A REGIONAL AND SECTORAL ANALYSIS ON PRODUCTION TECHNOLOGY DYNAMICS OF MANUFACTURING INDUSTRIES IN TURKEY

A Master's Thesis

by
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September 2015

To my beloved husband Halil and my family

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Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

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This thesis estimates regional and sectoral total factor productivity (TFP) using firm-level data on Turkish manufacturing industry over the 2003-2012 period to understand whether there is a parallelism between differences in TFP levels and differences in income per capita across regions. As propounded by Prescott (1998), TFP theory is utilized to explain international income differences in the existing literature. However, it still remains an interesting topic to study regional differences within countries and this thesis contributes to the literature with an empirical evidence from Turkey's regions. Based on the results obtained from different estimation methods, there is a significant heterogeneity across sectors and firms in the same sector in the micro-level and this results in different average TFP levels for regions at macro-level. Our findings suggest that discrepancies in regional TFP levels are determined by technological dynamics of the industries that are dense in those regions. Thus, different sector abundance in different regions may be one of the factors for different levels of income per capita among regions.

Keywords: firm-level data, total factor productivity, regional development.

ÖZET

TÜRKİYE İMALAT SANAYİ ÜRETİM TEKNOLOJİSİ DİNAMİKLERİ ÜZERİNE BÖLGESEL VE SEKTÖREL DÜZEYDE ANALİZLER

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İktisat Bölümü, Yüksek Lisans

Tez Danışmanı: Prof. Dr. Erinç Yeldan

Eylül 2015

Bu tez, 2003-2012 yılları için firma bazında Türkiye imalat sanayi verisi ile sektörel ve bölgesel düzeyde toplam faktör verimliliği tahminleyerek, bölgesel toplam faktör verimliliği farkları ile kişi başı gelir farkları arasında bağıntı olup olmadığına bir cevap aramaktadır. Prescott (1998) tarafından öne sürülen toplam faktör verimliliği teorisi, şimdiye kadar yapılan çalışmalarda uluslararası gelir farklarını açıklamak için kullanıldı. Fakat, bölgesel düzeyde farklılıklar alanında daha fazla çalışma yapılması gerekmektedir. Bu tez, varolan literatüre Türkiye'nin bölgesel analizi ile ampirik bir katkıda bulunmaktadır. Firma bazında tahminleme yapılırken kullanılan farklı yöntemlerle elde edilen sonuçlara göre, mikro düzeyde firma farklılıkları, ortalama toplam faktör verimliliğinde makro düzeyde bölgesel farklara sebep olmaktadır. Elde edilen bulgular bölgeler arası görülen toplam faktör verimliliği farklılıklarınn sebebi olarak bölgelerde yoğun olarak faaliyet gösteren sektörlerin farklı teknolojik dinamiklere sahip olmasını ortaya koymaktadır. Sonuç olarak, farklı bölgelerde farklı sektörlerin yığınlaşması bölgesel kişi başı gelir farklarını açıklayıcı bir etken olabilir.

Anahtar kelimeler: firma seviyesinde veri, toplam faktör verimliliği, bölgesel kalkınma.

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CHAPTER I

INTRODUCTION

A popular question in macroeconomics is, "why are some countries richer than others?". Not surprisingly, there is a rich literature providing a variety of answers. It still remains an interesting topic to study regional differences within countries rather than aggregated national data, since within country income distribution gives a clear idea about the country's level of development.

Many theorists try to model long run growth path of economies. Since the seminal work of Barro et al. (1991), convergence of income levels between countries or between regions of the same country draws the attention of many researchers (Blanchard and Katz, 1992; Sala-i-Martin, 1996). However, most of the time, heterogeneity across sectors and regions of the country remains in the background. The presence of such heterogeneity across sectors or regions could result in several outcomes, one of which is total factor productivity (TFP) differences among these sectors/regions and the other is misallocation of resources. These outcomes have been put forward as reasons for within-country income per capita differences (Restuccia and Rogerson, 2008; 716-720). In this thesis, I will analyze dynamics of regional and sectoral production technology in the manufacturing industries in Turkey using a panel data approach in order to examine whether TFP levels provide insight about different degrees of development within Turkey.

Understanding the characteristics of Turkey's regions is crucial, since it gives the motivation for this thesis. Figures 1,2 and 3 present an overview of Turkish regions based on data provided by Turkish Statistical Institute (TURKSTAT). For simplicity, I have aggregated data into three subgroups as high-income, middle-income and low-income regions according to their per capita gross domestic product levels of provinces in 2011. In Figure-I, apparently there is a huge difference between regions' participation to gross value added. The comparison between years 2004 and 2011 shows that there is an improvement in all regions over time.

To see the reason behind this variation between regions, Figure-2 could provide a clarification, in which economic activity of employment in percentage is shown. As seen in Figure-2, low income regions give more weight to agriculture than high-income regions, which has a lower value added compared to industry or service sectors. On the contrary, high income regions concentrate on services more than other regions. While considering the value added of these sectors as reported in Table-1, it is expected to see less value added in regions where agriculture plays a significant role.

Also in Figure-3, we observe that there is a large difference between disposable incomes of last deciles in three sub-regions. According to the per capita gross domestic products (GDP) of provinces, there is a sharp economic divide between northeast and the rest of the country. Thus, I divided the country into three sub-regions.

All the reasons I have mentioned above stimulate the assertions about misallocation, geography and "agglomeration effect" that Krugman (1990) and others

(Acemoglu et al. 2001, Restuccia et al. 2013) have put forward. As in Prescott (1998) and Hall and Jones (1999), I will mainly focus on estimation of regional and sectoral TFP using data on Turkish manufacturing firms to observe whether the dominant source of differences in output per worker is caused by differences in TFP levels.

The rest of the thesis is organized as follows. In the next chapter 2, summary of some key contributions from existing literature including estimation techniques is provided. Data and methodology are described in the third chapter. Chapter 4 discusses the estimation results and chapter 5 concludes with some policy recommendations.

CHAPTER II

LITERATURE REVIEW

In the first place, we can start with the origins of TFP traced back to Solow (1957). In his seminal paper, he defines change in the technology as “any kind of shift” in the production function, but he focuses on different saving rates to give an explanation for international income differences. As a follow-up, Lucas (1988) introduces the concept of human capital as schooling, experience or specializing to elucidate income differences between countries and he takes the neoclassical growth model a step further. However, Prescott (1997) finds earlier works unsatisfying since he shows evidence that the same level of human capital cannot explain international income differences. That’s why, he uses total factor productivity theory to clarify international and within country income differences.

After the seminal work of Prescott, the idea of productivity is used to explain developed and developing countries’ income levels or TFP approach is utilized to compare per capita income differences among countries after-trade income levels. Grossman and Helpman (1991), is one of the examples that model a close economy in which productivity increases after trade liberalization since the interaction between trading countries trigger knowledge and innovation spillovers.

Caselli (2005), endeavors to clarify cross-country income differences not only with factors of production but also with differences in efficiency levels using survey data from both OECD and non-OECD countries. He claims that differences in human capital or physical capital are not enough to explain income inequality, but efficiency would be the biggest part of the answer to the question. In addition, Sivadasan (2006) uses plant-level data on Indian manufacturing sectors to analyze increase in productivity following foreign direct investment (FDI) liberalization and tariff liberalization. His results reveal that productivity increases by more than 25 percent after both liberalization periods. Therefore, the results are consistent with the Grossmann et al. (1991) assertion about the knowledge spillovers. Having a far-reaching data set, Gennaioli et al. (2014) analyze 83 countries regional growth and convergence rates, including Turkey, over the period 1975-2001. They conclude that regional growth is shaped by national growth and countries with better regulation exhibit faster convergence. They study the slow convergence issue of subnational regions; however they could not understand the reasons behind it and advice to focus on technological dynamics of the regions.

2.1 Literature Review on Turkey TFP Estimation

To continue with the existing literature on Turkish TFP estimation, Atiyas and Bakıs (2013) provide us with an aggregate and sectoral TFP growth analysis in their recent work. Their findings show that TFP growth in Turkey after 2000s is more than 3 percent, and agriculture sector exhibits strikingly higher TFP growth than industry sector . They also compare the TFP levels in Turkey with some other 98 countries. However, the results could be biased since they use aggregated data and estimate TFP by Ordinary Least Squares Method only for three main sectors. Again, in his empirical work Filiztekin (2000) analyzes the productivity growth in Turkish manufacturing sectors after trade liberalization. In opposition to neoclassical growth theories, he finds a significant effect of openness to trade on productivity and growth. Yet, he uses the data up until year 2000 and his methodology is problematic while estimating TFP levels due to some endogeneity problems.

Aggregated data and endogeneity problems are also encountered in Saygılı et al. (2005) and Taymaz et al. (2008) where they use Ordinary Least Squares (OLS) estimation, fixed-effect method or GMM estimation of Cobb-Douglas production function with aggregated data. Focusing on the capital accumulation to explain sources of economic growth, Saygılı et al. ascertain that there is a positive correlation between economic growth and capital accumulation. Also, they claim that productivity indicators are weak for agriculture and services sectors, whereas it is high for industry sector. Both papers, draw attention to the increase in productivity with structural transformation after 2000s. While, all the papers I have reviewed above give a general idea about TFP levels, they do not provide a detailed analysis and they do not properly estimate TFP with an aim to explain regional income differences. Time interval, usage of aggregated data and methodological problems show that there is a need to estimate regional TFP using more recent and detailed data, a gap that this thesis aims to fill.

2.2 Literature Review on Misallocation

Apart from total factor productivity approach to explain differences in income per capita for countries or regions in a country, there is also an extensive literature on misallocation that investigates the regional differences within national boundaries. After the seminal work of Krugman (1990), in which distinct regions within a country are analogous to core and periphery dichotomy, many researchers have concentrated on the misallocation subject. In their paper “Agglomeration in the Global Economy” , Ottaviano and Puga (1997) analyze the share of sectors in each region and their input levels. What they conclude is that even if the regions are homogeneous ex-ante, more productive labors migrate from less productive regions, where agriculture is the main source of living, to more productive regions where industry or the services sectors are the main source of living. This creates a discrepancy in productivity levels of inputs across regions ex-post. After a while, some part of the world will function as a core whereas the other parts will be poor periphery. Also Acemoglu et al. (2001) highlight the impact of geography and institutions on the world income distribution and conclude that the region that institutionalized earlier has an advantage over the other regions that results in geographical per capita income differences.

Additionally, Jones (2011) explores the effect of misallocation of resources on different TFP levels and income differences. His paper not only provides empirical evidence from OECD countries, but also constructs a simple two-good economy model where inputs are allocated differently. He claims that the misallocation of resources at the micro-level results in different TFP levels at macro-level. Finally, Restuccia and Rogerson (2013) use the misallocation argument to explain the total factor productivity differences as a reason for the income differences. Getting to the main reason for income differences, they conclude that misallocation of resources driven by heterogeneity of firms/regions or distortions/externalities creates differentiation in efficiency across regions, thereby creating differences in income per capita across regions.

As mentioned in the first chapter, misallocation and TFP levels are argued to be the main reasons for income distribution. Recently availability of firm-level data and new estimation techniques stimulate the interest for TFP calculations and using region and sector specific data, it is possible to differentiate dynamics of the regional and national economies. In what follows, this thesis contributes to Turkish TFP estimation literature by utilizing firm-level data provided by TURKSTAT at regional (NUTS-2) and industry (NACE-2) levels, and using new estimation techniques.

2.3 Literature Review on TFP Estimation Techniques

Estimating TFP as residual from OLS estimation can create simultaneity since choices of inputs, such as labor, can be correlated with the unobserved productivity shock to the firm. Also in the balanced panel data, we only observe surviving firms over time, which may cause a selection bias. Therefore, estimating TFP with OLS method can cause endogeneity or selection bias problems (Van Beveren, 2012). There are some methods to get rid of simultaneity problem like instrumental variable (IV) estimation, fixed-effect (FE) (Mundlak, 1961; Hoch, 1962) or random-effect panel estimation. However, they all have some drawbacks in estimation process. For example, in fixed-effect estimation error term is divided into two parts, one of which is a time-invariant and firm specific ω_i, to solve the simultaneity problem with the following form.

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_i + \eta_{it}$$

However, it needs the assumption of strict exogeneity,

$$E(y_{it}|l_{it}, k_{it}, m_{it}, \omega_i) = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \omega_i$$

unless it causes inconsistency and bias towards to zero in the estimation and this assumption does not hold in practice (Van Beveren, 2012). Whereas, IV method does not need strict exogeneity assumption for consistent estimation. In this method a variable correlated with inputs and uncorrelated with the shock such as input prices is essential, but most of the time input prices are not observed or even if it is observed, firms with market power set their input prices according to their productivity and sales, so input prices become endogenous. Lagged levels of inputs can also be used as instruments. But this approach introduces a downward bias in the estimates of the coefficient of the capital input (Van Beveren, 2012). Therefore, Blundell and Bond (2000) introduce generalized method of moments (GMM) for more accurate estimates defining AR(1) process for a part in error term. Although GMM is a proper solution for endogeneity problem, it is not sufficient to deal with selection bias issue since it does not take survival probability of firms into account.

To correct the endogeneity and selection problems and to obtain more accurate estimates, there are some dynamic models used for firm-level data such as Olley and Pakes (1996) and Levinsohn and Petrin (2003). Working with the telecommunications equipment industry data, Olley and Pakes (OP) suggest that reallocation of capital towards more productive plants after regulation in the industry causes an increase in the productivity. They propose a model in which investment is chosen as proxy variable in order to get rid of endogeneity problem. They also suggest a solution to selection bias problem. While other balanced panel data methods require the existence of all firms in all years, Olley and Pakes argue that exit or entry decisions of firms depend on their future productivity. Therefore, they develop an algorithm in which at every period each firm decides whether to exit or continue according to their expected productivity level and if it exits it never re-enters. However the assumptions needed for Olley and Pakes method are too restrictive that only firms with non-zero investment levels can be included in the sample. Since in most of the developing countries data, including

Turkey, firms report zero investment, it is not a suitable method to use for Turkish TFP estimation.

In addition, Levinsohn and Petrin (LP) propose a technique in which they use intermediate materials as proxy in order to prevent endogeneity using Chilean manufacturing data (2003). While in most countries firms report zero investment, they report their use of material or energy, such as electricity and fuel. There are also other extensions to these models and there is no surely correct method since the data and assumptions should match in order to favor a method over others. Due to the structure of Turkey manufacturing data; I will be utilizing LP method to estimate TFP levels and the details about this method will be given in the next chapter.

CHAPTER III

DATA AND METHODOLOGY

The data set used in this thesis is provided by TURKSTAT and available only in the data research center of the institute. Data is collected from enterprises which have 20 or more employees at the end of every year. The survey covers between the years 2003 and 2012. The institute also has data for years between 1980 and 2001, but the structure of the surveys and data collection methods are completely different so that I could not use data before 2003. Also main activity codes of the firms at NACE2 level are available and the description of each sectoral activity is given in Table-2. Since manufacturing industry data does not include the regions of the firms, I used local unit micro data to obtain the location of the firms at NUTS2 level by matching identity numbers of enterprises and Table-3 specifies the provinces included in each region. Table-6 gives the summary statistics of the available data by years including number of enterprises, number of employed persons and production values.

Next, I will give details of variables used in the TFP estimation.

3.1 Data

3.1.1 Dependent Variables

Production value of the firms included in the data set is measured as the sum of annual sales and changes in the stock value of final products for that year. According to their sectoral inflation rates reported in Table-5 at 2-digit level, production value is deflated at base year 2003. Deflating the production value with own sector prices is a substantial factor since in some sectors there is 500% inflation over a period of 10 years such as petroleum and coal, whereas in some sectors price level decreases each year like pharmaceuticals.

Other dependent variable used in the estimations is value added with factor prices provided by TURKSTAT and it is also deflated by corresponding sector prices.

3.1.2 Independent Variables

Labor as an indispensable factor of production is given for firms in every year as total number of hours worked. The number of workers are also included in the data set, but there are different types of employees as full-time and part-time and the hours they work is not the same, so that I used number of hours worked for the sake of unity in all firms. Unfortunately, after 2001 there is no information about the skills, education levels or service area of the employees as white collar or blue collar. Therefore, there is only one type of labor in the estimation.

Another main factor for production, capital, is not reported in the survey data. Hence, it is estimated using investment data of firms which is reported separately as investments on machinery/equipment, patents/computer programming and building/structure. After deflating the investment series with relevant price deflators, capital stocks for each item is constructed with perpetual inventory method. Before applying the method, an assumption is needed for the initial capital stock estimation, that is firms' being at their balanced growth path.

Considering K_{i0} as initial capital stock of firm i and δ as depreciation rate, we can write

$$K_{i1} = (1 - \delta)K_{i0} + I_{i0} \tag{1}$$

Dividing both sides of equation 1 with K_{i0}, we get

$$K_{i1}/K_{i0} = (1 - \delta) + I_{i0}/K_{i0} \tag{2}$$

Since we have assumed that firms are at their balanced growth path

$$K_{i1}/K_{i0} = Y_{i1}/Y_{i0} = 1 + g_i \tag{3}$$

where g is the growth rate of the firm and calculated as growth of deflated production value, we get

$$K_0 = I_0/(g_i + \delta) \tag{4}$$

Since I have different depreciation rates for different investment types, I constructed capital for building using δ=5%, for machinery δ=10% and for patent δ=30% (Yılmaz and Özler, 2005).

In the data set, not all firms report positive investment for first year they appeared in the data set, for this reason I have taken the first year reported with positive investment to calculate initial capital stock and iterated back for former years with 1/(1-δ) for each type of capital stock.

Calculating the initial capital, perpetual inventory method is used for following years where,

$$K_{t+1} = (1 - \delta)K_t + I_t \tag{5}$$

Finally, aggregating the different capital stock of each firm, total capital for each year is constructed.

Another independent variable included in the estimates is material input calculated as value of purchases on intermediate inputs plus the change in the material input stock for that year and deflated by corresponding inflation rates in Table-4.

3.1.3 Proxy Variables

Starting with Olley-Pakes (OP) methodology, it is needed to use investment as a proxy to elucidate endogeneity problem mentioned earlier. Aggregated investment of the firm is used for this estimation. On the contrary, Levinsohn-Petrin (LP) mention zero investment reported in firm-level data to demonstrate the problem in OP method, especially for developing countries. Since the observation number is decreasing with investment as proxy, they suggest energy to be used as a proxy in the estimation which is a variable reported non-zero by most of the firms.

In my data set 1/4 of the observations are excluded when OP approach is applied to production function due to zero investment entries. Therefore, LP approach is more proper to apply with available data set of Turkey. I will use both techniques to give empirical evidence to Levinsohn and Petrin's objective to Olley and Pakes where estimate results are biased.

In addition, we need exit variable for OP estimation which equals 1 if the firm exited at the beginning of that period and 0 otherwise.

Another proxy variable used in LP estimation is energy and calculated as the purchases on electricity and fuel minus the revenues from energy. It is also deflated with energy prices reported in Table-4.

3.2 Methodology

Assuming that the production function of the firms take Cobb-Douglas production function form,

$$Y_{it} = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l} M_{it}^{\beta_m} \tag{6}$$

where Y_{it} stands for output of firm i at time t as dependent variable and K_{it}, L_{it} and M_{it} are capital, labor and material inputs of firm i at time t, respectively. A_{it} stands for the productivity level which is unobserved to the researcher whereas other independent variables are observable.

Taking the natural logarithm of production function in equation 6,

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \varepsilon_{it} \tag{7}$$

we get logarithmic form of production function where lower case letters correspond to natural logarithms of each variables.

Natural logarithm of A_{it} is equal to the summation of mean efficiency level,

β_0 and time and firm specific measurement error of TFP, ε_{it}.

3.2.1 Methodology for Olley-Pakes Approach

As mentioned earlier, estimating those coefficients with OLS can cause endogeneity since the time and firm specific shock to productivity is observed to the firm and can lead them to choose their inputs accordingly resulting in correlation between the coefficients and the shock. In addition to endogeneity, firms with lower productivity has higher probability to exit the market and average productivity increases when they exit. As a result, entering to market afterwards become more difficult for new entrants (Melitz, 2003) and this situation causes selection bias in OLS estimation.

To overcome those problems, Olley and Pakes suggest a model where ε_{it} is decomposed into an observable or forecastable component, ω_{it} as a function of productivity and capital and unobservable component η_{it} and production function takes the form below.

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \tag{8}$$

Hence, $\beta_0 + \omega_{it} = a_{it}$. To solve for a_{it} OP use exit variable, X_{it} following a first-order Markov process mentioned in the description of data section to prevent selection bias problem in addition to a proxy variable as investment levels of firms. They claim that investment as a function of capital and productivity is strictly increasing in productivity so that its inverse exits. Taking the inverse of function $i_{it} = h_t(k_{it}, a_{it})$, productivity as an unobservable variable can be written as a function of observables as $a_{it} = g_t(k_{it}, i_{it})$ where $h_t(.) = g_t^{-}1(.)$.

Setting $f(k_{it}, i_{it}) = \beta_0 + \beta_k k_{it} + g_t(k_{it}, i_{it})$ OP estimate the following regression using OLS method to consistently estimate β_l and β_m at first stage.

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + f(k_{it}, i_{it}) + \eta_{it} \tag{9}$$

Using the estimated coefficients and taking survival probability into consideration, OP estimate β_k in the second stage. Estimated productivity in OP method can be constructed as residual from the following equation.

$$\hat{a_{it}} = y_{it} - \hat{\beta_k} k_{it} - \hat{\beta_l} l_{it} - \hat{\beta_m} m_{it} \tag{10}$$

After taking the exponential of $\hat{a_{it}}$, TFP is calculated at firm level for each year. However, a severe truncation in the data is needed for OP method since 1/4 firms in my data set report zero investment and this fact could cause another type of selection bias. The estimation results for OP are reported in Table-12.

3.2.2 Methodology for Levinsohn-Petrin Approach

While Olley and Pakes suggest using investment as proxy variable so as to prevent endogeneity problem, Levinsohn and Petrin are aware of the fact that developing countries' data contains lots of zero investment entries. Since firms report non-zero material input such as electricity and gas consumption, they suggest material input as a proxy in estimation (LP, 322). It is also possible to get healthier results than investment as a proxy since materials like electricity can respond better to productivity shock.

Again taking the same productivity function equation

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \eta_{it} \tag{11}$$

and demand for material input positively depends on the firms state variable k_t and a_t

$$m_{it} = m_t(k_{it}, a_{it}) \tag{12}$$

Positive effect of a_{it} on demand of m_{it} allows the inversion of demand function as

$$a_{it} = n_t(k_{it}, m_{it}) \tag{13}$$

where $m_t(.) = n_t^- 1(.)$.

Therefore, unobserved productivity function becomes function of two observable inputs. LP also allow us to estimate TFP taking value added, v_{it} as dependent variable where

$$v_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \omega_{it} + \eta_{it} \tag{14}$$

and TFP can be calculated as taking the exponential of following equality.

$$\hat{a_{it}} = v_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} \tag{15}$$

The estimation process identified in the above includes two stages in which LP estimates first β_l consistently and at the second stage β_k is estimated and differs from OP as taking material input as proxy.

Difference between taking two variables as independent arises when executing the regressions. In the case where production value is dependent variable, LP is unable to identify coefficients of variables due to lack of variation in the data (Arnold, 2005). Therefore, my estimation relies on value added approach of LP estimation techniques tabulated in Table-13. I used value added in all estimation techniques to be able to compare results.

CHAPTER IV

EMPIRICAL RESULTS

In this section, the results of different estimation techniques and TFP estimation results are discussed using Tables 9-10-11 and 12.

4.1 Comparison of Different Estimation Coefficients

Arguing the possible problems of different estimation techniques in the above chapters, this section provides empirical evidence for those problems with Turkish manufacturing data. In Table-10, the coefficient estimates of production function with OLS are reported with significance levels for each region. Compared to other estimations' coefficients, OLS gives higher values for labor which is expected. Since the positive correlation between productivity shock and labor choice, OLS results are biased upwards confirming the theoretical results. When capital coefficients are examined, it is clear that OLS gives a downward bias that results underestimating the effect of capital in production.

The difference of fixed effect estimates with OLS and LP estimates can be explained by change in the magnitude of productivity shock of firms over time.

According to firm-level TFP estimation, what I observe is that firms' productivity level changes over time but not with a constant rate. Therefore, our data does not properly fit to fixed-effect estimation model.

In Table-12 and Table-13, there is no apparent difference between the labor coefficients in some regions. On the other side, capital coefficients become distinct due to loss of information caused by zero investment reports of enterprises in OP estimation. In addition, there is a column named "sum" corresponding to the sum of coefficients for each estimator and indicate almost constant returns to scale for OLS and decreasing returns to scale for FE.

As a superior estimation technique, LP results give more clear idea about the economies of scale for regions. For example, they indicate increasing returns to scale for Kocaeli, Sakarya and Ankara regions and decreasing returns to scale for most of the regions in the East.

4.2 Regional TFP Levels

As seen in Table-8 and Table-9, estimated average TFP levels of regions are weighted according to the number of people employed and reported with the number of firms in each region according to their economic activity. While analyzing each region's data specifically, it is observed that in Istanbul region (TR10) number of firms is high not only because of the existing firms in that region, but also it is high because of being the head of lots of local units. Therefore, Istanbul can be thought as the average TFP of the country. Although high productive sectors - manufacture of rubber-plastic and manufacture of non-metallic minerals - operate in regions like Tekirdağ (TR21) and Balıkesir (TR22), its TFP is not as high as expected since food products and textile products are produced in lots of small firms that have around 30 workers and these sectors are means of living for the big part of the population. Therefore, low levels of TFP is caused by the domination of low technology industries in these regions.

The remaining regions of the West like Izmir, Bursa, Eskişehir and Kocaeli, etc. including Ankara have relatively higher TFP levels. The reason for higher TFPs in these regions is that their giant firms operating in high technology industries defined by OECD in Table-14, such as chemical products, non-metallic minerals, basic metal industry, computer and optical instrument and transportation equipments or high value added sectors like petroleum and coal, like the ones in region TR42 shown in Figures 11-12-13-14. I expected the TFP level of Bursa, etc (TR41) more than the realized level since their sectoral activities in machinery, etc. have high value added. However, another essential sector in Bursa region is textiles and many small firms with low TFP's operate in this region that drag the average TFP down. Also in parts like Denizli (TR32) again the textile and wearing industries are the source of living resulting in low levels of TFP as shown in Figures 5 and 6. Since the privacy of firm-level data is an essential concern for TURKSTAT, it is not possible to report more detailed estimation results.

Apart from regions like Kayseri (TR72) and Hatay (TR63), average TFP levels for middle part of the country is not so high due to a great number of small firms operating in food and textile industries. There are very few firms in sectors non-metallic minerals and manufacture of furniture, but those are not enough to raise the average TFP levels. Excluded regions are TR72 and TR63 because of their main activities, such as manufacture of fabricated metals and basic metal industry. To exemplify, iron and steel plant in Iskenderun has a huge number of people employed and high value added to GDP so that the TFP levels in these regions shown in Figure-8 are not as low as the ones in the other central regions. As an explanation, Figure-7 stands for lots of firms with low levels of TFP in textile industry. Moreover, TFP difference between large and small firms in Kayseri in manufacture of furniture and building sector reported in Figure-9 could be an evidence for the efficiency differences according to the size of the firms.

On the north side of the country, there is only Zonguldak (TR81) region with relatively high productivity level due to again iron and steel factory that employs crowd in this region as shown in Figure-15. It would be worse if there were no firms in tobacco sector like the ones in Samsun (TR83) where tobacco sector is main source of living for most households. Moreover, it is wise not to expect high TFP levels like in regions Kastamonu (TR82), where firms concentrate on manufacture of wood and cork products.

Lastly, there are some regions in the East that have surprisingly high TFP levels like Erzurum (TRA1) and Mardin, Batman, etc. (TRC3). Since the average TFP is calculated, it is easy to increase productivity in this region by adding one big factory like the ones in Erzurum. As reported in Table-8 and Table-9, manufacture of non-metallic minerals are encountered in this region and they hire lots of people living in the area. Also in Figure-10 huge TFP differences between small and large firms shows the effect of large firms in increasing the average TFP of the region. Therefore, it is nothing but the effect of only sector 23 in TRA1 district. Other exception with high TFP in the East is TRC3 region. Again the same scenario with TRA1 underlie in this area where non-metallic industry and the petroleum is the main reason for high TFP level. However, in other regions in this district modest TFP levels are observed. In addition, Table-16 shows the t-test for constant returns to scale (CRTS) results in which the null hypotheses that regions exhibit CRTS is rejected for all regions at nuts-2 level.

4.3 Robustness Check for Capital

In this section, I provide two robustness checks both on capital stock estimation since it has a primary importance to have consistent estimates of TFP. As I mentioned earlier, I used investment levels of firms on different factor as machinery, building and patent and used perpetual inventory method to construct total capital stock for each year. Preferred by Conesa et al. (2007), value of depreciation, δ and the ratio of average estimated capital stock to average production is needed to be calibrated according to the ratio of depreciation value to GDP provided in the data. In my data set, firms also report their annual depreciation values and using the formula below

$$\frac{1}{T}\sum\frac{\delta K_t}{Y_t} = \bar{D}/\bar{Y} \tag{16}$$

I constructed the difference between alternative method and perpetual inventory method (PIM) reported in Table-15 and the difference is reported as percentage to the ratio used in the estimation. As seen, the difference is so low to ignore.

Apart from depreciation approach, they also suggest that ratio of initial capital stock to production level should match the average capital-output ratio of first ten years.

$$\frac{1}{10}\sum\frac{\delta K_t}{Y_t} = \frac{K_0}{Y_0} \tag{17}$$

Since I have data set for 10 years, it is the average of all years for this study and again the difference between PIM method estimates and initial ratio is given in Table-15 also with too low differences at percentage level.

CHAPTER V

CONCLUSION

The aim of this thesis is to analyze whether regional income per capita differences can be explained by the average total factor productivities of the firms. The existing literature on TFP estimation in Turkey is done with aggregated data or calculated with old fashioned techniques which have some problems. Also there is no study on regional income differences explained by technological dynamics of the regions.

To analyze the effect of total factor productivity in regional income per capita differences, Turkish manufacturing data at firm-level between years 2003 and 2012 is utilized. Since the data is unbalanced, firms with only one year data are extracted from the sample to be able to calculate capital stock. First, the capital stock estimation is constructed using the corresponding depreciation rates and some estimation techniques are used and results are presented in order to be able to compare.

The analysis is constructed by grouping the firms according to their regions and region specific coefficients used to calculate TFP for each. The results of the estimations indicate that regions with low average per capita income, reported in Table-17 at nuts-1 level, usually have low levels of TFP with some exceptions. Furthermore, these differences in TFP levels are mainly caused by the sectors that are abundant in the regions. Therefore, regional differences are the consequences of sectoral technology differences and the consequences are seen as differences in income per capita for regions. Table-8 and Table-9 bring the agglomeration and geography assertions in mind mentioned in the misallocation literature. Another aim of this study is to give practicable information. There are some stimulus packages conducted by Development Ministry and some regions are on top of priority. I hope, this regional and sectoral analysis can be used to form those packages.

One deficiency in this study is the lack of human capital due to unavailability of skills of workers in the data. To eliminate this lack, research and development data of firms or regional education levels can be used as a proxy for future research.

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APPENDIX

Table 1: Sectors value added for Turkey (Percentage to GDP)

Main Sectors	2012	2013
Agriculture	9	8
Industry	27	27
Services, etc.	64	65

Source: World Bank, World Development Indicators Statistics.

Table 2: Manufacturing Industry List

NACE2	Industry
10	Manufacture of food and food products
11	Beverage Industries
12	Tobacco Manufactures
13	Textile Products
14	Manufacture of Wearing Products
15	Manufacture of Leather Products
16	Manufacture of Wood and Cork Products (not furniture)
17	Manufacture of Paper Products
18	Publishing and Printing
19	Product of Petroleum and Coal
20	Manufacture of Chemicals and Chemical Products
21	Manufacture of Pharmaceuticals
22	Manufacture of Rubber and Plastics
23	Manufacture of non-metallic Minerals
24	Basic Metal Industry
25	Manufacture of Fabricated Metals (except machinery)
26	Manufacture of Computer and Optical Instrument
27	Manufacture of Electrical Machinery
28	Other Machinery Manufacturing
29	Manufacture of Transportation Equipment
30	Building, Repairing and Other Transportation Equipment
31	Manufacture of Furniture, Building and Repairing
32	Other Manufacturing Industries (not classified elsewhere)
33	Installation of Machinery and Equipment

*TURKSTAT, NACE Rev.2 Classification of Economic Activity, 2013

Table 3: Region Classifications at NUTS2 Level

Code	**Definition**
TRA1	Erzurum, Erzincan, Bayburt
TRA2	Ağrı, Kars, İğdır, Ardahan
TRB1	Malatya, Elazığ, Bingöl, Tunceli
TRB2	Van, Muş, Bitlis, Hakkari
TRC1	Gaziantep, Adıyaman, Kilis
TRC2	Şanlıurfa, Diyarbakır
TRC3	Mardin, Batman, Şırnak, Siirt
TR10	Istanbul
TR21	Tekirdağ, Edirne, Krklareli
TR22	Balıkesir, Çanakkale
TR31	Izmir
TR32	Aydın, Denizli, Muğla
TR33	Manisa, Afyon, Ktahya, Uşak
TR41	Bursa, Eskişehir, Bilecik
TR42	Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR51	Ankara
TR52	Konya, Karaman
TR61	Antalya, Isparta, Burdur
TR62	Adana, Mersin
TR63	Hatay, Kahramanmaraş, Osmaniye
TR71	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir
TR72	Kayseri, Sivas, Yozgat
TR81	Zonguldak, Karabük, Bartın
TR82	Kastamonu, Çankr, Sinop
TR83	Samsun, Tokat, Çorum, Amasya
TR90	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane

*TURKSTAT-Region Classifications

Table 4: Domestic Producer Price Index, Main Industrial Groupings

Year	Intermediate	Durable	Non-durable	Energy	Capital
2003	100.23	98.77	96.16	115.99	101.14
2004	108.99	101.3	104.74	100.28	101.64
2005	119.39	103.86	115.84	126.08	114.55
2006	122.26	105.36	117.44	146.91	117.75
2007	142.29	126.2	125.52	168.54	128.88
2008	151.84	122.66	135.47	211.16	131.61
2009	156.35	127.72	143.71	218.25	147.4
2010	164.68	127.23	152.92	245.24	146.95
2011	190.74	133.97	159.35	276.69	153.36
2012	204.14	150.58	174.07	306.28	164.72

Table 5: Domestic Producer Price Index- Sections, Divisions

Sec.	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
10	95.6	108.6	122.7	121.4	129.1	151.6	160.0	174.4	186.5	206.41
11	91.0	109.5	134,0	136.4	141.7	145.4	155.3	174.3	190.1	201.1
12	92.0	100.0	88.1	123.7	125.8	125.4	136.1	131.8	129.6	148.3
13	96.7	106.1	112.1	111.2	125.4	125.1	139.1	149.6	193.7	190.9
14	99.6	98.8	104.7	104.4	116.0	122.3	121.7	125.9	131.0	133.1
15	95.5	107.3	115.1	115.7	125.6	130.0	138.7	138.9	156.0	171.2
16	99.0	106.8	120.4	120.1	130.8	132.4	144.0	136.7	145.8	169.0
17	100.8	97.9	115.5	112,0	135.1	136.4	149.9	158.1	173.7	188.3
18	97.4	109.0	117.6	119.1	126.9	132.0	139.8	151.8	147.2	155.3
19	127.7	100.4	143.9	174.6	190.9	265.4	194.6	279.4	376.3	467.8
20	105.3	100.2	116.4	113.7	127.3	140.2	147.8	153.9	170.8	192.2
21	96.1	96.3	97.2	83.6	91.2	84.3	85.8	78.3	77.7	69.6
22	99.6	103.5	116.5	119.7	136.1	139.1	153.7	153.3	167.1	184.2
23	95.4	111.8	135.1	142.9	158.4	163.4	172.5	177.2	189.7	198.3
24	106.0	128.3	137.2	142.3	188.44	220.8	182.5	212.6	263.9	288.5
25	100.7	103.2	118.7	128.7	148.1	162.9	179.5	174.0	182.6	191.0
26	104.1	88.5	94.5	90.3	95.8	82.7	99.4	91.4	91.1	99.2
27	101.4	103.4	111.6	121.2	145.6	147.2	155.0	153.6	163.8	180.2
28	98.3	104.9	121.0	124.6	139.1	138.5	163.3	162.4	169.4	181.1
29	99.2	103.5	107.3	103.9	114.7	113.9	115.1	121.0	123.2	137.9
30	96.2	92.6	105.6	96.7	97.5	89.2	97.6	94.5	85.9	94.1
31	97.6	105.8	108.8	113.7	148.1	151.7	154.5	157.7	173.5	209.4
32	99.7	102.3	99.3	99.5	107.3	95.7	107.6	114.5	114.6	119.4

*TURKSTAT Inflation and Price Statistics (2003=100)

Table 6: Summary Statistics by Year

Years	#enterprise	#employed	Prod. Val.	Val. added	TFP
2003	234 633	2 172 190	223 117 694 181	56 022 507 491	2.8
2004	279 031	2 392 614	283 427 869 350	66 395 727 978	3.0
2005	300 083	2 568 013	309 593 984 732	59 657 357 712	2.6
2006	307 033	2 667 080	376 647 445 854	74 319 012 023	2.8
2007	313 467	2 761 349	411 944 201 017	78 444 846 566	2.3
2008	318 176	2 841 298	473 916 657 107	93 156 425 846	3.2
2009	320 815	2 584 773	420 380 698 940	84 735 484 301	3.1
2010	299 928	2 852 352	524 468 955 103	99 228 887 745	3.2
2011	333 288	3 151 019	696 363 747 424	128 950 258 765	3.3
2012	336 893	3 423 468	750 397 994 743	132 597 776 199	3.2

*TURKSTAT and own calculations

Table 7: Summary Statistics by Sectors

Sector	Mean Prod. Val.	Mean Val. Added	Obs.
10	60684.371	12482.618	19626
11	52906.543	10966.128	6132
12	108184.64	22234.449	5098
13	366773.41	32435.943	3527
14	242185.81	45012.73	4170
15	164399.92	41673.668	5604
16	111565.61	26648.119	4906
17	112241.88	30540.23	9093
18	559338.13	76049.031	4400
19	126717.59	25944.391	3246
20	71731.07	15925.865	8659
21	133978.72	28934.262	2405
22	252807.75	53547.605	2152
23	192634.22	37544.145	3311
24	73819.977	19865.148	5985
25	69212.43	18073.363	4259
26	354251.72	65783.5	4152
27	349165.25	65211.551	1145
28	102253.7	33177.664	2235
29	47634.867	11198.938	4847
30	53518.242	13311.24	1324
31	79195.031	12168.104	3224
32	28529.389	11635.842	2364
33	29797.379	11237.412	507
TOTAL	**3905765.819**	**750408.809**	**141809**

Table 8: Number of Enterprises in Each Region and Average TFP levels

Nuts	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**TFP**
TR10	4235	335	62	8957	22774	2865	531	2639	1763	176	2832	768	4.35
TR21	730	80	0	716	313	229	51	77	50	14	125	10	2.61
TR22	717	56	0	59	47	45	117	31	22	0	54	0	2.97
TR31	2024	144	123	724	3320	532	247	426	222	165	636	52	3.47
TR32	692	125	0	2063	1101	38	76	137	57	17	98	19	2.45
TR33	1053	48	0	1064	172	208	142	52	84	45	159	10	4.36
TR41	1045	118	0	4429	1352	104	314	186	150	10	233	3	3.13
TR42	979	94	0	455	453	61	573	132	68	110	475	68	4.78
TR51	1335	117	0	172	840	96	186	156	401	33	329	106	6.22
TR52	1222	9	0	55	184	183	59	153	85	21	135	10	2.80
TR61	703	38	0	169	140	20	207	33	57	8	270	10	2.83
TR62	839	30	16	522	392	56	142	164	48	40	217	42	3.15
TR63	384	14	0	876	123	15	51	63	52	36	25	16	3.67
TR71	293	35	0	60	111	48	22	5	41	3	67	0	3.03
TR72	544	11	0	337	223	37	113	101	46	18	87	0	3.52
TR81	235	28	0	18	296	41	91	19	21	13	34	0	4.82
TR82	204	0	0	33	119	12	99	2	40	3	27	2	2.00
TR83	907	26	0	76	349	71	74	98	34	10	69	17	2.45
TR90	1265	57	0	15	203	22	71	18	42	0	56	0	3.05
TRA1	223	10	0	9	11	0	15	3	29	0	10	0	5.05
TRA2	137	2	0	9	4	0	5	3	50	0	12	0	2.02
TRB1	463	17	0	152	111	17	7	68	34	11	55	0	1.64
TRB2	216	0	0	16	4	0	3	14	49	9	26	0	1.40
TRC1	660	24	0	1933	343	203	16	143	14	30	96	15	3.02
TRC2	240	14	0	362	38	8	2	6	13	18	21	6	2.01
TRC3	106	0	0	27	17	3	3	16	26	12	40	0	4.37
TFP	2.30	6.05	6.16	1.87	1.93	1.80	3.08	2.77	2.58	5.36	3.98	7.67	2.95

Note: TFP levels are the results of Levinsohn-Petrin estimation of production function where dependent variable is value added.

Table 9: Number of Enterprises in Each Region and Average TFP levels

Nuts	22	23	24	25	26	27	28	29	30	31	32	33	TFP
TR10	5292	2946	2476	6630	1135	3658	5789	2097	1356	2767	2702	2215	4.35
TR21	233	227	96	173	17	97	188	94	0	57	28	17	2.61
TR22	101	220	67	142	0	55	171	34	42	74	11	40	2.97
TR31	1169	766	444	1398	221	456	1611	685	128	683	496	78	3.47
TR32	169	997	252	241	0	136	331	103	97	154	24	35	2.45
TR33	290	1678	72	426	101	118	387	116	26	103	33	8	4.36
TR41	1171	874	348	1590	112	375	1311	1722	92	1269	74	50	3.13
TR42	1018	637	762	1916	67	559	913	904	285	370	62	305	4.78
TR51	567	1007	616	1977	307	599	1559	303	104	896	281	82	6.22
TR52	411	394	447	795	24	109	1094	617	16	124	35	14	2.80
TR61	190	808	6	293	16	75	180	22	93	166	50	41	2.83
TR62	338	318	110	587	17	80	433	171	8	218	46	67	3.15
TR63	121	186	322	374	2	6	218	87	6	68	24	26	3.67
TR71	109	339	46	118	4	25	132	109	28	117	43	45	3.03
TR72	319	469	153	606	24	367	257	84	19	1039	59	9	3.52
TR81	116	274	252	143	0	37	111	38	146	70	3	69	4.82
TR82	51	252	16	33	23	9	29	5	8	32	23	6	2.00
TR83	152	876	173	126	7	118	275	137	2	240	80	7	2.45
TR90	176	330	25	121	0	31	94	34	46	95	19	59	3.05
TRA1	56	138	0	43	0	46	2	17	0	17	9	6	5.05
TRA2	11	63	6	5	0	1	6	0	0	8	1	19	2.02
TRB1	133	322	61	75	2	98	90	13	0	84	16	5	1.64
TRB2	45	140	0	27	0	7	8	11	2	13	7	6	1.40
TRC1	232	193	48	168	6	42	164	57	9	94	18	15	3.02
TRC2	37	373	17	29	0	59	39	12	0	15	6	0	2.01
TRC3	40	146	7	42	0	7	10	4	7	9	3	3	4.37
TFP	2.85	2.70	2.95	2.26	7.51	3.44	2.65	3.98	6.27	1.78	2.86	4.69	2.95

Note: TFP levels are the results of Levinsohn-Petrin estimation of production function where dependent variable is value added.

Table 10: OLS Estimates of Production Function for Each Regions, Dependent Variable: Value Added

Regions	Labor***	SE	Capital***	SE	sum	N
TR10	1.021	0.003	0.074	0.001	1.095	85564
TR21	0.983	0.012	0.077	0.005	1.060	3544
TR22	1.018	0.019	0.072	0.007	1.090	2068
TR31	0.984	0.007	0.096	0.002	1.080	16667
TR32	1.029	0.010	0.048	0.003	1.077	6888
TR33	0.985	0.011	0.098	0.004	1.083	6305
TR41	1.010	0.006	0.078	0.002	1.088	16890
TR42	1.025	0.008	0.120	0.003	1.145	11164
TR51	1.014	0.008	0.073	0.003	1.087	11960
TR52	1.036	0.010	0.067	0.004	1.103	6144
TR61	0.943	0.015	0.084	0.006	1.027	3532
TR62	0.968	0.011	0.106	0.004	1.074	4875
TR63	0.975	0.014	0.090	0.005	1.065	3038
TR71	0.988	0.017	0.073	0.007	1.061	1764
TR72	1.012	0.012	0.083	0.004	1.095	4859
TR81	0.973	0.013	0.083	0.006	1.056	2034
TR82	0.881	0.022	0.084	0.010	0.965	1011
TR83	0.954	0.013	0.095	0.005	1.049	3903
TR90	0.935	0.016	0.106	0.006	1.041	2716
TRA1	1.037	0.035	0.078	0.014	1.115	628
TRA2	0.913	0.043	0.109	0.016	1.022	315
TRB1	0.933	0.014	0.067	0.006	1.000	1800
TRB2	0.992	0.036	0.074	0.017	1.066	580
TRC1	0.952	0.012	0.083	0.005	1.035	4448
TRC2	0.933	0.025	0.054	0.008	0.987	1283
TRC3	0.959	0.041	0.142	0.019	1.101	445

Note: Statistical significance indicated with ** and * at the 5 and 1 % levels, resp.. SE stands for standard errors and sum is the total effect of capital and labor. *** indicates that all the coefficients for that variable are significant at 5 % level.

Table 11: FE Estimates of Production Function for Each Regions, Dependent Variable: Value Added

Regions	Labor***	SE	Capital	SE	sum	N
TR10	0.775	0.005	0.167	0.006**	0.942	86649
TR21	0.797	0.022	0.190	0.032**	0.987	3581
TR22	0.534	0.030	0.254	0.044**	0.788	2091
TR31	0.666	0.010	0.181	0.012**	0.847	16736
TR32	0.732	0.019	0.141	0.022**	0.873	6932
TR33	0.760	0.018	0.155	0.020**	0.915	6340
TR41	0.686	0.010	0.170	0.011**	0.856	17002
TR42	0.800	0.012	0.178	0.013**	0.978	11265
TR51	0.698	0.013	0.144	0.016**	0.842	12099
TR52	0.666	0.015	0.188	0.017**	0.854	6196
TR61	0.660	0.025	0.251	0.031**	0.911	3563
TR62	0.761	0.018	0.164	0.020**	0.925	4919
TR63	0.679	0.023	0.231	0.031**	0.910	3070
TR71	0.814	0.031	0.204	0.036**	1.018	1806
TR72	0.606	0.018	0.260	0.025**	0.866	4929
TR81	0.788	0.027	0.169	0.029**	0.957	2059
TR82	0.592	0.033	0.346	0.060**	0.938	1033
TR83	0.838	0.022	0.189	0.026**	1.027	3932
TR90	0.779	0.028	0.147	0.029**	0.926	2734
TRA1	0.784	0.067	0.215	0.068**	0.999	645
TRA2	0.548	0.067	0.175	0.107	0.723	345
TRB1	0.707	0.023	0.147	0.024**	0.854	1839
TRB2	0.646	0.052	0.093	0.053	0.739	602
TRC1	0.590	0.019	0.194	0.022**	0.784	4506
TRC2	0.727	0.040	0.068	0.035	0.795	1312
TRC3	0.540	0.074	0.219	0.083**	0.759	505

Note: Statistical significance indicated with ** and * at the 5 and 1 % levels, resp.. SE stands for standard errors and sum is the total effect of capital and labor. *** indicates that all the coefficients for that variable are significant at 5 % level.

Table 12: OP Estimates of Production Function for Each Regions, Dependent Variable: Value Added

Regions	Labor***	SE	Capital	SE	sum	N
TR10	0.875	0.012	0.140**	0.026	0.875	68294
TR21	0.903	0.024	0.155	0.090	1.058	2923
TR22	0.718	0.065	0.306	0.158	1.024	1448
TR31	0.855	0.022	0.138**	0.035	0.855	13270
TR32	0.943	0.021	0.032	0.113	0.975	5321
TR33	0.913	0.029	0.138	0.077	1.051	4646
TR41	0.881	0.022	0.149*	0.072	0.881	13219
TR42	0.902	0.015	0.141**	0.054	0.902	9026
TR51	0.908	0.023	0.076	0.088	0.984	9215
TR52	0.896	0.027	-0.005	0.084	0.891	5110
TR61	0.862	0.035	0.162	0.084	1.024	2916
TR62	0.808	0.049	0.273*	0.125	0.808	3565
TR63	0.912	0.030	0.196	0.112	1.108	2271
TR71	0.898	0.031	0.200	0.141	1.098	1287
TR72	0.877	0.031	0.120	0.085	0.997	4090
TR81	0.858	0.021	0.186	0.113	1.044	1652
TR82	0.764	0.049	0.130	0.200	0.894	583
TR83	0.909	0.020	0.103	0.098	1.012	3037
TR90	0.893	0.034	0.107	0.104	1.000	2083
TRA1	0.840	0.043	0.120	0.141	0.960	444
TRA2	0.684	0.081	0.113	0.290	0.797	210
TRB1	0.885	0.031	0.043	0.046	0.928	1422
TRB2	0.693	0.117	-0.073	0.105	0.620	405
TRC1	0.838	0.027	0.060	0.072	0.898	3356
TRC2	0.938	0.046	-0.020	0.098	0.918	773
TRC3	0.586	0.108	0.050	0.305	0.636	251

Note: Statistical significance indicated with ** and * at the 5 and 1 % levels, resp.. SE stands for standard errors and sum is the total effect of capital and labor. *** indicates that all the coefficients for that variable are significant at 5 % level.

Table 13: LP Estimates of Production Function for Each Regions, Dependent Variable: Value Added

Regions	Labor***	SE	Capital	SE	sum	N
TR10	0.851	0.012	0.271	0.010**	1.122	83019
TR21	0.843	0.027	0.319	0.077**	1.162	3453
TR22	0.737	0.055	0.261	0.132*	0.998	2013
TR31	0.838	0.017	0.251	0.029**	1.089	16172
TR32	0.912	0.029	0.259	0.047**	1.171	6667
TR33	0.869	0.034	0.318	0.070**	1.187	6181
TR41	0.885	0.023	0.224	0.035**	1.109	16386
TR42	0.872	0.018	0.310	0.030**	1.182	10662
TR51	0.887	0.019	0.238	0.039**	1.125	11651
TR52	0.865	0.025	0.276	0.033**	1.141	6062
TR61	0.853	0.030	0.310	0.065**	1.163	3423
TR62	0.791	0.044	0.266	0.034**	1.057	4806
TR63	0.846	0.032	0.214	0.065**	1.060	2976
TR71	0.852	0.032	0.339	0.108**	1.191	1710
TR72	0.835	0.035	0.268	0.063**	1.103	4763
TR81	0.880	0.027	0.210	0.101*	1.090	1849
TR82	0.745	0.055	0.040	0.174	0.785	984
TR83	0.890	0.022	0.290	0.084**	1.180	3854
TR90	0.848	0.031	0.253	0.062**	1.101	2559
TRA1	0.826	0.060	0.018	0.111	0.844	627
TRA2	0.603	0.054	0.245	0.136	0.848	335
TRB1	0.759	0.033	0.175	0.085*	0.934	1811
TRB2	0.673	0.080	0.357	0.177*	1.030	561
TRC1	0.771	0.028	0.301	0.048**	1.072	4380
TRC2	0.835	0.037	0.105	0.058	0.940	1233
TRC3	0.581	0.088	0.435	0.288	1.016	434

Note: Statistical significance indicated with ** and * at the 5 and 1 % levels, resp.. SE stands for standard errors and sum is the total effect of capital and labor. *** indicates that all the coefficients for that variable are significant at 5 % level.

Table 14: Classification of Manufacturing Industries According to Technology Intensity

High technology industries	NACE-2 Code
Aircraft and spacecraft	28
Pharmaceuticals	21
Office, accounting and computing machinery	28
Radio, TV and communications equipment	28
Medical, precision and optical instruments	26
Medium-high technology industries	
Electrical machinery and apparatus, n.e.c.	27
Motor vehicles, trailers and semitrailers	29
Chemicals excluding pharmaceuticals	20
Railroad equipment and transport equipment, n.e.c.	30
Machinery and equipment, n.e.c	33
Medium-low technology industries	
Building and repairing of ships and boats	31
Rubber and plastics products	22
Coke, refined petroleum products and nuclear fuel	19
Other non-metallic mineral products	23
Basic metals and fabricated metal products	24
Low-technology industries	
Manufacturing, n.e.c.; Recycling	32
Wood, pulp, paper, paper products, printing and publishing	16,17,18
Food products, beverages and tobacco	10,11,12
Textiles, textile products, leather and footwear	13,14,15

Source: OECD Science, Technology and Industry Scoreboard 2011

Table 15: Robustness Check for Capital

Nuts	Estimated-Initial	Estimated-Depreciation
TR10	1.42	3.09
TR21	-1.69	1.75
TR22	-2.39	1.22
TR31	-1.87	1.48
TR32	-0.22	2.54
TR33	-2.43	1.87
TR41	-6.18	2.44
TR42	-2.48	1.40
TR51	-2.66	2.26
TR52	-2.34	1.09
TR61	-1.78	0.91
TR62	1.41	1.14
TR63	-2.52	1.09
TR71	-3.19	1.29
TR72	-3.11	1.90
TR81	-1.40	1.18
TR82	1.60	0.94
TR83	-2.20	0.90
TR90	-0.63	0.65
TRA1	-0.10	0.28
TRA2	-4.76	2.51
TRB1	-1.09	0.53
TRB2	0.78	0.22
TRC1	-1.03	1.13
TRC2	-0.14	1.46
TRC3	0.57	0.29
Total	**-0.79**	**2.24**

*Own calculations using estimated capital initial-output ratio, average capital-output ratio and average depreciation-output ratio.

Table 16: T-test for CRTS

Regions	Coeff.	Std. Err.	z	$P > \|z\|$	[95% Conf.	Interval]
TR10	1.12	0.01	81.22	0.00	1.10	1.15
TR21	1.16	0.07	17.50	0.00	1.03	1.29
TR22	1.00	0.13	7.50	0.00	0.74	1.26
TR31	1.09	0.03	32.13	0.00	1.02	1.16
TR32	1.17	0.05	23.02	0.00	1.07	1.27
TR33	1.19	0.07	16.69	0.00	1.05	1.33
TR41	1.11	0.03	33.46	0.00	1.05	1.18
TR42	1.18	0.03	39.07	0.00	1.12	1.24
TR51	1.13	0.05	22.70	0.00	1.03	1.22
TR52	1.14	0.05	24.10	0.00	1.05	1.23
TR61	1.16	0.07	15.67	0.00	1.02	1.31
TR62	1.06	0.04	25.26	0.00	0.97	1.14
TR63	1.06	0.08	12.72	0.00	0.90	1.22
TR71	1.19	0.10	12.35	0.00	1.00	1.38
TR72	1.10	0.08	13.37	0.00	0.94	1.27
TR81	1.09	0.12	9.39	0.00	0.86	1.32
TR82	0.79	0.17	4.52	0.00	0.44	1.13
TR83	1.17	0.10	11.52	0.00	0.98	1.37
TR90	1.10	0.07	16.41	0.00	0.97	1.23
TRA1	0.84	0.14	6.01	0.00	0.57	1.12
TRA2	0.85	0.14	6.25	0.00	0.58	1.11
TRB1	0.98	0.09	11.31	0.00	0.81	1.15
TRB2	1.03	0.12	8.76	0.00	0.80	1.26
TRC1	1.07	0.06	18.85	0.00	0.96	1.18
TRC2	0.94	0.07	13.52	0.00	0.80	1.08
TRC3	1.02	0.29	3.55	0.00	0.45	1.58

Table 17: Regional Household Average and Median Disposable Income (Yearly)

Regions	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
TR	15 102	18 827	19 328	21 293	22 063	24 343	26 577	29 479
	11 387	14 493	14 810	16 200	17 190	18 749	20 618	22 650
TR1	19 883	25 484	26 458	28 520	29 972	32 622	35 045	39 412
	15 430	20 008	20 834	22 779	23 428	25 380	26 440	29 577
TR2	13 121	14 904	16 165	17 811	18 856	20 769	22 928	25 507
	10 664	12 318	13 530	13 973	14 904	15 961	17 938	20 344
TR3	15 894	18 301	18 881	21 260	22 467	26 190	27 749	29 936
	11 795	14 573	14 489	16 362	17 236	19 416	21 196	23 063
TR4	17 004	22 255	21 262	23 760	22 080	23 440	27 365	29 944
	12 890	16 518	17 434	18 484	18 105	19 224	22 272	24 650
TR5	17 866	21 252	22 318	25 345	24 374	27 020	29 973	34 506
	13 202	16 657	16 800	19 023	19 322	21 454	24 065	26 153
TR6	11 876	15 020	15 325	17 613	20 023	21 961	23 340	25 293
	8 970	11 093	11 820	13 212	14 969	16 215	17 112	18 252
TR7	13 527	16 034	15 894	18 997	19 256	21 699	24 491	25 366
	10 710	13 146	12 978	13 779	15 209	17 326	19 891	20 855
TR8	12 038	16 360	16 203	17 630	17 942	20 071	22 866	25 124
	9 769	13 152	12 524	13 788	14 764	16 433	19 123	20 879
TR9	14 479	17 311	18 387	19 441	19 061	20 399	22 221	25 298
	11 467	13 797	14 323	15 116	15 721	16 800	18 708	21 200
TRA	11 237	16 451	17 007	16 181	17 398	19 326	20 257	23 606
	9 203	12 980	12 048	12 403	13 608	14 844	15 532	17 673
TRB	11 079	14 932	15 839	16 226	18 193	19 030	19 928	21 941
	8 555	11 342	12 120	12 084	13 862	14 498	15 868	17 603
TRC	8 225	11 119	12 606	13 495	15 026	15 767	17 346	20 403
	6 297	8 565	9 269	9 836	11 509	12 131	13 904	15 831

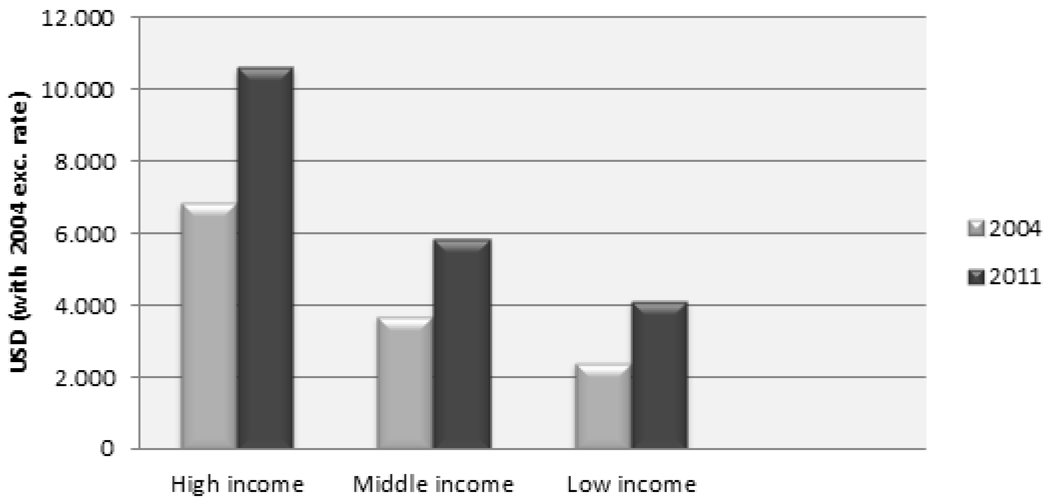

Figure 1: Per Capita Gross Value Added of Regions to Turkish Economy

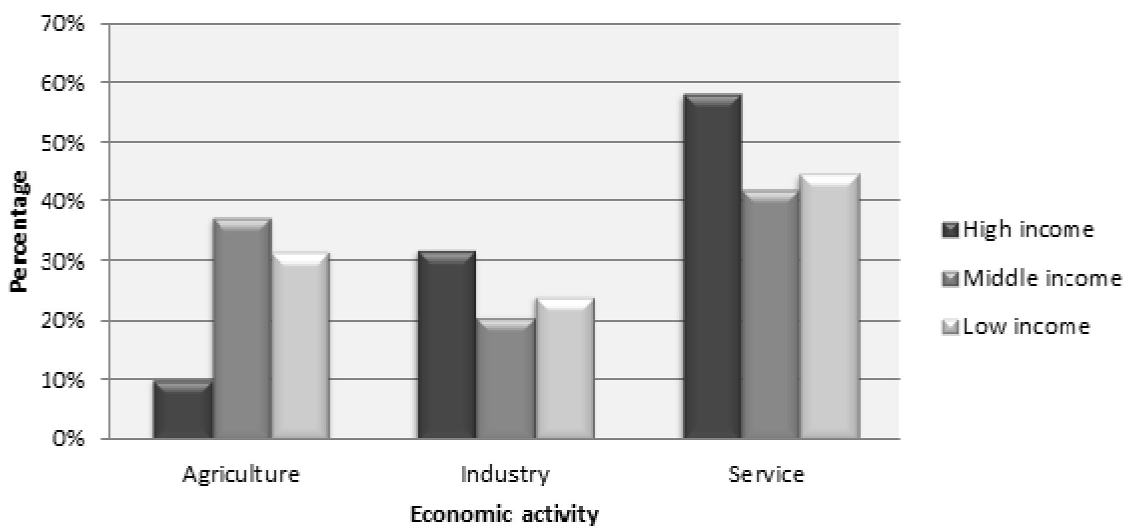

Figure 2: Distribution of Employed People by Economic Activity

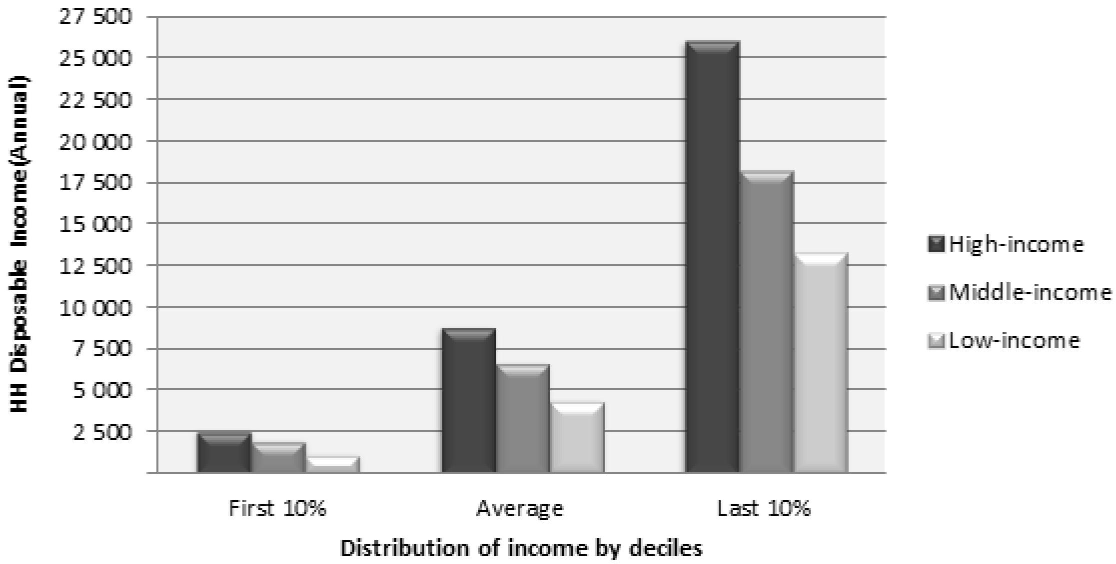

Figure 3: Distribution of Income by Deciles

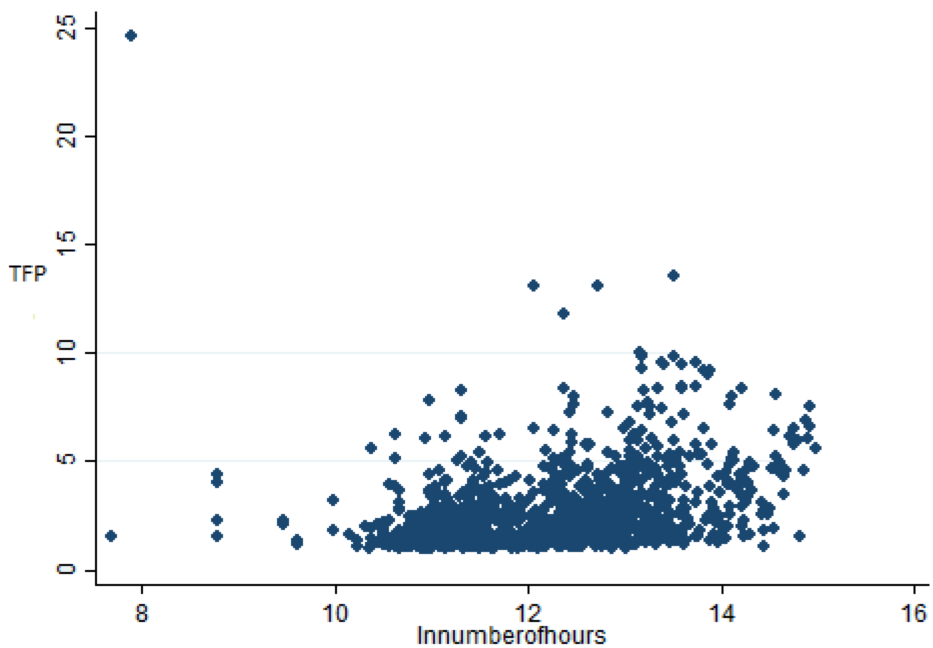

Figure 4: TR41-Manufacture of Transportation Equipment

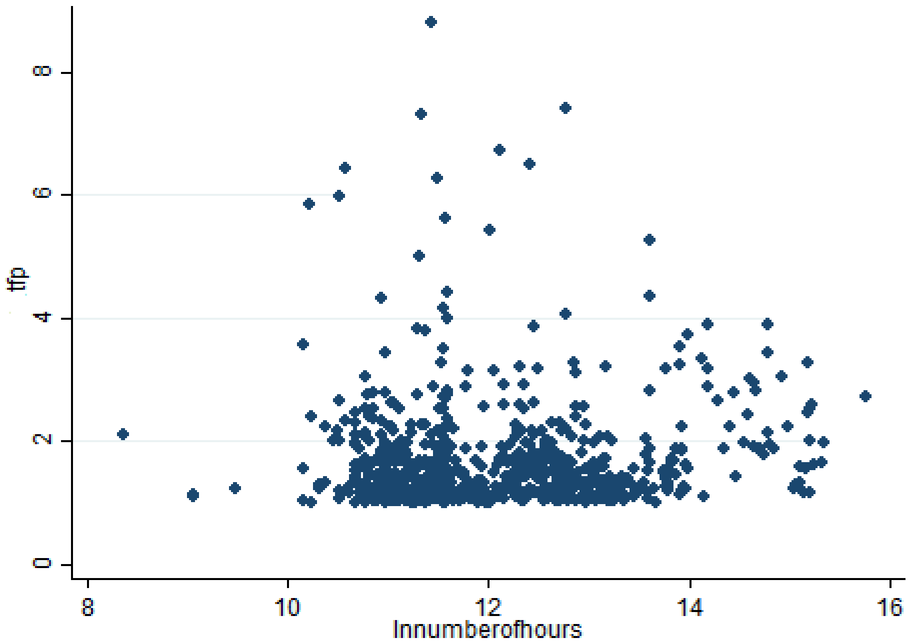

Figure 5: TR32- Textile Products

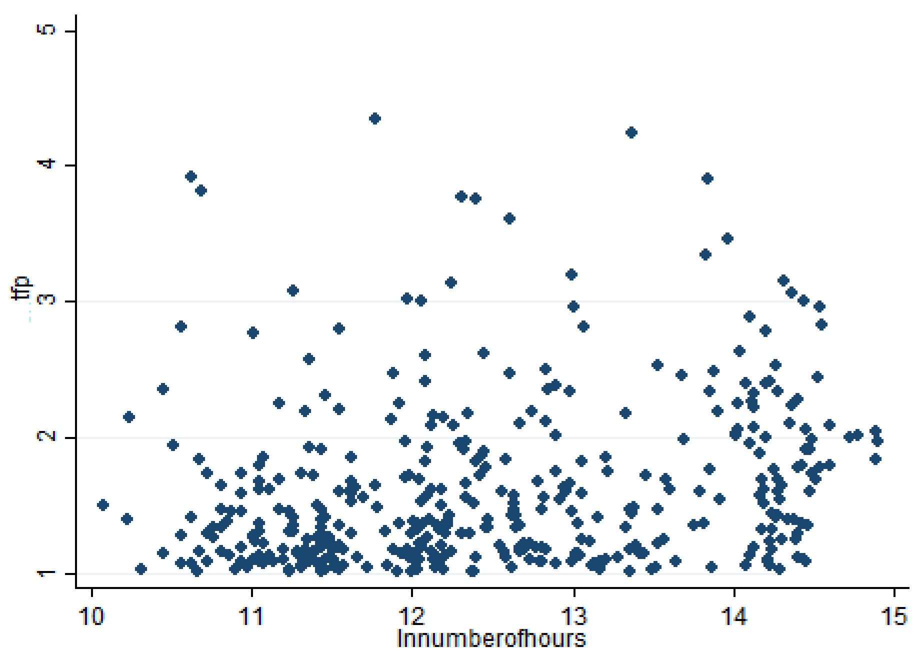

Figure 6: TR32- Manufacture of Wearing Products

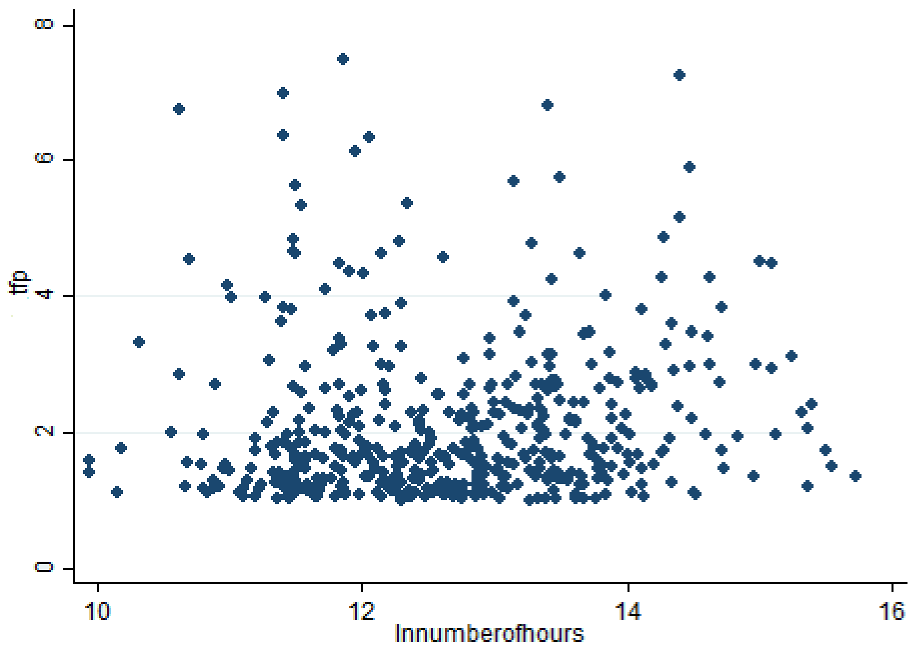

Figure 7: TR63- Textile Products

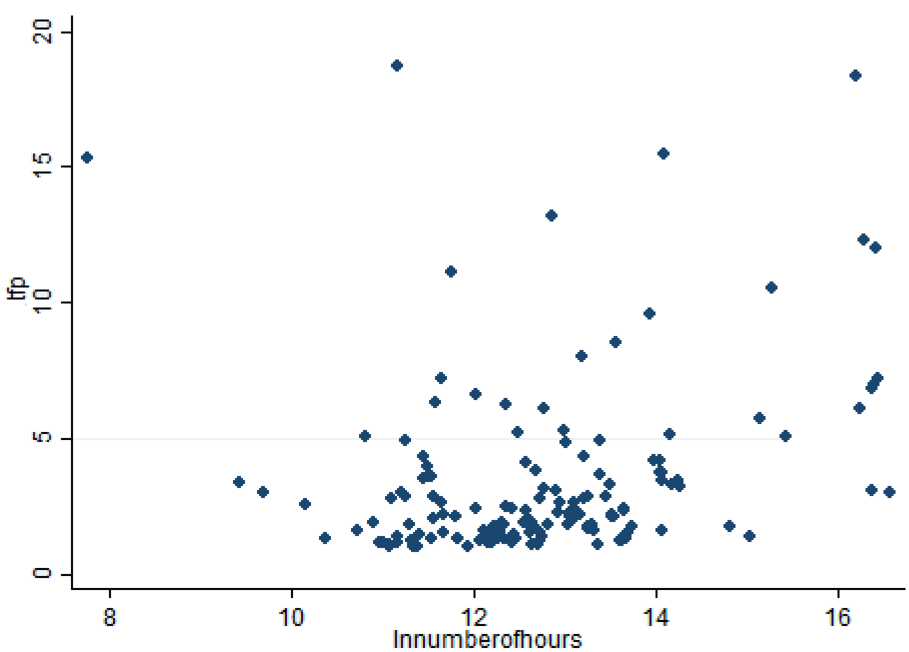

Figure 8: TR63- Basic Metal Industry

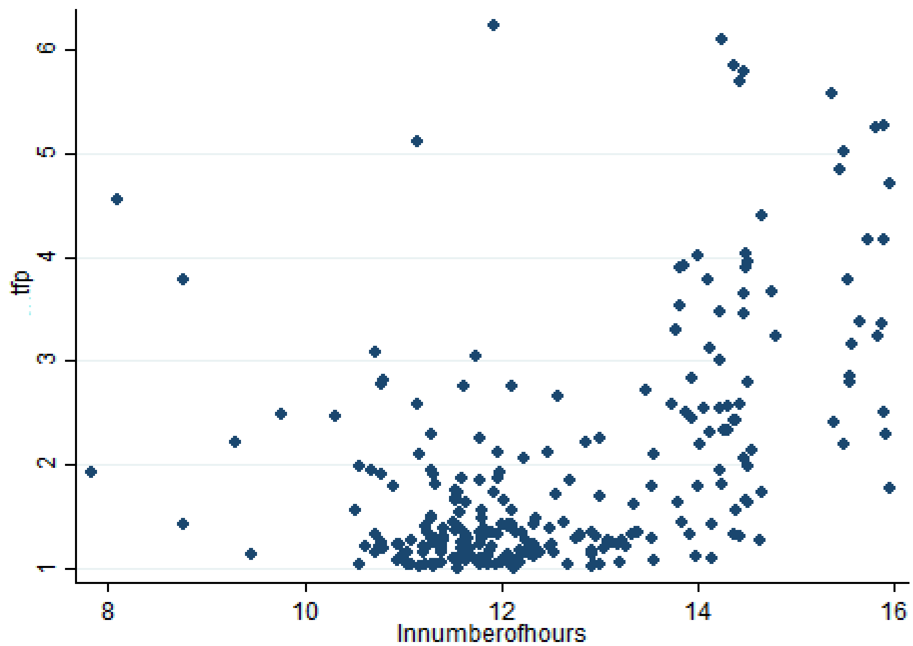

Figure 9: TR72- Manufacture of Furniture, Building and Repairing

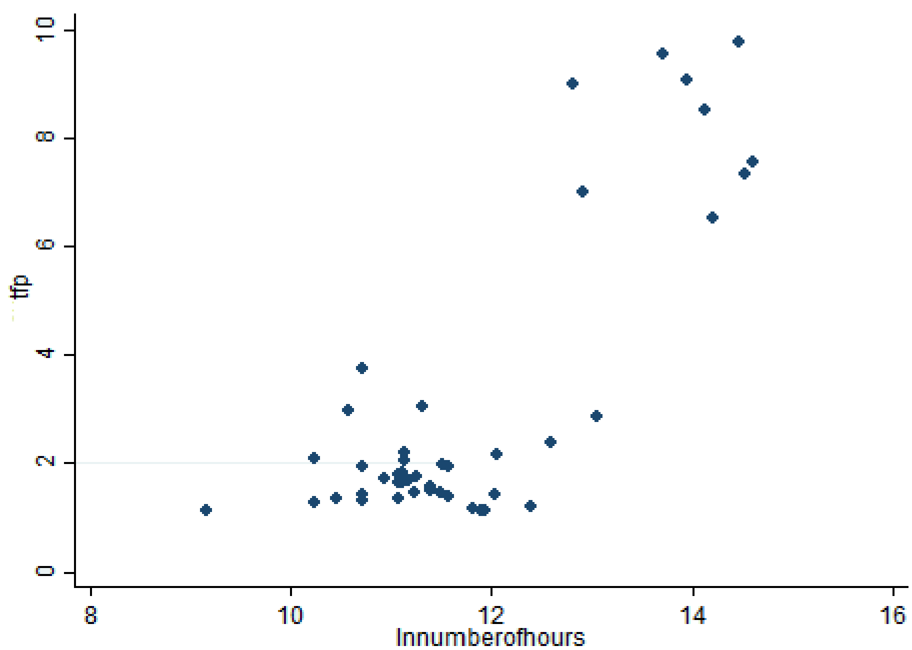

Figure 10: TRA1- Manufacture of non-metallic Minerals

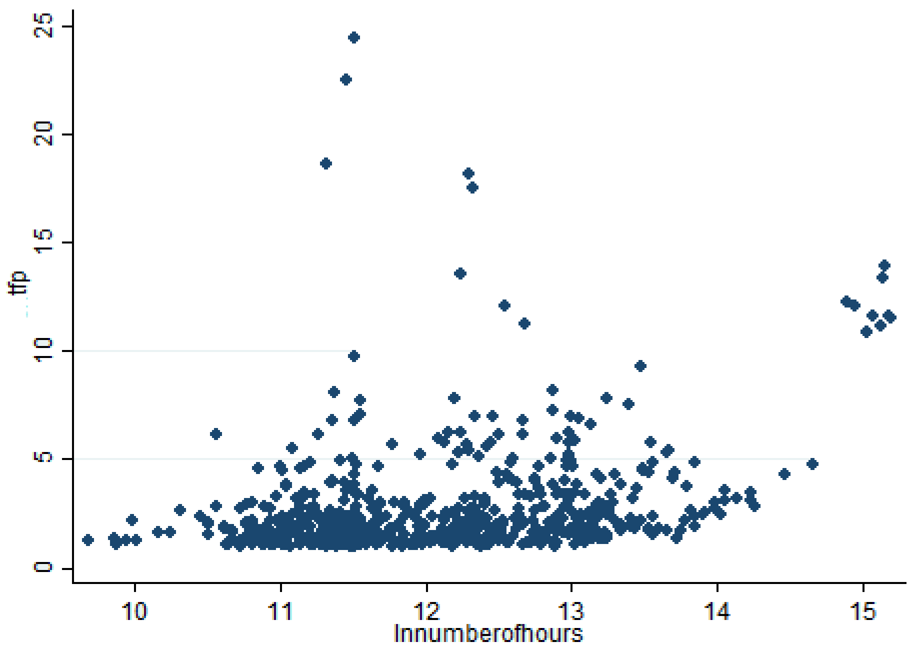

Figure 11: TR42- Manufacture of Rubber and Plastics

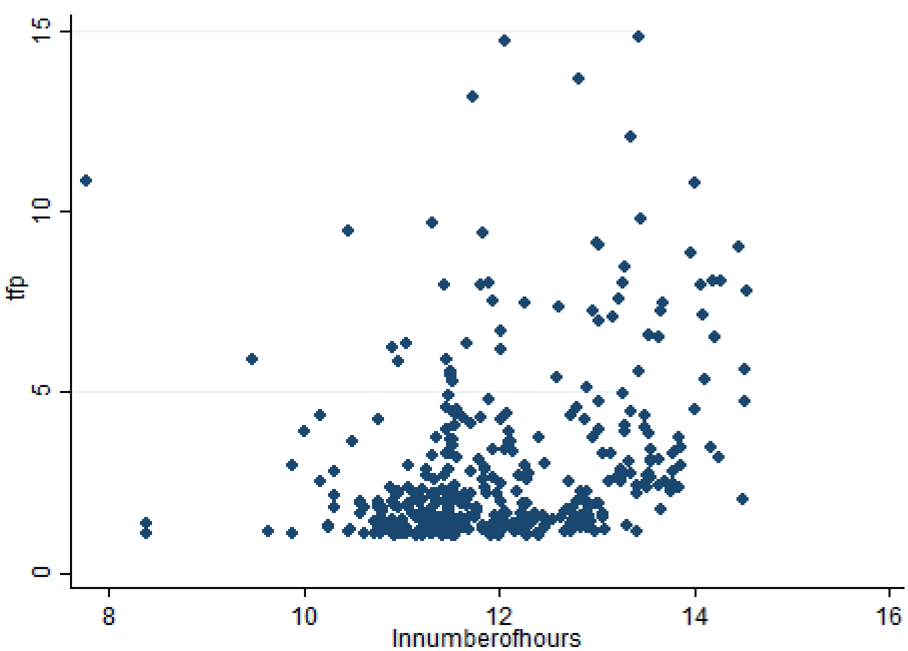

Figure 12: TR42- Basic Metal Industry

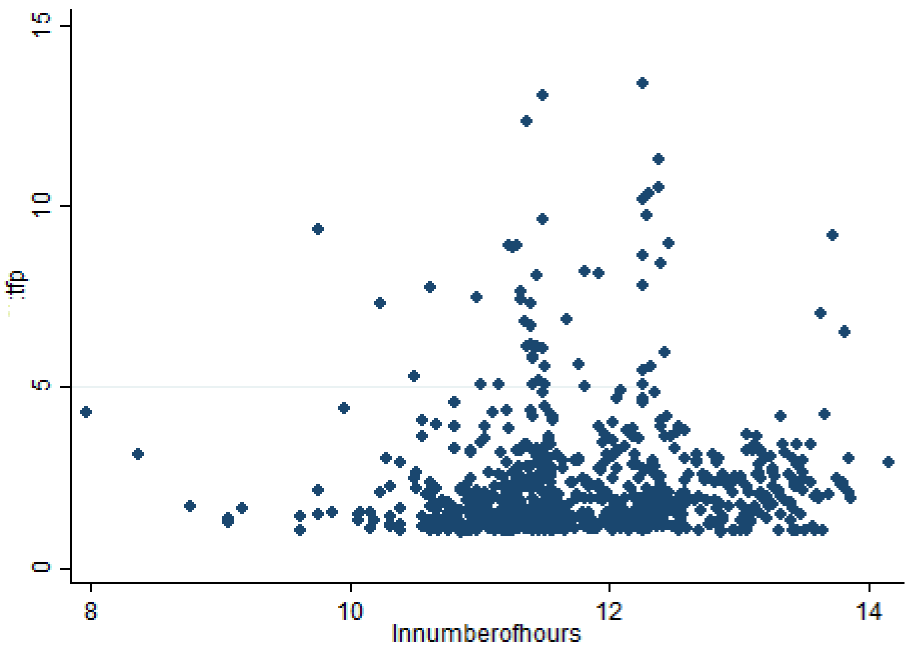

Figure 13: TR42- Manufacture of Fabricated Metals (except machinery)

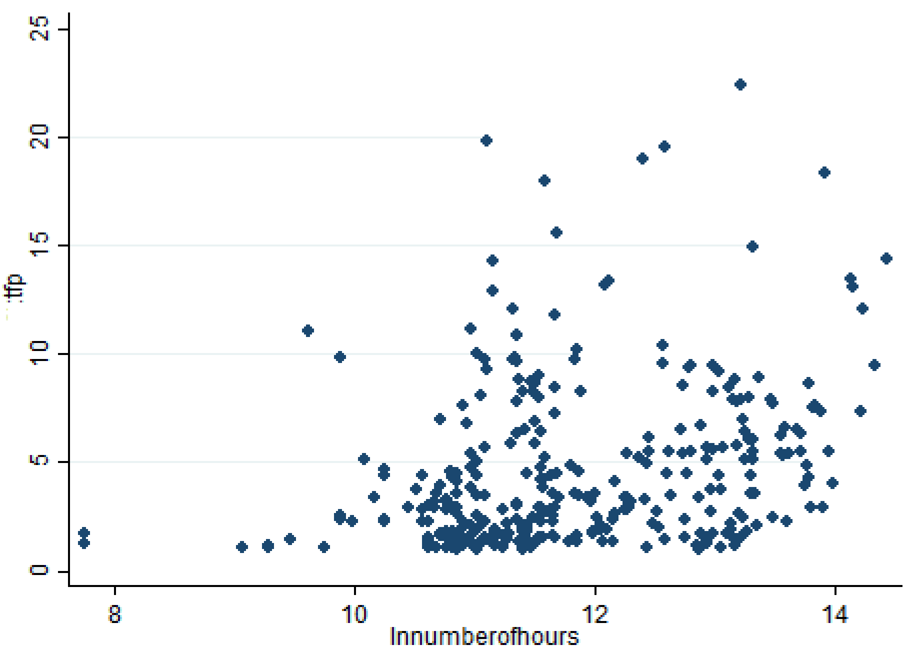

Figure 14: TR42- Manufacture of Chemicals and Chemical Products

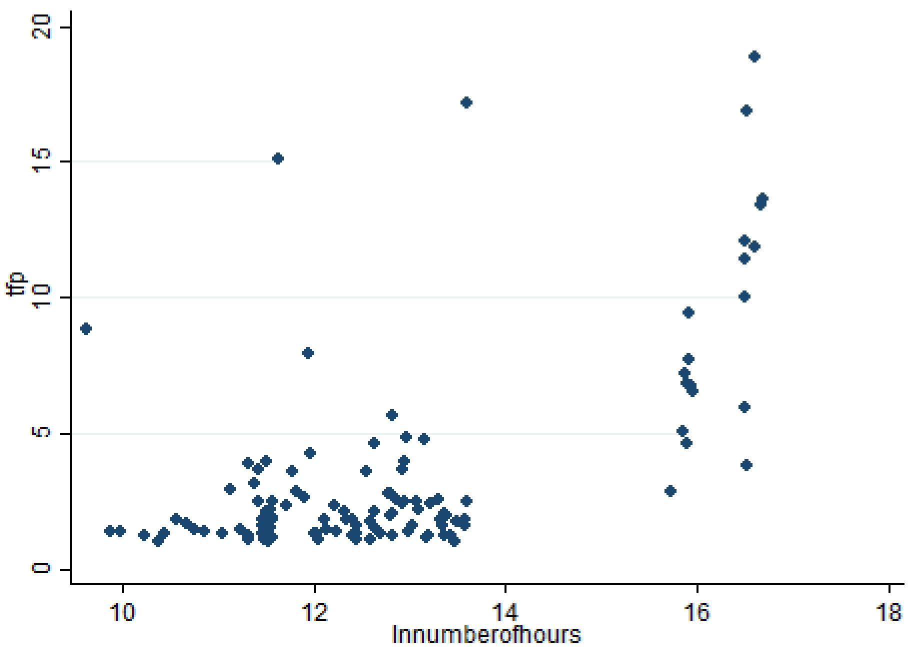

Figure 15: TR81- Basic Metal Industry