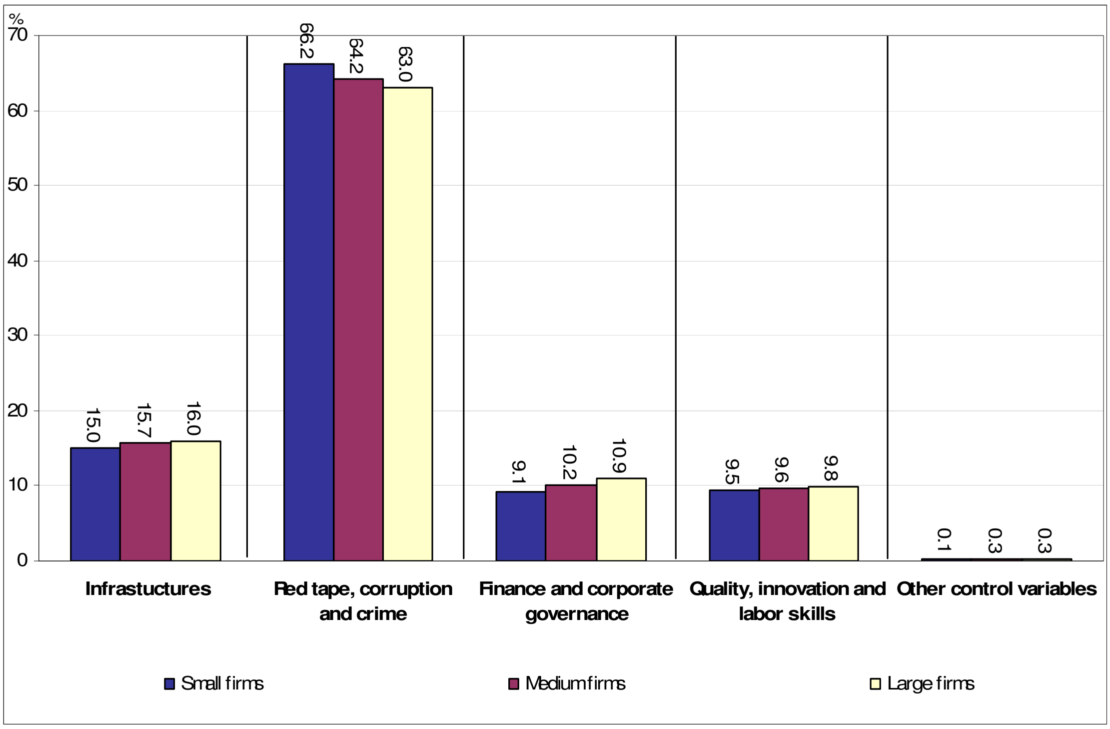
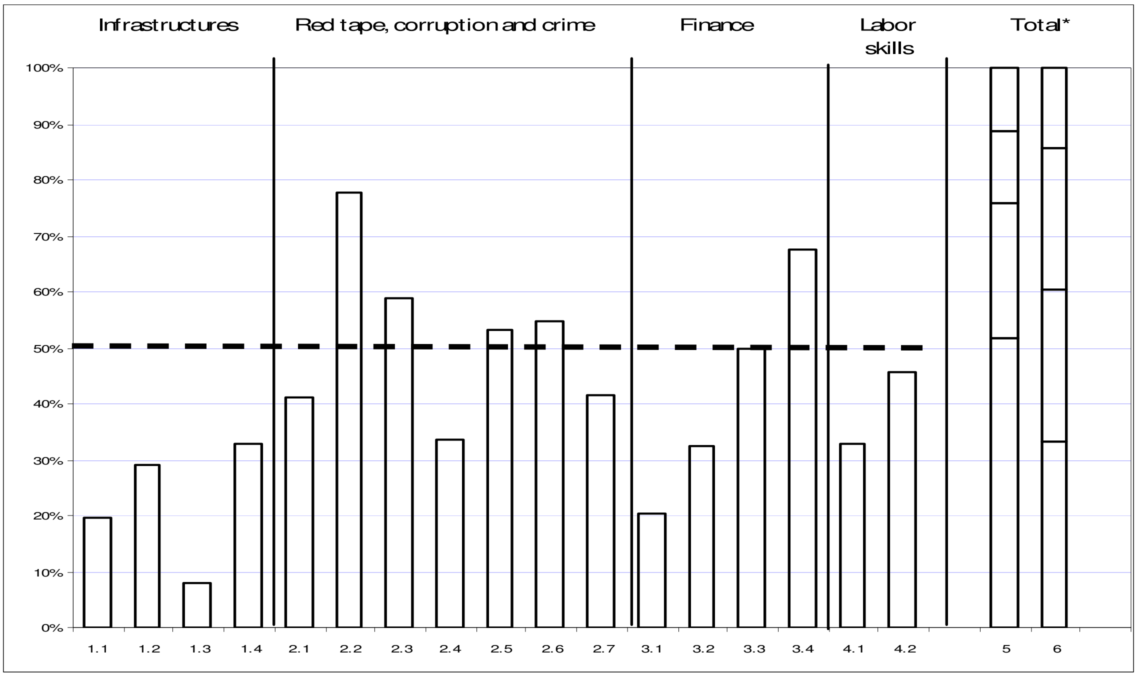


Figure 6

Firm's perceptions; percentage of firms that considers each one of the following problems as a severe obstacle to firms' economic performance



LEGEND:

1 Infrastructures.
1.1 Telecommunications
1.2 Electricity
1.3 Transportation
1.4 Customs and trade regulations

2 Red tape, corruption and crime.
2.1 Business Licensing and Operating Permits
2.2 Tax Rates
2.3 Tax Administration
2.4 Corruption
2.5 Crime, theft and disorder
2.6 Anti-competitive or Informal Practices
2.7 Legal system/ Conflict Resolution

3. Finance.
3.1 Access to Land
3.2 Access to Finance
3.3 Cost of Finance
3.4 Macroeconomic uncertainty

4. Labor skills.
4.1 Labor Regulations
4.2 Skills and Education of Available Workforce

5. Total relative weights.
6. Average group relative weights.
* (Totals are computed as the relative weigh of each group of perceptions over the sum of all perceptions' weights)

Figure 7a: Evolution of GDP per capita in Turkey and selected comparator countries, 1990-2004

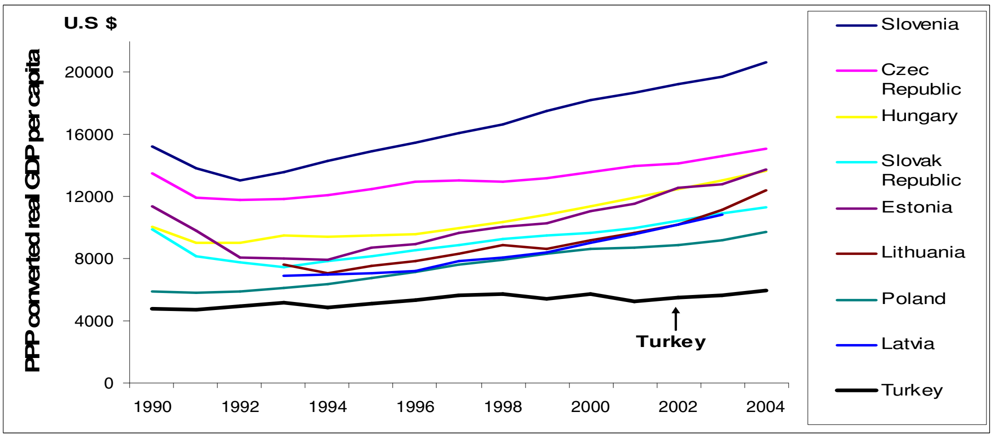


Figure 7b: Evolution of GDP per worker in Turkey and selected comparator countries, 1990-2004

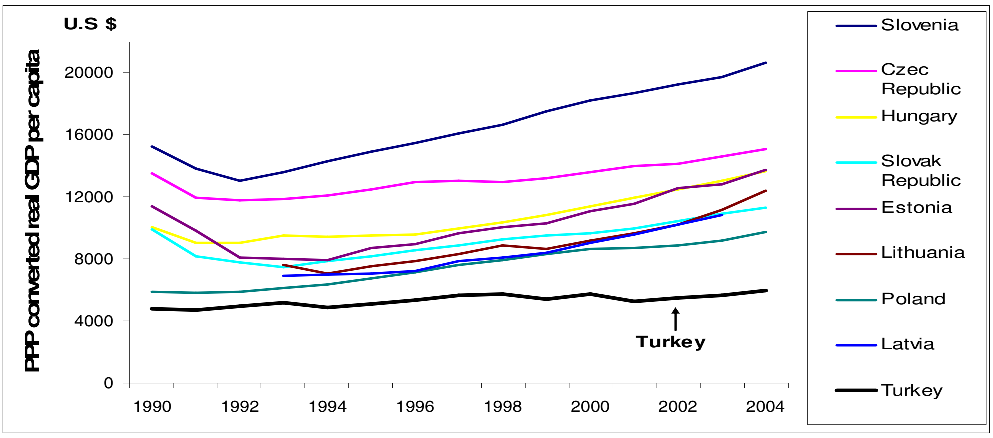
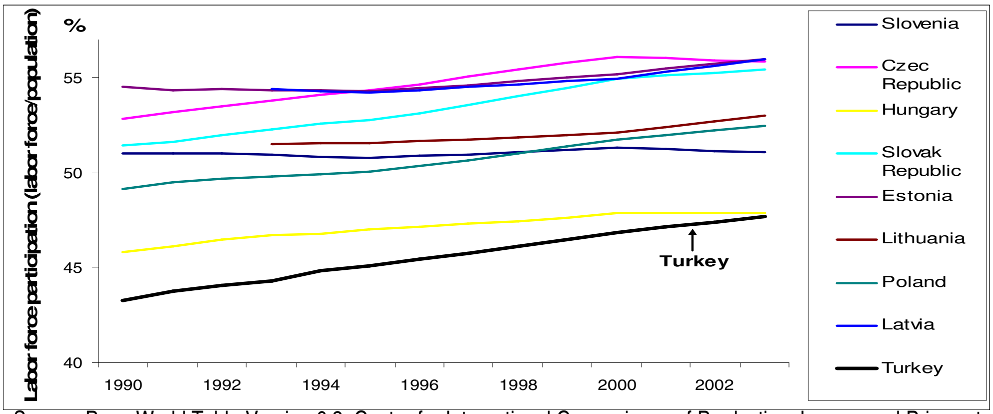


Figure 7c: Evolution of labor force participation in Turkey and selected comparator countries, 1990-2003



Source: Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

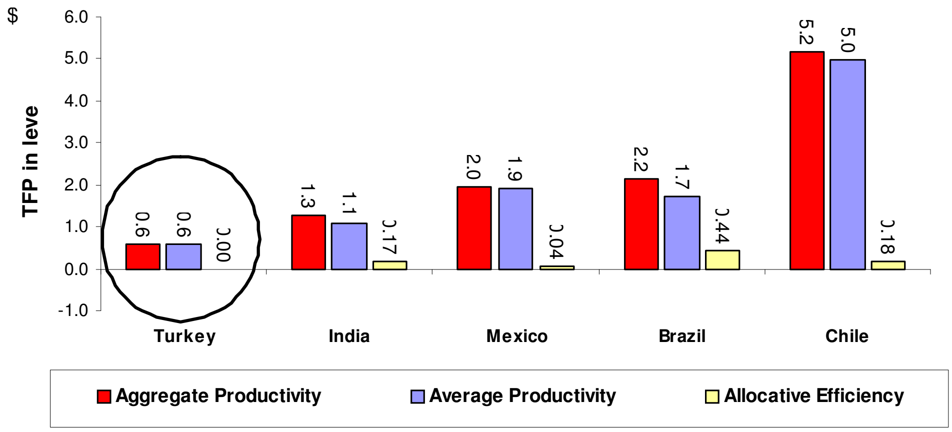
Figure 8: Comparison of Turkey's performance with 4 selected economies according to World Bank's Doing Business Report 2007

Economy	Ease of Doing Business Rank	Starting a Business	Dealing with Licenses	Employing Workers	Registering Property	Getting Credit	Protecting Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Closing a Business
Chile	28 (1)	33 (1)	59 (2)	67 (1)	32 (2)	45 (1)	32 (1)	34 (1)	35 (1)	63 (1)	98 (2)
Mexico	41 (2)	62 (3)	20 (1)	134 (4)	79 (3)	45 (1)	32 (1)	140 (4)	69 (2)	79 (2)	23 (1)
Turkey	**65 (3)**	**40 (2)**	**126 (4)**	**138 (5)**	**30 (1)**	**62 (3)**	**62 (5)**	**85 (2)**	**73 (4)**	**36 (4)**	**114 (3)**
Brazil	113 (4)	120 (5)	95 (3)	116 (3)	109 (5)	80 (5)	62 (5)	139 (3)	70 (3)	112 (3)	136 (5)
India	132 (5)	93 (4)	133 (5)	83 (2)	108 (4)	62 (4)	32 (3)	158 (5)	142 (5)	177 (5)	135 (4)

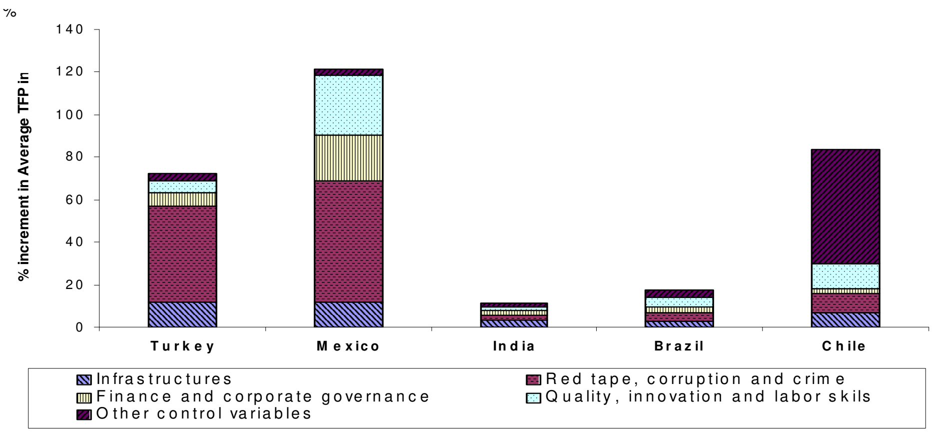
Notes:
Ranking out of 178 economies, in parentheses is the ranking within the sample of five economies included in the figure.
Highlighted in red are the factors for which Turkey is below the middle of the ranking, says 89 out of 178.
Source: Doing Business Report 2007, World Bank, Washington D.C.

Figure 9: Comparing Turkey's IC effects on the O&P decomposition with selected comparator countries: *demean O&P decomposition in levels*

A. Demean O&P decomposition in levels



B. Percentage increment in average productivity from a 20% improvement in IC variables



C. Percentage increment in allocative efficiency from a 20% improvement in IC variables

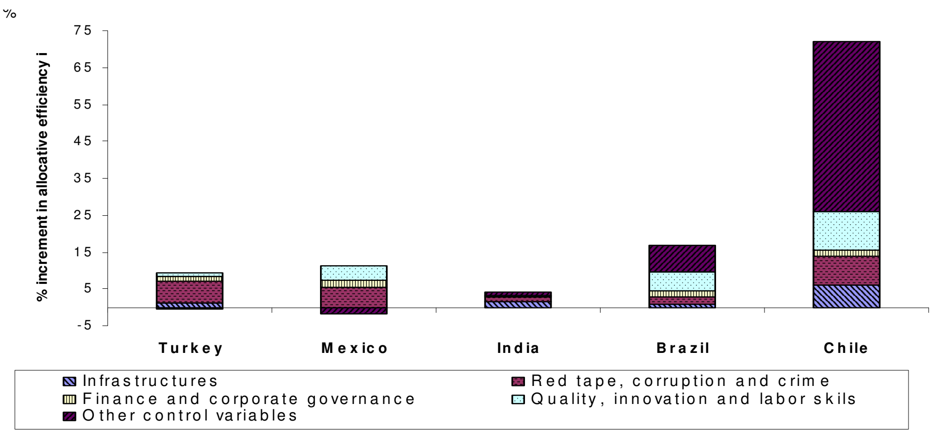
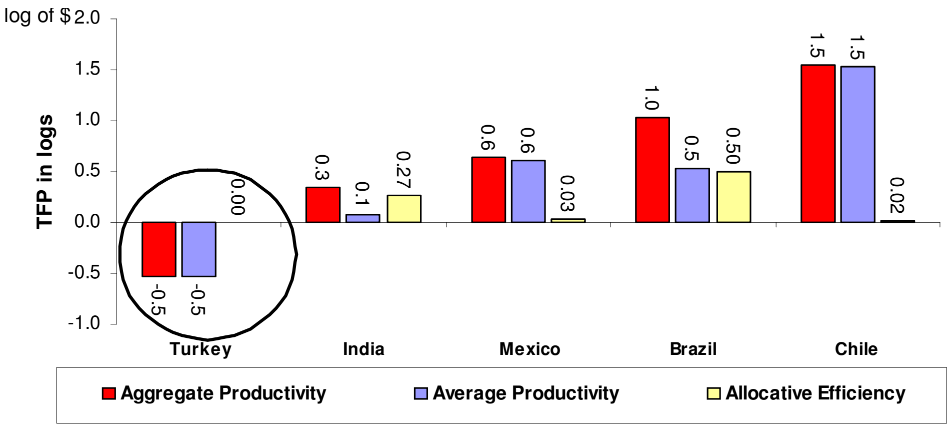
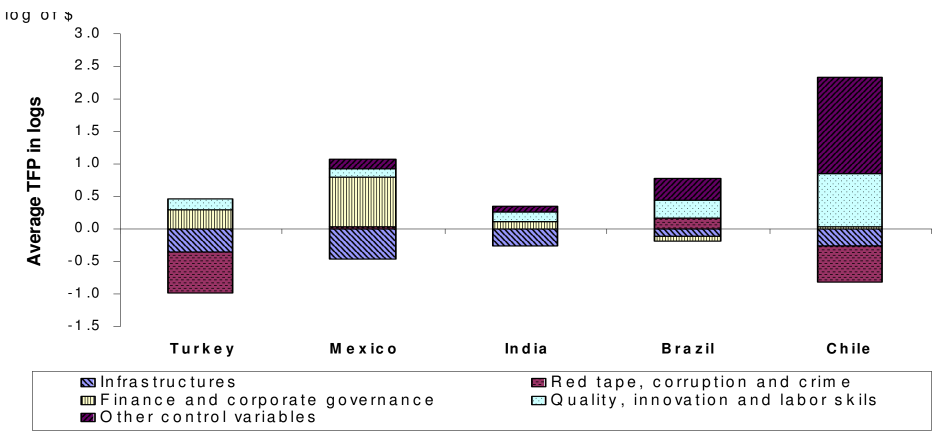


Figure 10: Comparing Turkey's IC effects on the O&P decomposition with selected comparator countries: *demean mixed O&P decomposition*

A. Demean O&P decomposition in log



B. Average productivity gains and losses from the investment climate conditions



C. Average allocative efficiency gains and losses from the investment climate conditions

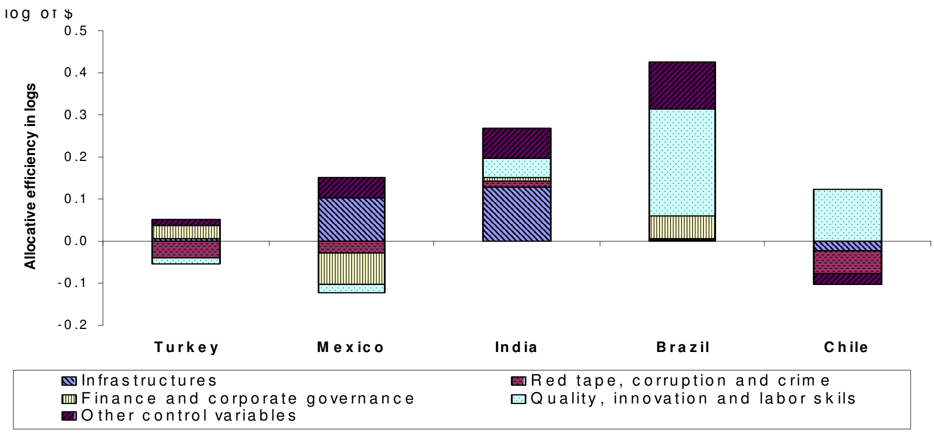
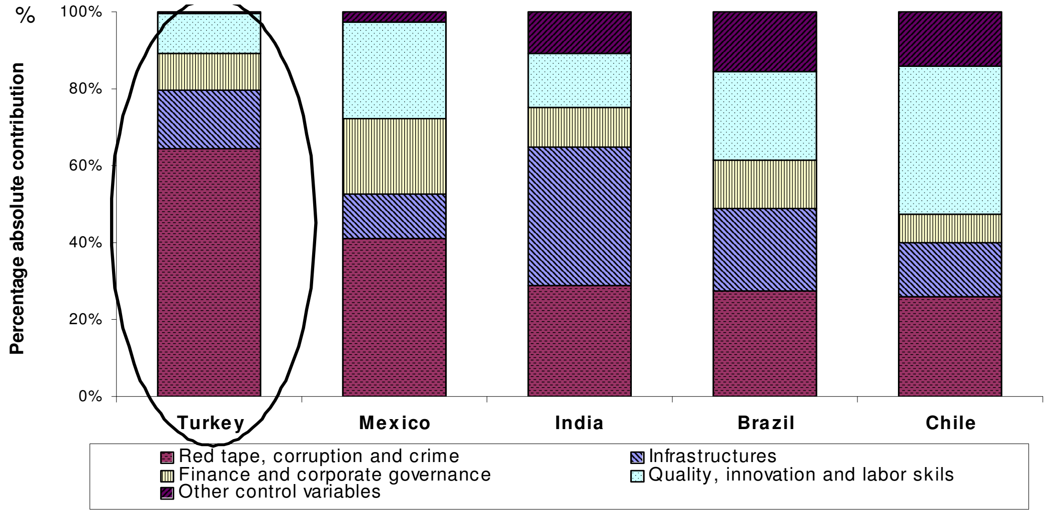
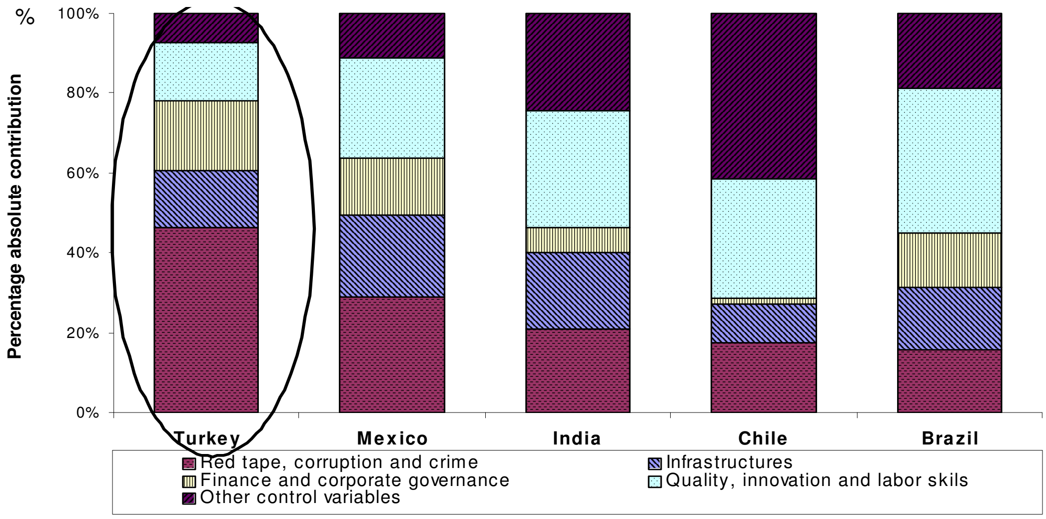


Figure 11: Comparing Turkish performance (II): IC absolute percentage effects on the O&P decomposition

A. Percentage absolute contribution on average productivity

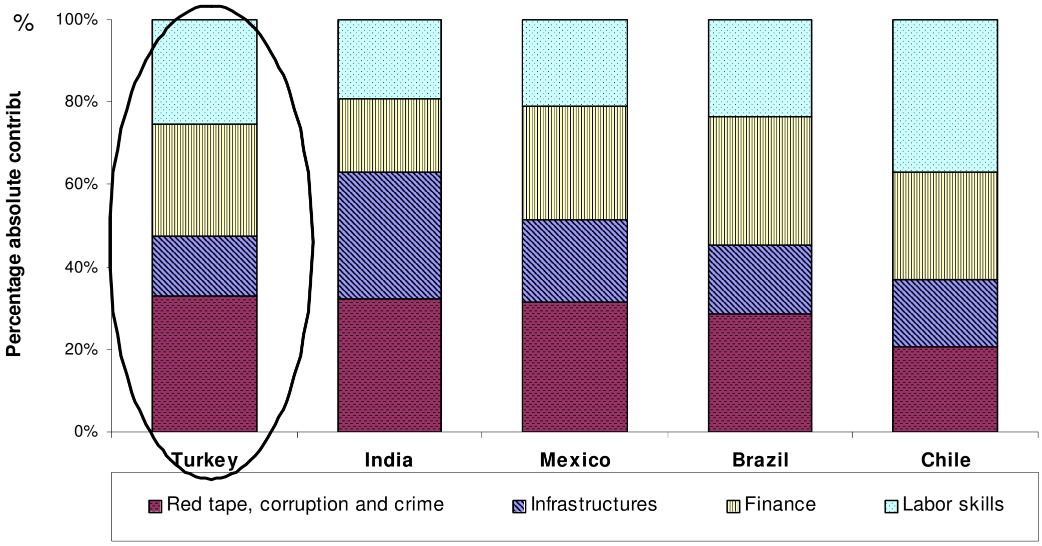


B. Percentage absolute contribution on allocative efficiency



Source: Authors' calculations with World Bank's Investment Climate Assessment data.

Figure 12: comparing Turkish performance (I): Average relative weights of manager's perceptions



Source: Authors' calculations with World Bank's Investment Climate Assessment data.