

**THE SIGNIFICANCE OF STRUCTURAL CHANGE TO
PRODUCTIVITY GROWTH: THE CASE OF TURKEY**

PHD THESIS

Maya WAFEK MOALLA

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Prof. Dr. İsmail TUNCER**

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OCAK - 2021**

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ÖZET

Türkiye ekonomisinde ve özellikle Türk imalat sanayinde firma ve sektör düzeyinde emek verimliliğinin gelişimi irdelenmeye çalışılmıştır. Bu amaçla Türkiye İstatistik Kurumu (TÜİK) tarafından ve NACE Rev.2'ye göre sınıflandırılmış olan dört haneli yıllık sanayi ve hizmet verileri kullanılmıştır. 2010-2015 döneminin ele alındığı çalışmada firmalar üç gruba ayrılmıştır. Birinci grupta ilk ve son dönemde varlığını devam ettiren firmalar (C), sadece başlangıç (2011) döneminde olan (sonra kapanan) firmalar (X) ve başlangıç döneminde olmayan daha sonra kurulan yani 2015 yılında var olan firmalar (N). 2011-2015 döneminde bu üç grubu oluşturan ve analize dahil edilen toplam firma sayısı 65719'dur. Dönem boyunca varlığını devam ettiren (C) firma sayısı 18 528'dir. Sadece 2011 yılında faaliyet gösteren (X) firma sayısı 21 451'dir. Sadece 2015 yılında faaliyet gösteren (N) firma sayısı 25 740'tır. Çalışmada geleneksel pay kayması yöntemlerine ek olarak, evrimci iktisat yaklaşımının önerdiği ve "Price Equation" olarak anılan yöntem tekli ve çoklu düzeyde uygulanmıştır. "Price Equation" tekli düzeyde uygulandığında emek verimliliği büyümesinin kaynakları: firma/sektör-içi etki, yenilik etkisi ve çıkış etkisi olarak görünmektedir. Bununla birlikte, çoklu düzey olarak yöntem uygulandığında ise, toplam emek verimliliği büyümesinin kaynakları: endüstri-seçim etkisi, yenilik etkisi ve çıkış etkilerinden geldiği görülmektedir. Tüm dönemi daha kısa alt dönemlere ayırıp sonuçları toplama yoluna gidildiğinde, seçim (selection) eğiliminin daha güçlü olduğu görülmüştür. Kısa dönemde, yönetim becerilerinin ve üretkenliği artıran bilgi ve beceri birikiminin (know-how) arttırılması, firmaların emek verimliliklerine katkı sağlayabilir. Uzun dönemde ise, iş yapma ortamının kapsamlı bir şekilde iyileştirilmesi, mevcut düzenlemelerin daha rasyonel hale getirilmesi ve Ar-Ge faaliyetlerine yapılan harcamaların artırılması gibi yenilikleri teşvik eden stratejilerin verimlilik artışlarına katkı vereceği anlaşılmaktadır.

Anahtar Kelimeler: Price denklemi, Evrimci iktisat, Emek üretkenliği artışı, Yapısal değişim, Firma heterojenliği.

Danışman: Prof. Dr. İsmail TUNCER, İktisat Anabilim Dalı, Mersin Üniversitesi, Mersin.

ABSTRACT

In our thesis, we tried to examine the relationship between the micro and macro labor productivity evolution in the Turkish economy and especially in the Turkish manufacturing sector at the firm level. The data compiled by Turkish Statistical Institute (TSI) that classified according to NACE Rev.2 at four-digit level is employed. The available years are from 2010 to 2015. We distinguished between three sets (groups) of firms. The firms those are exist in both pre- and post-evolution population (C), the firms those are exist only in the pre-evolution population (X) means the exiters and the firms those are exist only in the post evolution population (N) means the entrants. The total number of firms during this period is 65 719. The number of the firms those are exist in both 2011 and 2015 is 18 528. The number of the firms those are exist only in 2011 is 21 451 and the number of the firms those are exist only in 2015 is 25 740. Both single- (at whole level) and multi-level (at industry level) of the “Price equation” method had been utilized. According to the single-level Price equation, the key sources of the aggregate labor productivity evolution were: firm selection effect, innovation and exit effects. However, in the multilevel decomposition key sources were, industry selection effect, innovation and exit effects. When splitting the whole period into shorter sub periods and summing up the results, we found the tendency for selection was stronger. In the short run, developing the management skills and the productivity-boosting know-how practices may enable firms increasing their labor productivity. In the long run, a comprehensive upgrading of the business environment is vital to improve the ineffective regulations and support the strategies of innovation incentives such as increasing the expenditure on R&D activities.

Keywords: The Price equation, Evolutionary economics, Labor productivity growth, Structural change, Micro heterogeneity.

Advisor: Prof. Dr. İsmail TUNCER, Department of Economics, Mersin University, Mersin.

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1. INTRODUCTION

Development economics deals with the long run processes of evolution and structural change in developing countries. Structural change can be used in quite different meanings. We make use of the term structure in the sense of the relative size of main industries in the whole economy. This size might be in terms of output and/or inputs. Any economy can be analyzed in respect of its relative size of 'primary', 'secondary' and 'tertiary' sectors. The change in the relative size of these sectors usually termed as structural change. In the development process of any developing economy, output growth must be accompanied by structural change. Economic growth accompanied with productivity enhancing structural change is usually referred to as structural transformation.

Over time the structure of any economy is doomed to change. In the high-income countries, for instance, whereas the service sector's share in GDP increased from (65%) in 1997 to (69.8%) in 2017, the shares of the agricultural/manufacturing sectors in GDP decreased from (2%/17.5%) in 1997 to (1.3%/14%) in 2017. In the low-income countries, the agricultural sector's share decreased from (36%) in 1990 to (26%) in 2017 versus a decrease in the manufacturing sector's share in GDP from (12.6%) in 1990 to (8%) in 2014 and an increase in the service sector's share in GDP from (37.7%) in 1994 to (38%) in 2017. In the middle-income countries, the agricultural sector's share decreased from (22%) in 1980 to (7.8%) in 2018, but the manufacturing sector's share in GDP increased from (17%) in 2002 to (19.5%) in 2018. The service sector's share in GDP is also increased from (37.7%) in 1980 to (53.9%) in 2018 (WDI, 2020).

Despite the diminishing share of the manufacturing sector in the high- and low-income countries and the slow growth of it in the middle-income countries; the manufacturing sector had been considered as the "growth enhancing" sector (McMillan, Margaret, & Rodrik, 2011). This is due to two reasons. First, the manufacturing sector can absorb resources from low-productive activities -with limited possibilities for technological change and value-added gains- such as urban informal services or rural agriculture. Second, manufacturing sector exhibits "unconditional convergence" in labor productivity irrespective of country policies, institutions, geography and, infrastructure the matter that stimulates the process of the structural change (Rodrik, McMillan, & Sepulveda, 2015).

The patterns of structural change are naturally responsive to demand as well as supply conditions. The main drivers of structural change, from the supply side perspective, are the variations in labor-augmenting technological progress, factor shares and elasticity of substitution across industries (Herrendorf, et al., 2013). At low per capita income levels, the scarcity of the capital input leads to increase in the price of capital-intensive goods as well as

prices of products with low elasticity of substitution of inputs. Through time, as GDP per capita increases, the availability of capital inputs decreases relative prices the matter that stimulates the transformation of resources that is the structural change (Acemoglu, Daron, Guerrieri, & Veronica., 2008).

It is not only the supply side which stimulates structural change. Final demand, the intermediate demand and trade characterize the process of structural change. At high income levels, the relative share of food consumption will decline concurrently with shifts in demand from basic goods into manufactured goods and then to services. The pattern of demand is also responsive to trade. The composition of trade and the type of specialization are determined by the natural resources and commercial policies that reinforce the transformation process from primary economic activities into tertiary activities. Either from the supply side or from the demand side, structural change is inevitably the core feature of the economic growth and development process.

One of the most exciting elements of the structural change is the change in employment or the labor transformation. In the rich countries, employment in the agricultural sector decreased from (6.6%) in 1991 to (2.9%) in 2019; at the same period, the service sector's employment share increased from (63%) to (74.7%), but employment in the industry decreased from (30.4%) to (22%). In the low- income countries, whereas the employment in agriculture decreased from (71.4%) in 1991 to (65.5%) in 2019, employment shares in the total labor force increased from (19.9%) to (25.9%) in service sector and from (8.7%) to (11.5%) in industry at the same period. The matter is the same in the middle-income countries, a decline in employment share from (51.6%) in 1991 to (30%) in 2019 in agriculture versus an upsurge in employment share in service (from 28% to 45.7%) and industry (from 20% to 24.3%) at the same period.

The magnitude of the shifts in labor on economic growth is controversial. Empirical studies that make use of the traditional shift share analysis provide weak support to the structural bonus hypothesis. However, the studies that based on the evolutionary methods have tended to emphasize the significance of labor transformation as the component that accelerates or decelerates growth according to its velocity and direction. As labor moves from lower value added into higher value-added activities, aggregate productivity rises, and economy grows. Labor productivity differences among firms and industries are an important stimulator for the change in economic structure. Developing countries are characterized by the persistent productivity differences across (heterogeneity) firms even in the same industry. The productivity improvements stemmed from inside the same industry is called the *within growth effect* while the productivity gains originated from movements of labor or other inputs across industries represents the *structural change effect*. The summation of within growth- and the

structural change- impact formed aggregate labor productivity growth. Despite the widespread use of this decomposition technique in the related literature; we think that it is not enough to split the aggregate productivity growth into the mentioned two impacts because of following two reasons: (1) the shift share method (McMillan, Margaret, & Rodrik, 2011) doesn't take the role of entry and exit of firms into account on one hand and (2) on the other hand it can't quantify the evolution at the disaggregate level. Another shortcoming of this technique may be that it determines growth from the pre- to the post-evolution by the productivity in the pre-evolution, paying no attention to the length of the interval between the two censuses. In other words, it cannot take the role of structural change into consideration. Avoiding these shortcomings is the core reason for choosing an evolutionary direction in this thesis. That means that we will assess the nexus between labor transformation and total productivity evolution at the firm level by taking into accounts the role of entry and exit in long and short periods relying on an evolutionary decomposition technique, namely the "Price's Equation"¹. Moreover, the results of a one long period are compared with the results of the sub-periods. In other words, we will examine the importance of the labor transformation to total productivity evolution using data of the periods (2010-2015), (2010-2011), (2010-2012), (2011-2015), (2012-2013), (2013-2015) and (2014-2015). Only the results of the period of (2011-2015) will be reported in this thesis. (2010-2015) data allow for an assessment of examining one period of six years versus three periods of two years (2010-2011), (2012-2013) and (2014-2015). At the same time, it allows for an assessment of examining one period of six years versus two periods of three years (2010-2012) and (2013-2015). To achieve our goals, we had to distinguish between three groups of firms which are: firms those are survive in both pre- and post-evolution population, firms those are survive only in pre- evolution and firms those are survive in post- evolution population.

Therefore, the "Price Equation" method presents a coherent technique for decomposing aggregate productivity growth from a supply side perspective at two stages: single- and multi-level. The single level decomposes aggregate labor productivity into four effects which are: selection-, learning-, entry- and exit- effects (the entry effect and the exit effect are usually known as the net entry effect). The multilevel technique decomposes the aggregate labor productivity into five effects which are: industry selection-, firm selection-, learning-, entry- and exit effects. The distinction between the two techniques is that multi-level equation allows for

¹ Price's equation is an evolutionary tool has been inspired from theoretical evolutionary biology and applied in economics (Metcalf 1994; Andersen 2004). The classic reference is Price (1970). The empirical applications of Price Equation in economics are not abound, whereas methodological contributions do. Providing a coherent method for decomposing sources of aggregate labor productivity growth at more disaggregated level.

examining the selection effect within industries. For this reason, multi-level Price equation is more preferable when measuring the significance of selection effect to overall labor productivity evolution.

In the light of foregoing considerations, we search for the answers of two question. *The first one predicts that the results of applying the Price equation at the firm level will provide more reliable results for the impact of the structural change on productivity evolution rather than applying the traditional methods. The second, predicts that the results of decomposing one long period will change if splitting up that period over shorter sub periods and summing the effects.* In the light of these two research questions and based on the decomposition equation that splits total productivity evolution into the effects of industry-selection, firm-selection, learning, entry and exit at disaggregate level, our expected results will be as follows: *The first one expects a negative entry effect according to the single level equation versus a positive entry impact and a negative industry-selection impact according to multi-level equation, if firms enter industries with low-mean productivity accompanying with intensifying their employment shares. The second one expects a positive exit effect according to both single and multilevel decompositions if the productivity of the exiters in the post evolution period is lower than the productivity of the industry. The third one expects same learning effect according to the single-level technique and the multilevel one. The fourth one expects a negative inter- firm effect according to the single-level technique versus a positive inter-firm impact and a negative industry-selection impact according to multi-level technique, if firms decrease their productivity comparing to the productivity of industry. The fifth one expects that when decomposing one long period the industry and firm selection effects will be smaller compared to these effects if they are summed up over shorter periods. The sixth one expects that the exit and entry effect will be smaller when taken as sums over sub- periods.*

By decomposing the aggregate productivity growth utilizing Price equation we should answer the following questions: Does the structural change process become the driving force of labor productivity growth during the studied periods? How does the selection effect at the firm level influence the aggregate productivity evolution? How to support the sectors that contribute positively to Turkey's productivity growth? What can be done for the sectors that contribute negatively to the aggregate productivity growth? How do the lengths of interval studied affect the results? Utilizing the traditional shift share analysis, the results revealed that the within-sector effect accounts for a major part of the overall productivity gains, while the structural change- seems to bring a drag on overall labor productivity evolution, rather than a bonus in the Turkish manufacturing industry. Using the evolutionary methods, the concludes revealed that at single level, the labor productivity evolution was driven by the positive learning-, a positive firm selection- and a positive exit effect. At the multilevel type of the Price equation, the productivity

evolution was driven by the learning- and the positive exit effect. As the period becomes shorter, contrast to the entry effect the firm selection-, the industry selection- and the exit effect become stronger. Building on these results, the eligibility for incentives had been determined.

The rest of thesis is structured as follows: In section 2, a theoretical and empirical overview of the literature is given. In section 3, methodology, data materials and hypothesis will be discussed. In section 4, the results are presented and evaluated. In section 5, the conclusions have been discussed.



2. THEORETICAL AND EMPIRICAL OVERVIEW OF THE LITERATURE

2.1. Theoretical Review

2.1.1. Classical economists

The structural change process is a complex economic event which takes place by changing the input and output composition in the economic system, such as changing the sectors' share of employment and/or GDP. Change in sector shares occurs by the transformation of the workers from the labor-intensive economic activities to the modern capital-intensive activities or in other words from low to high value-added economic activities and vice versa. The structural change process has been considered as a fundamental component for the process of economic development. The typology of structuralism can be sketched from the exertions of classical economists like Adam Smith, David Ricardo, and Karl Marx. From Marxian perspective, the structural change process is associated with changes in the value added of economic activities. Marx labels the economy as a capitalist process of production and appropriation of surplus value. So, he classified/categorized economic activities by their aptitude to produce surplus-value or not. According to Marx, vital component which can produce the surplus value is the productive labor that can expand the capital stock. On the contrary, the unproductive labor is the one which does not produce surplus value and consequently would not be able to expand the capital in excess with the wages paid. The discrimination between productive and unproductive labor is ascribed to all classical economists including Marx. Productive labor is the one which produces a surplus value, or in other words, the productive labor is the wage labor that valorizes capital by either generating surplus value or transforming it. The prominence of the produced surplus value comes from the ability to accumulate a part of it, the matter that increases the value-added of the economy. Nonetheless, unproductive labors consume surplus value levering value added of the whole economy down. According to Marx, the economy is comprised of the activities that produce value added, based on the productive labor and the activities that do not produce it. At the same time, the activities that produce surplus value consist of productive and unproductive labors. In other words, although the economic activity produces surplus value; that does not mean that it does not contain unproductive labor. Figure 2-1 may shed some light on the subject.

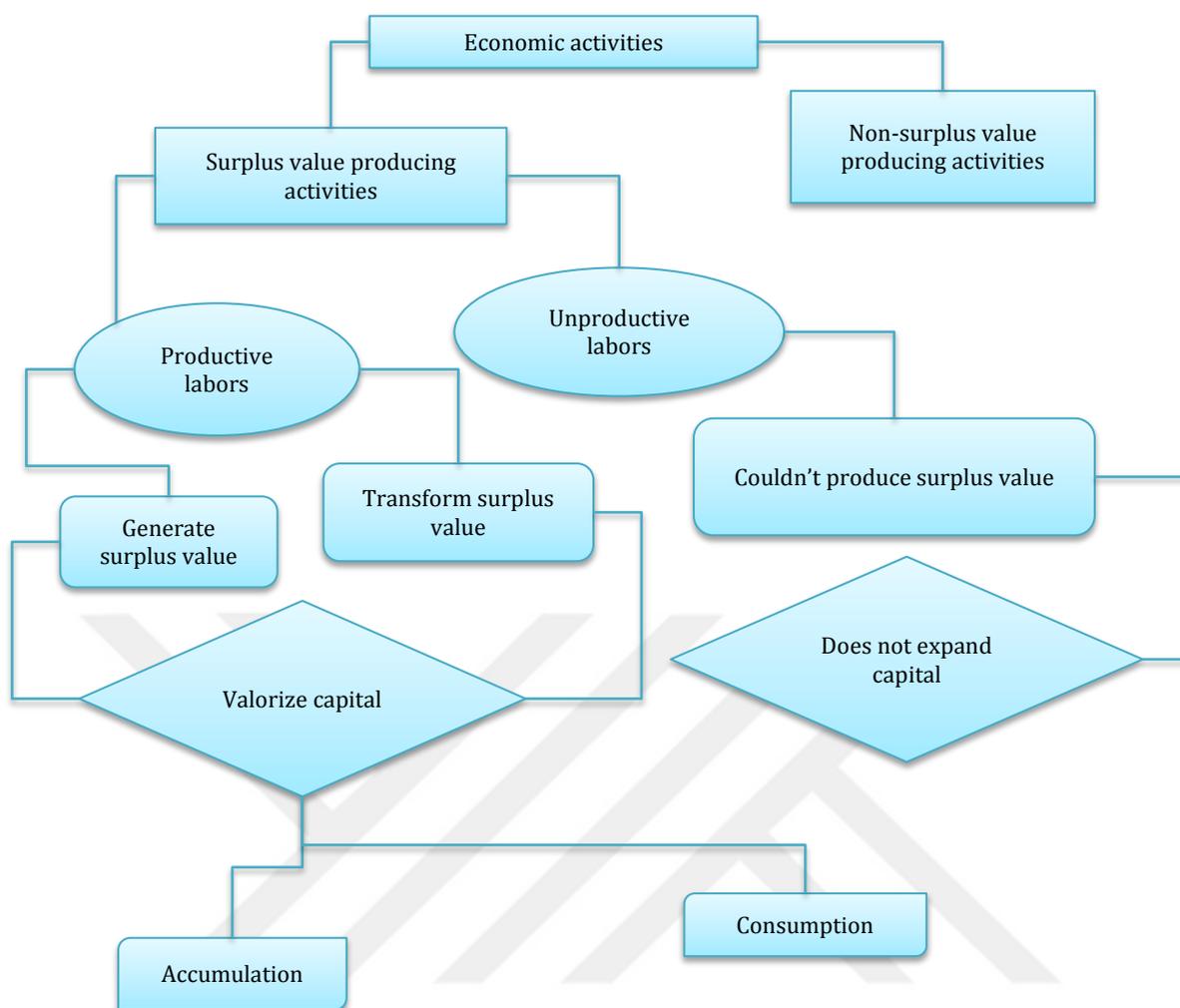


Figure 2.1. Marxian classification of the economic activities according to their ability to produce surplus value.

Source: Author’s preparation based on literature.

Even though, the Marxian perspective is not associated with sectors, there is, to some extent, a connection between economic activities that have been classified by Marx and the sectors themselves. Tregenna (2014) mapped economic sectors built on Marxian classification of economic sectors and emphasized that the capitalist manufacturing activities can be classified under the economic activities that yield surplus value. The first point of convergence regarding Marx’s clarification is the existence of the surplus labor that could not produce surplus value; by virtue of describing the structural change process as the transfer of the surplus labor from the labor-intensive sectors to the modern ones and vice versa. The second one is categorizing the manufacturing activities under the economic activities that virtually produce surplus value. Furthermore, Marx associated sustained economic growth to the role of the manufacturing activities that reinforced the mechanization, competition, accumulation, division of labor and capitalist development. This alludes to role of the technological progress in surplus value

producing which increases productivity. Therefore, change in the composition of the activities accompanying the technological progression are expected to have potential signs of growth. Marx links such vicissitudes in the structure of economic activities, to accumulation of surplus value. This accumulation enables expanding production from one side and on the other one, provides the opportunity to appropriate the surplus value. He weighs up the production of the surplus value as the essential component of the maintained accumulation, especially the accumulation of the productivity improvements across different activities. At this point, the criterion of the competence of the manufacturing sector that affects economic growth should be considered. This is because manufacturing activities have superior potential for maintaining and cumulating productivity increases. On the other hand, manufacturing has higher levels of technological progression contrasted to the rest of the economy's activities. The increases in cumulative productivity and high level of technological evolvement create and expand the scope to produce the surplus value. The decline in the manufacturing activities with high levels of technological progress do not necessarily result in dampening growth, because of the combinatory activities that are generated from the mutual relationship between the technological progress and that growth.

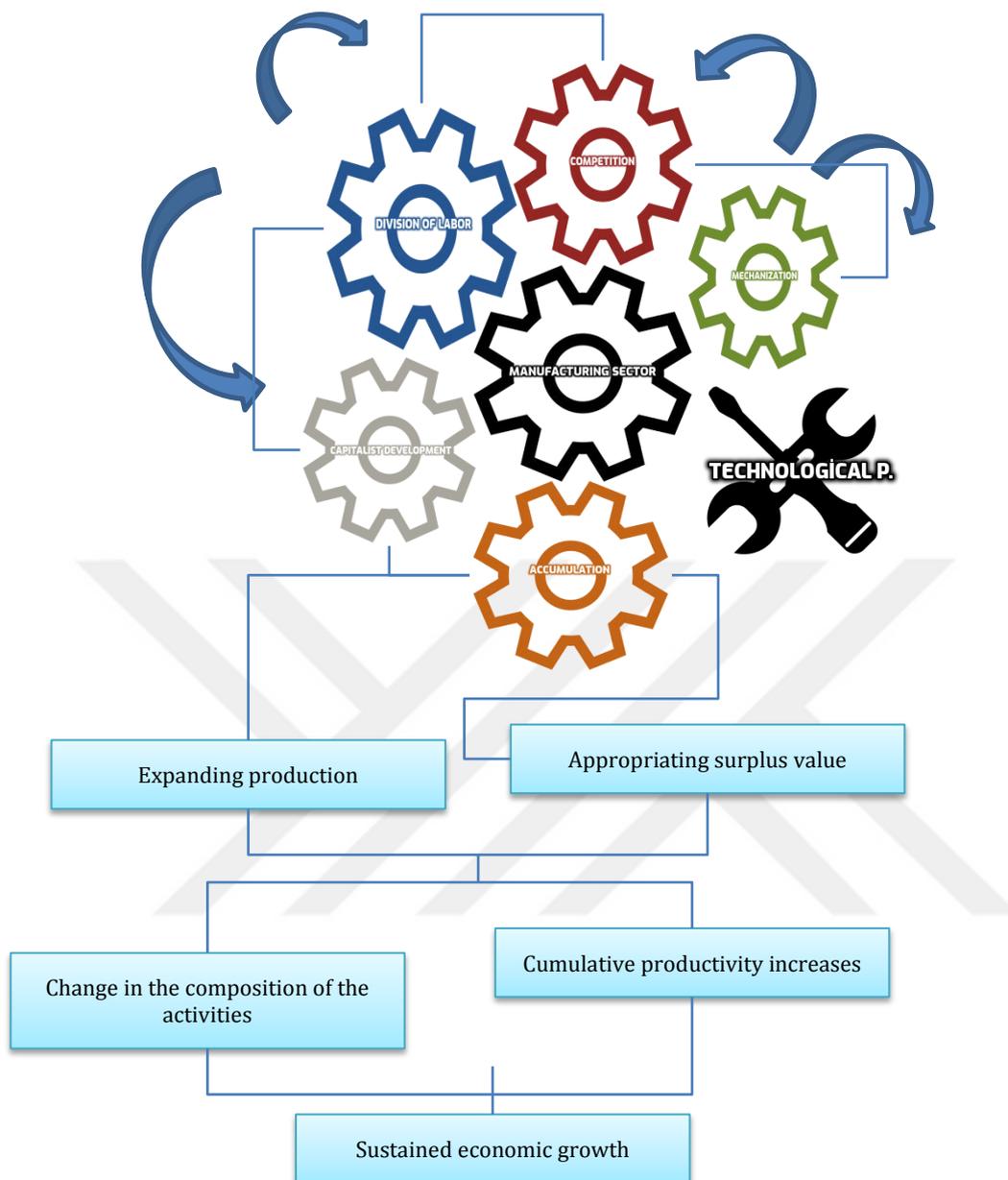


Figure 2.2. A connection between structural change and sustained economic growth.

Source: Author’s preparation based on literature.

Built on Marxian terms, Tregenna (2014) develops new conceptualizations and typologies of deindustrialization in which the structure shifts away from the manufacturing sector, towards services. Tregenna discriminates between two forms of deindustrialization: Form I and Form II. Form I denote the shift from the manufacturing sector to non-surplus value producing activities. Form II denotes the shifts from the manufacturing sector to the surplus-value producing activities. Tregenna’s suggested forms aren’t the same in terms of their inferences on the economic growth; contrarily, they affect economic growth in other ways. Such distinctions give sight to the heterogeneities between economic sectors. The most common

instance of Form I deindustrialization is the shift from the manufacturing sector, to the financial sector in a single country. Such transformations can be seen in the upper income economies. Another example of Form I deindustrialization is the potential transformation of the manufacturing production, from the developed countries, to the countries that can produce goods with lower labor cost. One of the direct consequences of reallocation from the manufacturing sector to the non-surplus value producing activities could be the decreasing surplus value production in relation to the entire economy, due to the decrease in the rate of accumulation. This is not the rule. Form I deindustrialization can take place in concomitant with increasing the surplus value production in the short run by deepening the yields of the goods produced elsewhere in order to fuel the growth of the economy. Moving to Form II deindustrialization, as mentioned above, it refers to transformation from the manufacturing sector to the surplus value producing activities. This definition details two cases: the first one is the transferal from the manufacturing sector to mining and agriculture, the second situation, however, is the transferal from the manufacturing sector to the services. A common example of the Form II deindustrialization is the Dutch disease which means that the shift from manufacturing to the primary sectors takes place when the country is rich in its natural resources. An example for this phenomenon can be seen in the U.K. and it is an outcome of the discovery of North Sea oil. Common examples of the transformation from manufacturing to services can be seen with the shift from the manufacturing sector to the hair salons, restaurants, cleaning services etc. The direct effect of such transformation could decrease the accumulation of the surplus value and consequently could contribute negatively to economic growth. At this juncture, the supreme important role can be attributed to the technological progress. In other words, a manufacturing activity with a lower level of technological progress can be substituted with a service sector that has a higher level of technological progress.

It is not only supplying technology that affects economic growth, but also the effective demand that forms the dynamics of production, which can be seen in the Keynesian approach. In this respect, Pasinetti reports that the technological progress expands the market, the matter that influences the consumption, and shifts the demand from the primary to the secondary and henceforth to the tertiary sector according to Engel's law (see paragraph 2.1.4.2. Pasinetti's model). The early studies termed the patterns of the long run growth of the now developed countries. The most common instances of such studies are: Chenery (1960); Chenery & Watanabe (1958); Chenery & Taylor (1968) and Chenery & Syrquin (1975). A point that these studies have in common, could be the emphasis on the idea that the sustained economic growth can be achieved, by alteration of production, trade and demand on the one hand and the reallocation of the production elements from the labor intensive sectors to the capital intensive ones on the other. The phases that an economy has to pass through the development process

had been clarified by Rostow's stages of development model (1960). Rostow penned five stages of economic development: (1) the stage of traditional society; (2) a prerequisite takeoff; (3) the stage of take-off; (4) the movement to maturity (5) the period of high consumption. Here, the heterogeneity between different countries plays the most important role. In other quarters, some countries are rearwarded and others are not in terms of knowledge according to Alexander Gerschenkron. Gerschenkron (1962) reported that the way that the rearward countries had to follow to catch up the leading countries and attain the sustained economic growth is lasting the knowledge gap by innovations. The literature typifies two solutions to last the knowledge gap between leading and backward countries. While Gerschenkron emphasizes the prerequisites of the takeoff stage, Myrdal (1957) emphasizes the self-reinforcing of the backward country to attain sustained economic growth and catch up leading countries. He confirms the significance of the "cumulative causation" which means that the countries that are backward will grow by attracting more entrepreneurs and labor once it takes the leading role in the economic development process. Albert O. Hirschman (1958), in his turn, also emphasizes the role of self-reinforcing to achieve the sustained economic growth. Other different approaches labeled the process of the structural change based on integrating the heterogeneous economic sectors; for instance, the Lewis (1954) model of dual economy and 'big-push' theories. Such models divided the economy into two major sectors: the primary and the modern sectors. Additionally, the maintained economic growth can be achieved by the transformation of the labor force from the primary sector to the modern one, till the latter reaches the level of saturation. The significance of the covariance between the economic sectors to the balanced economic growth had also been emphasized by Rosenstein- Rodan's big push theory (1961). Rosenstein- Rodan (1961) focused on the importance of the complementarities between the different industries to push the economy forward. Nurkse (1953), claimed that the expansion of the complementarities between different industries can be allied to the intensifying labor productivity. When exploring other points of view, other approaches divided the economy into small units and attributed sustained economic growth to the evolution of these units. For example, Hoffmann (1958) attributed the industrial growth to the evolution of the consumer and capital goods industries. Other examples Fisher (1939) and Kuznets (1961, 1971) who divided the economy into three sectors: the primary, the secondary and the tertiary sector. He attributed sustained economic growth to structural changes which takes place between the mentioned sectors and results from the change in the structure of the consumer demand (see paragraph 2.1.4.3. The Three-Sector Hypothesis). The simulation of the selection either from the supply aspect or from the demand one necessitates analyzing the structure in the economic system. The literature signifies horizontal and vertical clarifications of the economic structure. The horizontal clarification of the economic structure can be traced back to the classical

economist who describes the economic structure as a circular process consisting of dependent clusters. In the latter periods, the horizontal clarification of the economic structure can be found in the works of Sraffa (1960); Neumann (1945) and Leontief (1941). Neumann (1945) and Sraffa (1960) represent the production function as a circular process starting with producing a simple two-commodity and ends with a complicated system with multiple commodities; in other quarters, they scrutinize the economic structure as a process by which the production of physical goods occurs by means of goods. Leontief (1941, 1991) also illustrated the horizontal flows of basic inputs to produce other outputs which are different. The vertical representation of the economic structure divided the economic system into subsystems where each of them produce a different commodity and the different commodities combine to produce the final one. The vertical structure of the economic system had been discussed in the work of Pasinetti (1973). Pasinetti shows that the economic system consists of several vertically integrated sectors which combine by utilizing the necessary requirements of labor and intermediate goods to produce the final commodities. Developing the economic structure from the horizontal to the vertical had been suggested by Goodwin (1976, 1983) and Goodwin & Punzo (1987). Hicks (1973) split up the process of vertically integrated production into two phases; the phase of 'construction' in which $n-1$ intermediate goods can be manufactured over n periods of time by means of labors without final goods which can be fabricated and the phase of machines' 'utilization', in which final goods are formed by dint of using the labor and the intermediate goods produced in the former stage. The sustained economic growth can be achieved by innovating developments in the economic system vertically and horizontally as referred by Georgescu-Roegen (1971). For example, Lowe (1955, 1976) horizontally modified a reproduction schema developed by Marx. He divided the capital-intensive sector into two subsectors: the first one includes the equipment necessary for the consumer goods sector and the second one is the 'machine-tools' sector, this includes equipment for both subsectors. The enlargement of the consumer goods sector necessitates the expansion of the 'machine-tools' sector which has been considered by Lowe as the fundamental component of economic growth. Utilizing 'traverse analysis', a vertical approach had been adopted by Hicks (1973). This approach claims that the change in the economic structure takes place concurrently with the technological progress by which a transition period from using the old techniques of production to using the new techniques of production takes place until new technological innovations occur. One of the expected concerns of such a transitional epoch is increasing the rate of unemployment in the short run; nevertheless, this will be a non-issue in the long run. Another significant consequence of the transition period could be the increase of the residuals because of the imbalance between supplying products and the sufficient use of it. It is important here to figure out that the supply of technology should be successive, keeping in order and

compensating the scarcity of the production factors as supported by Quadrio-Curzio & Pellizzari (1990). Pasinetti (1981, 1993) considered full-employment and complete use of productive resources as key sources of sustained evolution. He emphasized that the full employment of the labor force can be achieved by the transformation of labor between the productive sectors. Moreover, he stated that this could be done by decreasing the amount of them. Furthermore, he emphasizes the essential role of the individual and social learning in intensifying labor productivity on one side and increasing the income per capita, which in its turn affects the consumer’s demand according to Engel’s law on the other side. After the above review of the classical literature, we thought that figure 2-3 may, to some extent, give a simple definition for the process of structural change.

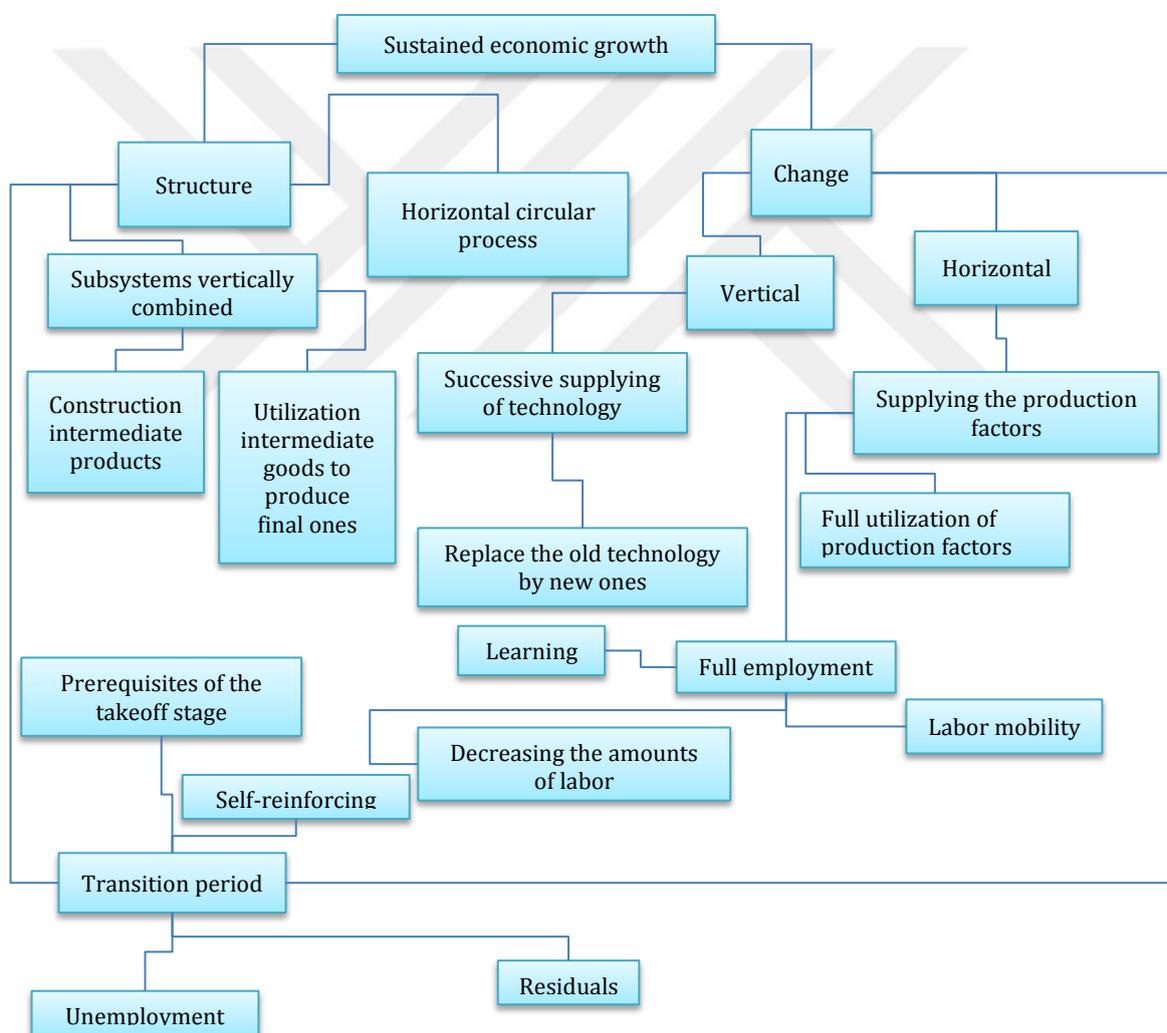


Figure 2.3. A simple definition of the structural change process.

Source: Author’s preparation based on literature.

2.1.2. The Contribution of Schumpeter

Joseph Alois Schumpeter was one of the leading economist dealing with long-run capitalistic development. Schumpeter's aim was developing an evolutionary theory of economic change, different from the static equilibrium theory. Schumpeter's approach had been heavily influenced by the classical political economy (Marx). Schumpeter believed that the equilibrating forces which had been discussed by the static equilibrium theory, push the economy into a steady state but only in a state where there is an absence of innovation. However, that would never be the case in the real world, because the innovation processes itself shapes economic evolution and makes economic structures vulnerable and continue to change over time. Schumpeter defined innovation as the outcome of a struggle between the firms who do things in better ways and the inactive environment that prefer to work as usual. He attributed innovation to technological progress that stimulates the dissemination of high value-added activities, to yield more profits and attain further developments to achieve sustained economic growth. Schumpeter referred to the dissemination as the process that takes place between the related activities in reference to the product space i.e. he demonstrated that the economy consists of clusters and that each one of them consist of connected activities subject to the impact of the technological progress either by the self-innovation or by imitation in order to survive and gain market shares. The activities that catch up to the technological progress grow faster than the other activities and even more than the whole economy; this is temporary however, and only happens until the technological progress splashes through the other activities in the same cluster and then to the other related clusters and the whole economy. At this juncture, the growth of the first cluster starts to decrease till catching up to new innovation or imitating it. In order to survive, the rest of the firms have to make further improvements, otherwise those firms will be forced to exit the market. In the light of the foregoing, Schumpeter confirmed that the structural change process is not a complementary element; on the contrary, he considered it as the stone foundation of sustained economic growth. Furthermore, he could not imagine maintained economic growth without continuous structural change based on innovations or imitations which resulted from technological progress over different periods of time. The following paragraphs may give an explanation to the Schumpeterian approaches and contributions to the literature of structural change. Figure 2-4 gives a sketch of the structural change process at certain moment of time based on the Schumpeterian legacy.

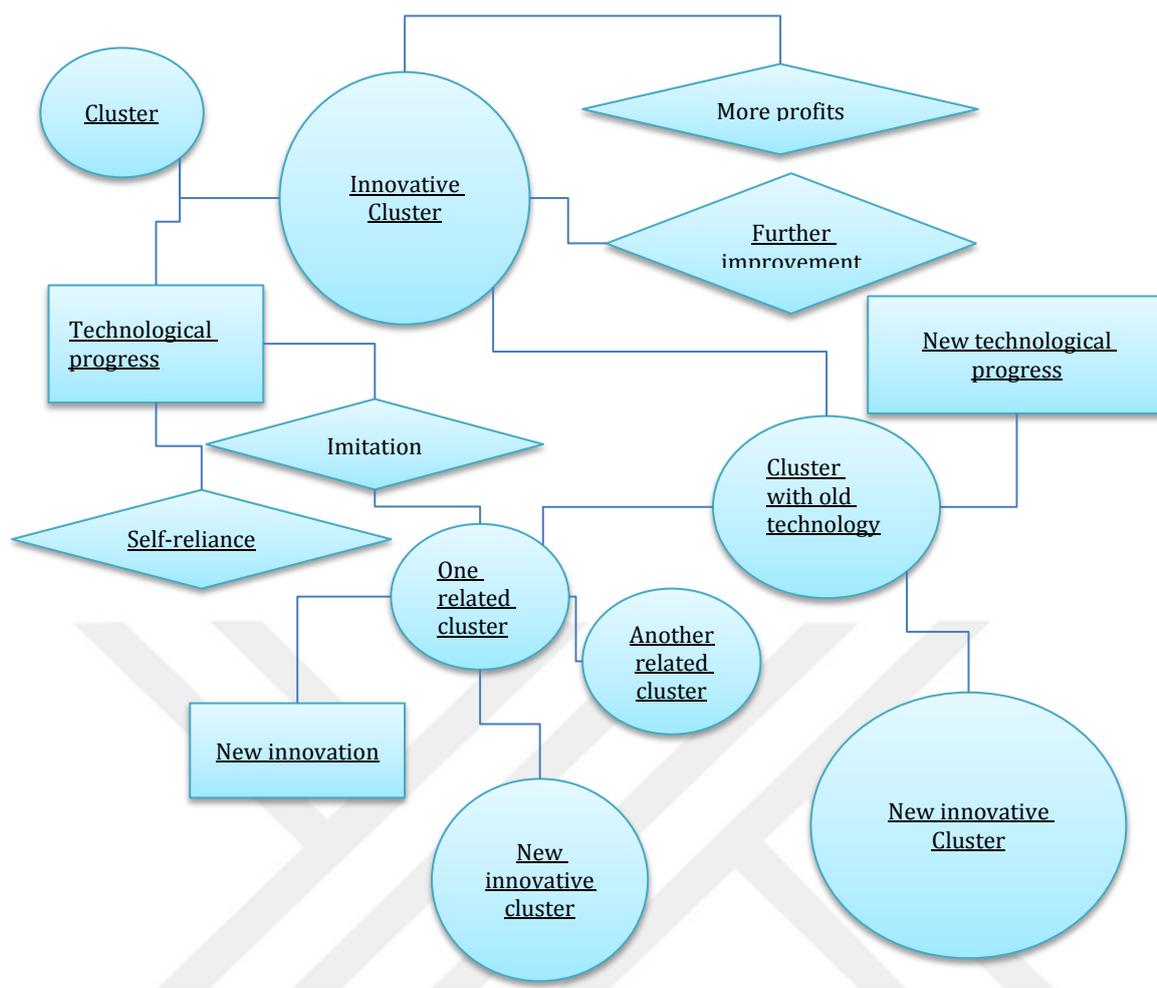


Figure 2.4. A sketch of the structural change process at certain moment of time based on the Schumpeterian legacy.

Source: Author’s preparation based on literature.

2.1.2.1. Technology and Competitiveness

Schumpeter forcefully adopted the idea that the long-run capitalist development is driven by the firms’ technological competitiveness. In other words, it is the technology, rather than price competition that drives capitalist evolution. Schumpeter suggested that the principal way for firms to maintain their competitiveness is supplying new technology, new products, and new types of organizations to increase their productivity. The more productive firms increase their R&D expenditures on innovation and imitation, to introduce new and more efficient machinery, the matter that enables them to achieve more profits, invest more, grow faster, and increase their market shares. The less productive firms, will consequently be forced to either improve their productivity or exit the market (Schumpeter J. , 1934). Schumpeter's competitiveness analysis is constructed on the vital role of the entrepreneur and innovations. He indicated that two significant phases of innovation can be identified: the first phase affirms

that technological progress stems from the firms' competitiveness in research and development (R&D) activities; the second phase sustains that innovation authorizes a firm to obtain monopolistic profit. Temporary monopolistic revenues can be enjoyed by innovators due to imitation activities, the matter that reinforces new efforts for research and innovation. Over time and due to the recurrence of these processes, the criterion to determine whether the economic system has a comparative advantage or not, depends not on its share of production factors but on its share of R&D activities. The ability of an economy to create competitive advantages from R&D activities or from technological progress based on the dynamic capacity with which companies and organizations can diffuse, adapt, and apply information and knowledge. Therefore, the knowledge can be intrinsically thought as any other capital product and even more competent because it can be produced, employed in the production of itself or other goods and stored. Furthermore, it is subject to appreciation based on R&D activities and depreciation by adopting new ones. Of course, there are some central distinctions between the production of knowledge and the capital products. For instance, the production of knowledge is not a physical material compared to other physical capital products; it can be used in a software program, a patent, an artefact, a design etc. Another difference between production of knowledge and production of other capital goods, is the ability to share the knowledge with others. Undoubtedly, there are costs that must be paid for knowledge acquisition; but with the appearance of the information and communication technologies, firms prioritize to accomplish R&D activities by themselves rather than having it signed out or licensed. So, the firms' know-how to consolidate the relevant knowledge in innovative ways and utilize it for economic goals, impact the competitiveness at all levels. Abstractly, the knowledge plays an essential role in the economic process not only for firms but also on a global scale. Firms endowed with more productive knowledge are more competitive and eligible to survive and increase their market shares. Without technological progress, capital accumulation will not be persistent, and the equilibrium of the economic growth will inevitably come to a halt.

2.1.2.2. Innovation and entrepreneurship

One of Schumpeter's most influential contributions to economics is the answer given to the question: how to create innovation. He defined innovation as the tradable economic process in which the "new combinations" draw the necessary new resources, knowledge, or equipment from the old ones. The "combinatory" activity describes the entrepreneurial function. In other words, the entrepreneurial function implies the supplying of new organizations, systems, products, knowledge, strategies, markets, and services. Schumpeter argues that the entrepreneurial function can be fulfilled by acquiring the knowledge until it 'sinks into the

strata of sub consciousness'. Firstly, it will be challenging to change the usual routines. However, if the pursuit of knowledge becomes a habit, the innovation becomes automatic. The accumulated theoretical-practical experience will be itself an economic force that enables discovering new ways of doing things (Schumpeter, 1934). It is not only the new ideas that remove the individuals' reluctance and encourage them to adopt the new methods, but also, the managerial competencies such as the leadership skills, the energy of action, the dynamism, and the constructiveness are required to implement successful innovation. Schumpeter stresses the significance of human capital and competencies in the process of innovation, in terms of having the required skills to take a risk, discovering solutions, and creating rules. That is not to say that the entrepreneurial function must be embodied in one physical person. Societies in any period differ from one another in terms of finding the suitable strategies by which they organize the entrepreneurial function (Schumpeter, 1989). We will now explain Schumpeter's innovation and entrepreneurship theory in more details.

First, Schumpeter claimed that to yield profits, innovation must be achieved. He defined the innovation process as an industrial mutation by which the economic structure changes continuously. Schumpeter determined five methods of innovation: 1- Promotion of a new species of already known product; 2- Manufacturing distinct schemes of production; 3- Forming distinct techniques for marketing; 4- Supplying new raw resources or semi-finished goods; 5- Changing the industrial assembly by the creation or destruction of the monopolistic position. In Schumpeter's claim, the recurrence of innovations driven through destruction old structure and creation a new one is the main foundation of the economic development. The main cause for such a claim, according to Schumpeter, is the competitive advantages created by innovations. Schumpeter argued that the innovation process takes place through four facets: invention, innovation, diffusion, and imitation. In his theory, though the imitation and diffusion processes have far greater impact on the economy, the invention phase has less influence on it. The entrepreneurs are the central component of Schumpeter's theory regarding creating new opportunities for investment, growth, and employment. According to Schumpeter, it is not only the creation of the basic innovation that accelerates the sustained economic growth, but also the diffusion of it. Schumpeter defined the diffusion of the basic innovations as the period when imitators start to yield profits from the new product or process. Here, Schumpeter completely distinguishes between the creation and the execution of the innovation because it is not the discovery itself, but the entrepreneur who gets things done by apportioning existing resources to new uses and new combinations. According to him the entrepreneur is the central innovator, and innovations are elemental to explaining economic growth in the capitalist system. One of Schumpeter's most influential involvements was his assertion that entrepreneurship is a distinctive component of production and a unique input that renders the economy goes

forward. Particularly, while the innovation is the creative destruction process that evolves the economy, the entrepreneur is the creator that implements the function of it.

The entrepreneur had been respected as a principal component of economic growth before the neoclassical era. It had been defined as an undertaker that embraces risk-taking, buying and producing goods for a certain price to sell it later on an undefined price. The utmost inclusive definition of the entrepreneurship had been improved in 1845 by Jean-Baptiste Say. He claimed that the entrepreneur benefits from the ideas of a philosopher as new knowledge to apply it to the economy to produce new goods. Entrepreneurs utilize labors, natural resources, and capital, to objectify the new knowledge into a tradable product. The inventors of the new innovations are called the leaders-new people. The administrators of production instruments can utilize created innovations. The units which took bank loans for the purchase of these innovations had been called entrepreneurs by Schumpeter. They were important for him because they enabled the banking system to implement innovations in the economy. Although the concept of the entrepreneur had been represented by others such as Walras, Marshall, Wieser etc... Schumpeter's vision was different. So, while the entrepreneur was simply the organizer, manager of production and trade or the owner of a capital in the view of most economists at that time, Schumpeter's thinking was that it is unnecessary to own the capital to be an entrepreneur; the entrepreneur is the person who has special character and cares only about functions allied to innovation. The entrepreneur is the only person who destroys the old traditions and creates new ones with abnormal confidence. According to Schumpeter, it is not necessarily an entrepreneur who yields profits, but assuredly profits are generated solely due to the contributions of the entrepreneur. Profit goes to the sponsor or the capitalist who owns the company. Moreover, based on Schumpeter's circular flow; a person who has established his business is immediately losing their function as an entrepreneur. For this reason, there is no person who can permanently be an entrepreneur, and there is also no businessman who was never an entrepreneur. According to Schumpeter, there are three motives that make the entrepreneur innovate, first: the desire to create own their kingdom or to like a European medieval lord; second: the desire for gain, competition by showing their notability over others or win for the sake of charming; third: the joy of creation, to attain something or just practice the energy and innovation. In the late thirties, Schumpeter presented a completely different theory of entrepreneurship. In his new theory, innovation in the strict sense gains much more importance than entrepreneurship. Specifically, the new theory is less individualistic. In other words, Schumpeter claims that the entrepreneur does not necessarily need to be one individual, but the country itself or its program can proceed as an entrepreneur. In the new theory, Schumpeter did not relate concept of the entrepreneur to other concepts. The connection linking the entrepreneur and banker was perceived in a different way too. Expressly,

Schumpeter's old theory considered the banker as the most vital authority of the capitalist economy because of the fact that he offers financial sanction to innovative activities of entrepreneur. However, the new theory, replaces the old vision by a more pragmatic one and adopts the notion of modern impersonal judicious bank that provides flexibility to innovator striving to keep the enterprise under control. Schumpeter's new theory had been ignored, especially by the American economists because he claimed that the historical method is much more appreciated than the theoretical and statistical ones when analyzing the business cycle. Schumpeter reported that the entrepreneur should have a special character which can be characterized as one who takes a risk, solves problems, enjoys uncertainty and copes with it, looks for opportunities and is flexible, proactive, and committed to make things happen. Such properties enable him to direct the use of funds based on two components: the first constituent is the capital sources that have been taken from the banker (according to the old theory) or from the government (according to the second theory); and the second constituent is the technical of know-how. The entrepreneur, due to the special character, knows how to direct the new combinations (i.e. the new products, markets, methods, sources, or organizations) that have been created by the innovator. The disproportion between the entrepreneur and the capitalist is that the capitalist tenders the finances, but the entrepreneur directs the use of funds. The divergence between the entrepreneur and the innovator is that the innovator is the person (who could be a man or woman) who invents in new ideas, but the entrepreneur is the person who brings the new ideas to life. The above discussed paragraphs have been depicted in figure 2-5.

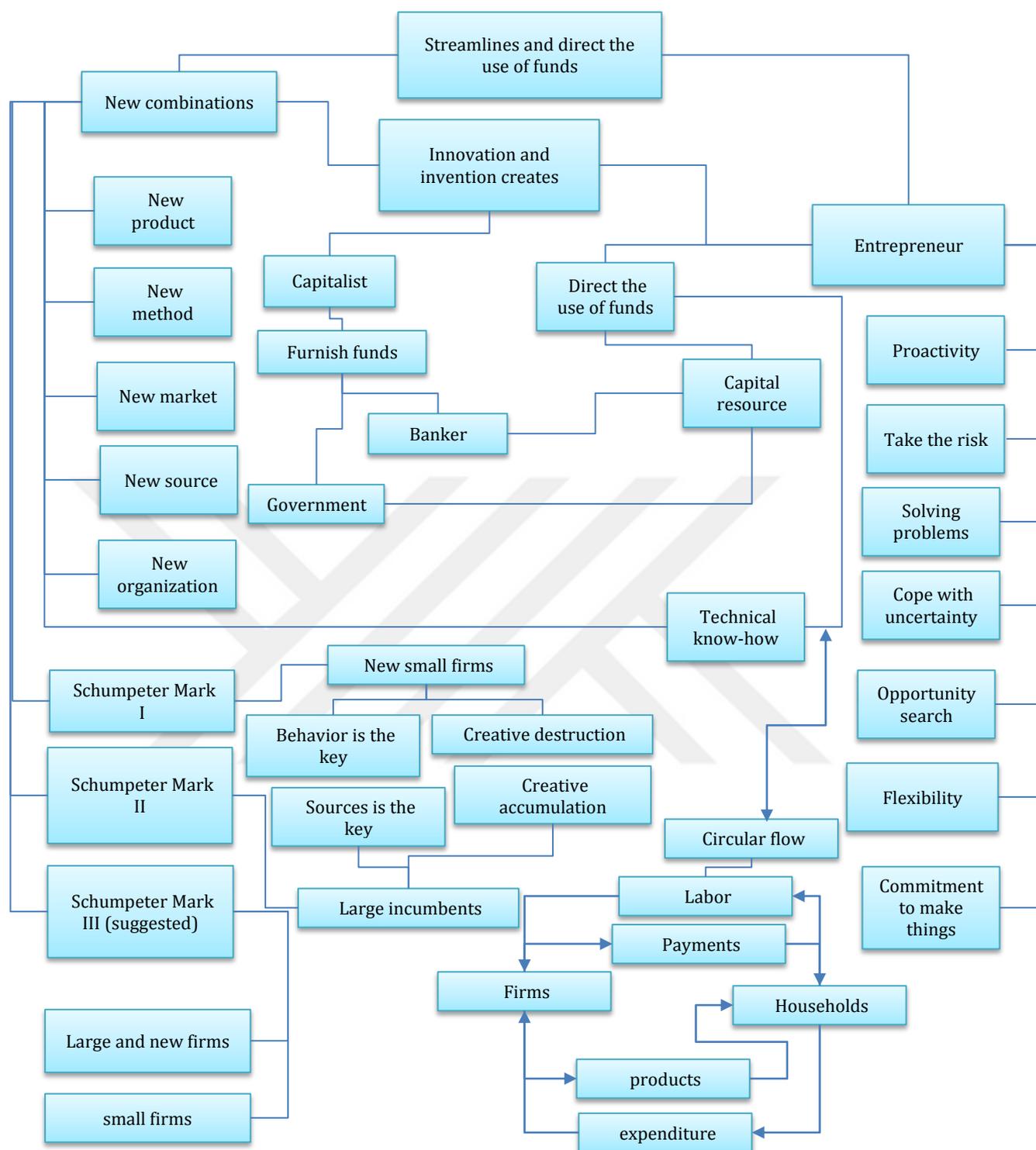


Figure 2.5. A simple explanation of Schumpeter’s innovation and entrepreneur theory.

Source: Author’s preparation based on literature.

Boutillier (2020) tried to examine the relationship between the entrepreneur and the banker; which had been scrutinized by the pioneer economists; to shed light on their contributions to the comprehending of today's reality. He considered the connection between the entrepreneur and the banker as fundamental to any scrutiny of business creation

and innovation management. His key result shows the significance of trust between the entrepreneur and the banker. Such contribution remains basic today, as he referred, to study the behavior of the two protagonists in the key places of emergence of innovation such as the business eco-systems, clusters, and science parks. Malerba & McKelvey (2020) constructed the concept of knowledge-intensive innovative entrepreneurship based on three components which are the Schumpeterian entrepreneurship, the evolutionary economics, and the innovation systems approach. They claimed that the knowledge-intensive innovative entrepreneurship is a crucial occurrence in the modern economy. Built on their view, knowledge-intensive innovative entrepreneurs are those who create new- technologies, products, resources, and ideas based on knowledge to make change in the economy. Bagley (2019) reported that the survival of the firms depends on the motivations of the entrepreneur, even if the firms succeed in existing in industrial clusters. Such success can be ascribed to two vital motives; the transference of knowledge and routines from parent firms to spinoffs that localize in the same region, and the revenues from co-location of firms. Bagley reported that the previous studies derived the existence of parent-spinoff networks and the impact of geographic location, but few studies have measured them, so he analyzed the impact of transferring knowledge from parent to spinoff. In addition, he analyzed the impact of the geographic location on firm survival and found that although the firm's historical relations shaped through parent-spinoff connections have a momentous impression on the firms' survival, the motivations of the entrepreneur acts as the key role of it. Guichardaz & Penin (2019) claimed that Schumpeter did not care about the patent as a component that plays a vital role for promoting innovation, even though the patent system is an essential part of this field of research today. They consider Schumpeter's ignorance to develop any scientific analysis of the patent system as a blind spot. According to them, the Schumpeterian vision of the economic process diminishes the economic weight of patents. In order to interpret this blind spot, they offer clarification built on three traits of Schumpeter's thoughts: entrepreneurs enjoy a first-mover advantage since imitation is challenging, they are usually prompted by non-monetary components; and finally, Schumpeter considered the innovation race as a ruthless process in which firms are doomed to innovate to survive. Lipieta (2018) revealed that in light of Schumpeter vision, it is not only the innovations and innovative entrepreneurs that subsidizes economic growth; but that also imitations and producers-imitators are needed in disseminating and familiarizing innovations into the economic exchange processes. Lipieta presented the imitative mechanisms defined in conceptual apparatus of Hurwicz's theory of economic mechanisms; that is the function of topological tools usually employed in the general equilibrium theory. Moreover, Lipieta's main result displays that the economic growth can be achieved by the means of innovation as well as imitation. Akdere & Benli (2018) wondered if it was attainable to apply the

Schumpeterian conviction of entrepreneurial innovation to the financial field. They aim to show that Schumpeter's analysis of entrepreneurial innovation, which occurs predominantly in the real economy, also offers a foundation for a contemporary account enabling understanding the dynamics of financial innovations. They reported that examining the financial innovations based on Schumpeter's vision does not mean authorizing all of them. On the contrary, it is an inspection for differentiating financial innovations depending on their knock on the real economy. Based on Schumpeterian concept of entrepreneurship, Haga (2018) examines the function and features of entrepreneurial leadership in aging rural communities in Japan. He reported that the oldest society in Japan must redefine local business to survive for the reason of the declining regional economy stemming from agricultural communities suffering from demographic change. The solution for such a problem, according to Haga, is to combine the elderly residents, who exist in the aging communities as a large population group, in a new business. Here, the efficiency of Schumpeter's notion about the function of entrepreneurs gains prominence because they can offer new combinations of given resources with a strong leadership, thanks to their distinctive entrepreneurial characteristics. For instance, their strong ability to empathize with their community as well as residents.

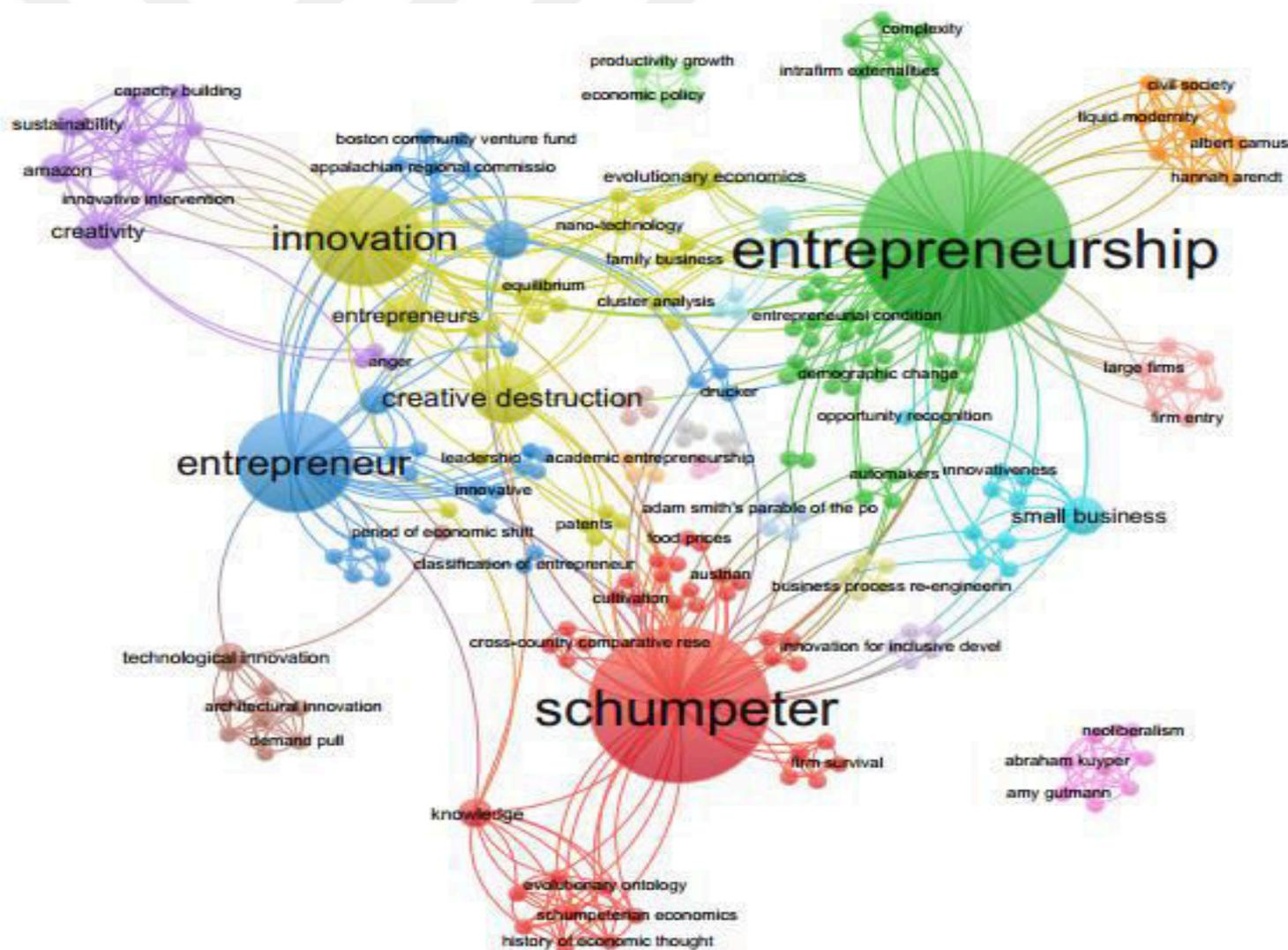


Figure 2.6. A sketch of Schumpeter's notion about innovation

Source: Author's preparation based on literature.

2.1.2.3. Schumpeter on the Evolution of Capitalism

The early work of Schumpeter had been criticized because he was mainly focused on the individual entrepreneur. However, regarding the changes in the productive organization of capitalism, Schumpeter distinguished between two forms of the capitalist systems: the “competitive” and the “trustified”. Competitive capitalism is epitomized by individual entrepreneurs themselves denoting that the innovation in the competitive stage can be achieved by the creation of new firms. Instead, the trustified capitalism is characterized by the large enterprises with no birth of new firms because the big firms play leading roles in the economy (Schumpeter, 1939).

The discrepancy between the two types of the capitalist systems sheds light on other significant concepts: competition and monopoly. As Schumpeter indicated, the real competition in the capitalist system means competition that occurs in the innovative firms that execute the entrepreneurial function. The real competition leads to the creative destruction process by which new production units or new productive processes replace old ones. The mentioned understanding of competition reflects, to some degree, the concept of monopoly because the entrepreneur will earn profits before the spread of his innovation. According to Schumpeter, the evolution of capitalism from the “competitive” to the “trustified” one, is achieved through the destruction of the older innovations while simultaneously creating new ones without reducing the quantity or the quality of economic growth (Schumpeter, 1939).

2.1.3. Neo-Schumpeterian Evolutionary Economics

The formal equilibrium models that had been implemented after the death of Schumpeter were not enough to treat the observed evolution of the economic structure and international trade. At the same time, the equilibrium models did not deal with technological change which was the main basis for economic growth and development. Unlike the neoclassical assumptions, the evolutionary approach deals with technological competition in order to illuminate the observed changes in the economic structure by creating a connection between the firm-level heterogeneity and industrial levels, accompanied with the inclusive macroeconomic dynamics on the other side (Fagerberg, 2002). Linking the microevolutions to the macroeconomic variables offers several benefits in both economic analysis as well as policymaking. Hence, the importance of the evolutionary economical approach took action as an alternative approach which scrutinizes the structural changes based on the associations between the innovation induced by technology adoption and its influences on the aggregate economic growth; matter had been ignored by the mainstream equilibrium approach. This, in

turn, explains the recent rise of interest in structural change analysis (Silva & Teixeira, 2008).

The fundamental involvement that had been endeavored to develop formal models of the economic evolution can be traced back to Nelson and Winter in their 1982-book: *An Evolutionary Theory of Economic Change*. The contributions of Nelson and Winter take inspiration from Schumpeter's ideas which focused on technological competition as the compelling force of economic evolution. As indicated by Nelson and Winter, firms should spend a constant amount of money on innovation and imitation. These firms should improve their productivity by increasing their R&D expenditures to yield more profits. More productive firms should reinvest their profits in adopting new and more productive technology. The firms that succeed in gaining more profits grow faster and enlarge their market shares. In turn, the firms that fail to make profit will ultimately go out of business (Nelson & Winter, 1982).

Although Nelson and Winter share similar ideas with Schumpeter when it comes to explaining the significance of innovation created by the adoption of new and productive technology, there are some differences between them. In other words, there are three interdependent basic discrepancies between the "the old evolutionary economics" i.e. the Schumpeterian economics and the "the new wave of evolutionary theorists" that was begun by Nelson and Winter's works.

Those differences are the way to determine the driving forces of the evolutionary economics, its regularities and the connection between the evolution, cognition, and action (Fagerberg, 2003). Another important difference is that Nelson and Winter, unlike Schumpeter, extrapolate theories from the natural sciences and apply them to economics to explain the evolution of the economic structure. In this thesis, one of those applications has been occupied to scrutinize the significance of the structural change to productivity evolution. The applied treatment is "Price equation" which is emanated from biology. According to Nelson and Winter, the goal of such application is to benefit from whatever they found beneficial to scrutinize the complex and uncertain relationships between the microevolutions and the aggregate levels of economic growth.

In consideration of the foregoing, innovation is the energetic ingredient of economic development and growth. Many decisive questions arise here: how could one revolutionize this? What is the nature of directs need to be taken for further innovation? How can keys be found? The responses of these questions can be shortened to two words: creation and destruction. It is the creation of the new and productive technology accompanied with the destruction of the old ones. There is no precise prescription for this revolution, and it is not painless as it appears. The innovation has been characterized by five 'stylized facts' which are: the uncertainty caused by the lack of information and the techno-economic problems, the increasing reliance on the scientific knowledge, the intricacy of the R&D activities, the momentous effect of the learning by

doing process and the cumulative and path-dependent innovation (Dosi, 1988). Put simply, innovation can take place when the firms change their strategies in research and development based on their accumulative experience in order to achieve various combinations of the market structure and raise the R&D intensity (Silverberg & Verspagen, 1994).

Another set of questions arise when we try to understand the nature of innovation. For example: how and at what rate does the process of innovation disperse. Undoubtedly, there is a mutual or reciprocal relationship between innovation and the diffusion of innovation. In other words, innovation and diffusion are interdependent. The diffusion has been considered as a mechanical process in which new technology, knowledge or products spread to be received by the potential participant who may adopt or reject it. The adoption or rejection of the new technology, knowledge or products might substitute or develop the technology, knowledge, or products themselves. As a result, not only new technology, but other related innovations (technical and economical) may come into existence. This is touched upon by Freeman in 1991. Those constellations of innovations could take place in booms as well slumps (Freeman, Clark, & Soete, 1982).

The diffusion of the innovations does not occur arbitrarily. It is liable to cluster in certain industries and time periods due to specific historical, cultural, institutional, and geographical factors. The idea of the 'technological paradigm' had been utilized to determine the potential directions the cluster has to pursue. From this outlook, two patterns of technological changes had been considered. The first one is the continuous technological innovation occurring along the technological paradigm and the second one is the discontinuous technological innovation known as the long waves, which results from all the commercial processes of the paradigm itself. Many components influence the appearance of new technological paradigms. Due to these continuous and discontinuous technological innovations, new techniques to manage and systematize the economy and this is what has been described as the 'new techno-economic paradigms' or the 'new technological styles'. In other words, the technological innovations enable draw the transformation paths from one cluster to another one by discovering the fundamental ingredients such as the abundant supply and rapidly falling costs (Silva & Teixeira, 2008).

As has been mentioned above, the diffusion occurs due to historical, cultural, institutional, and geographical factors. This shows that there are technological gaps between different economic systems or between sectors or even between the firms at the same sector. This means that while some sectors or firms achieve productivity improvements and increase their market shares in the economy, others may lose their competitiveness and reduce their market shares. In an international perspective, globalization removes barriers between countries and adds pressure on domestic products; the matter that requires finding new ways

to adopt the new and productive technological innovations in order to increase their productivity and enter into rivalries. The velocity in which the countries catch-up to the new innovations differentiates the successful countries from the unsuccessful ones. The countries that are equipped with the necessary capabilities and equipment guarantee catch-up, on the contrary, if market leaders raise their productivity, the poor countries are at risk of being “trapped” because of the lack of necessary innovation. The proficiency to adopt new innovations is shaped by the levels of demand, investment, and the degree of ‘technological congruence’ (Abramovitz, 1986).

Literature has emphasized two challenges by which the process of catch-up can take place: the structural transformation and the fundamentals. The first challenge assumes that achieving economic development requires rapid resources flowing from lower value-added to higher value-added sectors. In other words, the first challenge is based on the dual economy approach which sharply discriminates between the traditional sectors and the modern sectors with greater opportunities for accumulation, innovation, and productivity evolution. In this respect, manufacturing sector plays an imperative role, as the engine of economic growth. The second challenge assumes that sustained productivity growth can be attained by accumulating physical and human capital and generating new combinations of the economic structure based on the R&D activities.

These effects direct the associations between the micro and macro evolution in the economic structure. The internal productivity evolution and productivity enhancing selection must go hand in hand during the development process. So, the structural changes can generate sustained rapid growth on its own, but if it is not supported by accumulating the skills and the institutional capabilities, growth grinds to a halt. Furthermore, the accumulation of fundamentals, without transforming the resources to the higher productivity modern sectors; generates stable but sluggish growth. For developing countries, at least part of the economic growth can be achieved via structural transformation from productive sectors ranging from low- to high- productivity. If trade is not considered, such transformations may be caused by the change in demand conditions. According to Engel’s law; as the income of households increase over time, food consumption declines in terms of expenditures towards food. The enlargement in demand for manufacturing products will raise firms’ labor demand. Therefore, ‘surplus labor’ in the agricultural sector will migrate to fill the need in the manufacturing sector to a certain extent.

As soon as people settle for their nutrition requisites, they will start to consume superfluous manufacturing products. If income rises more, people will use their incomes to purchase services and products which exist at the top of the pyramid of needs. Once trade is taken into respect, only the comparative advantage determines the degree, direction, and the

force of labor mobility. In a given country, if the agricultural sector, for example, works in high labor productivity, then it will compete and deliberate development of other sectors, especially the manufacturing sector. But if this traditional sector works in low productivity, then it will include cheap 'surplus labor' which migrate to the industrial sector and as a result encourage industrialization.

2.1.4. Evolutionary Theories

The evolutionary growth theory perceives an economic process as an open-ended one which changes the average populations of the firms, creates competitive advantages, and finds the best technological solutions far from the optimal behavior and equilibrium paths. Therefore, the evolutionary theory suggests that economy entails firms that differ in their productivity due to market uncertainty, geographical location, capital vintages, availability of knowledge and input/output shares. That means that while some firms increase their market shares because of their high productivity levels, others lose their competitiveness due to lack of necessary knowledge or the capacities to assign probabilities or process information when making their decisions. Productivity improvements are based on innovations driven by technological progress.

2.1.4.1. Replicator Dynamics mechanism of evolution

Selection under constant returns

Under the assumption that: homogenous competing firms in perfect markets; suppose the unit cost for producing is h_i discriminates the firms from each other and reflects the firm's technology and behavioral rules. The prevailing profitable price during the supposed moment of time is p . More profits enable the firms to reinvest them to expand their production. The firms with no capability to yield profits or produce with a unit cost which is under the prevailing price are supposed to exit the market.

The picture here is a selection process resulting from the competition to produce with a lower cost. Of course, the cost of the ingredients ranges among firms. The firms' ability to grow can be represented by the following equation,

$$g_i = (p - h_i) \tag{2.1}$$

where the firms are homogenous in their propensity to accumulate (f) and invest the same proportion of their profits so as to expand their capacity to produce. Now, as firm i 's share in the overall output denoted by s_i , the mean unit cost is:

$$\bar{h}_s = \sum s_i h_i \quad (2.2)$$

In the same manner, g_i is firm i 's growth rate, the mean growth rate of the profitable firms is:

$$g_s = \sum s_i g_i \quad (2.3)$$

and

$$ds_i / dt = s_i(g_i - g_s) \quad (2.4)$$

which resulted in:

$$ds_i / dt = f s_i (\bar{h}_s - h_i) \quad (2.5)$$

This relation (2.5) symbolizes the distance from the mean unit costs and summarizes the selection process considered here. Two sets of growing firms concur at every moment of time: the firms that raise their market shares $p > \bar{h}_s > h_i$ and the firms that decrease their market shares $p > h_i > \bar{h}_s$

The two growing firms' entire population can be symbolized as:

$$\frac{d}{dt}(\bar{h}_s) = \sum_i \frac{ds_i}{dt} h_i = C_s(h_i, g_i) \quad (2.6)$$

Equation (2.6) summarizes the secondary theorem of selection and symbolizes the association between the average evolution and the covariance between the growth rates and the unit costs. Because the firms are homogenous in their propensity to accumulate; the variance in unit costs has been associated to the following covariance:

$$\frac{d}{dt}(\bar{h}_s) = -f V_s(h_i) \quad (2.7)$$

Equation (2.7) summarizes Fisher's basic theorem of selection and represents association between the variance within the population and its average reduction rate. As seen from comparing (2.6) and (2.7), $C_s(h_i, g_i)$ is negative meaning that higher growth rates are associated with lower costs. In a similar manner, the variance evolution rate can be symbolized as follows:

$$\frac{d}{dt} V_s(h) = f \sum_i s_i (h_i - \bar{h}_s)^3 = f K_s(h_i) \quad (2.8)$$

Where $K_s(h_i)$ symbolizes asymmetry of the unit cost distribution. Clearly, a symmetric unit costs' distribution, which results in a steady variance, which symbolizes the stabilizing selection. The selection process is a progressive process in terms of continuously reducing the mean of the unit cost not by decreasing the unit cost but by increasing the market share of the firms with the below mean unit costs. By the same token, the variance of the unit cost is close to zero in the

best practice firm in which output is ultimately strenuous.

Applying the growth rates of the individual firms to Fisher's fundamental theorem can be symbolized as:

$$\frac{d}{dt} g_s = \sum_i \frac{ds_i}{dt} g_i + \sum_i s_i \frac{dg_i}{dt} = V_s(g) + f \frac{dp}{dt} \quad (2.9)$$

The first term on the right-hand side of the equation symbolizes exact economic analogue to the Fisher Theorem. The second term symbolizes impact of environment and market price evolution on the firm's growth rate.

Taking into consideration that the evolution rates' variance is a secondary variance stemmed from the primary variance in unit costs across the individual firms, the previous relation becomes as follows:

$$\frac{d}{dt} g_s = f^2 V_s(h) + f \frac{dp}{dt} \quad (2.10)$$

Fisher argued that the selection process increases the mean growth rate; but the adverse selection decreases average growth rates. The market price can be formed when restraining the total output growth to meet an exogenous evolution rate of market demand as follows:

$$p' = g_D / f + \bar{h}_s \quad (2.11)$$

As Fisher's law couldn't be applied to the evolution rate, it had been applied to the rate of reduction in the market price as follows:

$$dp / dt = -f V_s(h) \quad (2.12)$$

Abstractly, there are two situations in the market: the case of unbalanced demand and the case of balanced expansion. In the case of balanced expansion, the output growth rate meets market's exogenous growth rate meaning that $p = p'$. In the case of unbalanced expansion, the output evolution rate will not meet the market's exogenous growth rate and the relationship that will connect the actual market price with the balanced one is as follows

$$g - g_0 = f(p - p') \quad (2.13)$$

Clearly, the discussion mentioned above reflects the replicator dynamics process which symbolizes the associations between the changes in the firm's weight and market share from one side and the distance between own unit cost and the mean unit cost on the other side.

The replicator dynamics of selection are dissimilar to the dynamic adjustment processes where the evolution is associated with the skewness from a given equilibrium position. The core feature of the replicator dynamics is that they reflect the actual not potential behaviors and discover an attractor, an outcome where all related diversity in behavior has been eliminated.

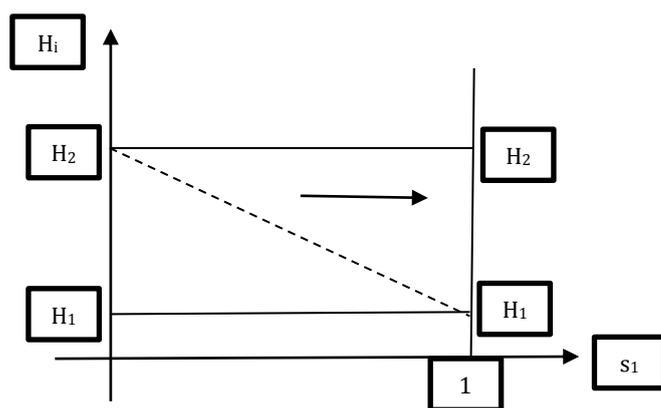


Figure 2.7. Selection under constant returns (two firms)

Source: Metcalfe, 1994.

Figure 2-7 explains the selection under the constant returns case when competition is between two firms. The horizontal axis represents the market share of the firm and the vertical axis represents the unit cost levels. Since firm one can produce a unit cost which is lower than that of firm two, it will continue to increase its market shares. Firm two will survive in the long run only if it has capacity to produce a unit cost which is lower than the market price. The slope of the dashed line which presents the path of the average cost shows the continuous competition between the two firms.

Selection under increasing returns

Explaining the selection under constant returns leaves open the issue of what happens when firm behaviors change in response to the selection process. Within economic literature, the theories of innovation and the theories of increasing returns explains the endogenous changes in firms' behaviors. Here, the Fisher principle works in line with Kaldor/Verdoorn principles of cumulative causation in that increasing returns raises the rate at which the mean unit costs are reduced. Increasing returns includes three characteristics: static internal economics, static external economics, and dynamic economics. The static internal economics are associated with the individual firm's output scale. The static external economics are associated with the industry's output and the firm's size in relation to that of the competing firms. The dynamic economics are associated with the internal accumulated experience and the external knowledge spillovers. The mentioned characteristics indicate that the population's structure is responsible for the behavior's variety. To wit: as the population structure (regarding competing firms' market shares) shifts, as does the variety and distribution of selective pressure. The internal dynamic economics will be explained here.

Let's consider a behavior function that symbolizes each firm' unit cost as follows:

$$h_i = h_i(x_i, E_i, L_i) \tag{2.14}$$

Where, x_i symbolizes the firm's current output, E_i symbolizes the external economies of scale,

and L_i symbolizes the accumulated dynamic internal economies. There is an inverse relationship between each of these arguments and the unit cost meaning that increasing the firm's output, its external or internal economies reduce unit costs.

Consider that

$$E_i = \phi_i(s_i)X \quad (2.15)$$

where X symbolizes the competing firms' overall output and $\phi_i(s_i)$ symbolizes the transfer function meaning that the firm's benefit degree from these economics. In this discussion, the $\phi_i(s_i)$ is supposed to be non-decreasing and equal to one. Suppose an increasing function of the firm's experience accumulation

$$L_i = \psi(\int_0^t x_i(t)dt) \quad (2.16)$$

Consequently,

$$\frac{dh_i}{dt} = \frac{\partial h_i}{\partial x_i} \frac{dx_i}{dt} + \frac{\partial h_i}{\partial E_i} \frac{dE_i}{dt} + \frac{\partial h_i}{\partial L_i} \frac{dL_i}{dt} \quad (2.17)$$

Consider the following elasticities:

$$\beta_i = \frac{-\partial h_i}{\partial x_i} \frac{x_i}{h_i}, \varepsilon_i = \frac{-\partial h_i}{\partial E_i} \frac{E_i}{h_i} \text{ and } \eta_i = \frac{\partial \phi_i}{\partial s_i} \frac{s_i}{\phi_i} \quad (2.18)$$

Consider that:

$$\gamma_i = \frac{-\partial h_i}{\partial L_i} \quad (2.19)$$

Since the marginal costs of expansion are supposed to be positive, then $\eta_i \leq 1$ and $\beta_i < 1$; also one must take into consideration that $\eta_i = 0$ for the pure externalities. When substituting these relations in equation (2.17) we can conclude that:

$$-\frac{dh_i}{dt} = \beta_i h_i g_i + \varepsilon_i h_i (\eta_i (g_i - g_s) + g_s) + \gamma_i x_i \quad (2.20)$$

Equation (2.20) summarizes the endogenous changes in the behavior of firms and it symbolizes firstly the learning economies associated with the current output, secondly the static internal economies associated with the evolution rate of output and thirdly complex external economies. While in the pure case $\eta_i = 0$ these accumulations are shared to the same extent by all firms; in the impure cases $1 \geq \eta_i > 0$ these accumulations are based on the variance between the average industry growth rate and the firm's growth rate meaning that there is a positive nexus between the market shares and the firms' proportion of available external economies. Combining equation (2.20) with the traditional selective forces as follows:

$$\frac{d\bar{h}_s}{dt} = \sum_i \frac{ds_i}{dt} h_i + \sum_i s_i \frac{dh_i}{dt} \quad (2.21)$$

Equation (2.21) summarizes the firms' mean unit cost evolution. Setting this equation requires supposing same elasticities $\beta_i, \varepsilon_i, \eta_i$ and the coefficient γ_i for all firms. The first ingredient on the right hand of equation (2.21) symbolizes pure selection. The second ingredient symbolizes ingredients' average evolutions in the single competitive characteristic. So,

$$\frac{-d\bar{h}_s}{dt} = (\beta + \varepsilon\eta - 1)Cs(h_i, g_i) + (\beta + \varepsilon)\bar{h}g_D + \gamma HX \quad (2.22)$$

By eliminating the covariance, it turns out to be

$$\frac{-d\bar{h}_s}{dt} = f(1 - \beta - \varepsilon\eta)V_s(h_i) + (\beta + \varepsilon)\bar{h}g_D + \gamma HX \quad (2.23)$$

Each ingredient of equation (2.23) represents a measure of population structure. The last ingredient presents dynamic learning economies' mean accumulation; which based on Herfindall index of concentration

$$H = \sum_i s_i^2 \quad (2.24)$$

Which had been illuminated as mean market weighted share. The mean of unit cost is affected by the dynamic economics. The second ingredient symbolizes the Kaldor Verdoorn principle and summarizes the relationship between decreasing mean of the unit cost and industry's evolution rate. The final ingredient symbolizes the Fisher principle ingredient, which summarizes the relationship between the variety of behavior and the growth rate of its mean. The principle had been applied at two levels: to the traditional selection process at certain unit cost and secondly to unit cost's evolution rate because of the accumulation of static internal and external economies of scale. As Schumpeter claimed, the evolutionary mechanism applies to the rate of economic variety generation in addition to the competitive selection across variety. This is an essential feature of the modern capitalist economies. Under the increasing returns to scale, the selection process consumes the diversity and regenerates it endogenously. In this case, the variety stimulates the behavior and output evolution based on the elasticity sum $\beta + \varepsilon\eta$. The external economies play the vital role since $\beta < 1$. The selection under the increasing returns to scale works gradually in terms of reducing the mean of the unit cost.

The difference between Pasinetti's analysis and replicator dynamics mechanism of evolution is that the former considers the demand side as mainspring of selection process while the latter considers the supply side more significant. Another difference between the two approaches is that the Pasinetti's analysis cannot be applied to the real data. On the other side, instead of considering each sector to be occupied by a single representative firm, the replicator dynamics mechanism of evolution takes into consideration both intra- and inter-sectoral

competition. Salter (1960) confirms that the mutual connection between the Inter-industry structure differentials and the variations of labor productivity evolution rates arise from technological progress that changes the structure of costs, output, prices and employment. Metcalfe (1998) using the replicator dynamics mechanism reports that while the firms with below-mean unit costs increase their market shares, others with above-mean unit costs decrease their market shares which eventually converge to zero forcing the firm to leave the industry (Metcalfe J. , 1998). The rate of decrease in the mean unit cost is ascribable to the changes in the unit costs of firms in the industry. In other words, higher changes in unit costs, faster mean unit costs decrease according to Fisher's fundamental theorem of selection. The decline in the mean unit cost increases the number of firms with above-mean unit costs because of increasing variance of the unit cost and forces them either to improve their productivity or to leave the market. Eventually, only firm with lowest unit costs gains the market shares and at that time the changes of the unit costs converges to zero (Metcalfe J. , 1994). Montobbio (2002) oversimplifies the standard replicator dynamics mechanism to analyze the process of selection driven by mutual relationship between the changes in unit costs on demand side and income elasticities at the industry level on the demand side. Such selection process inspires aggregate productivity evolution that arises from heterogeneities between labor productivity at the firm level.

2.1.4.2. Pasinetti's Model

Pasinetti's analysis had been implemented utilizing formal as well as appreciative theorizing, mixing positive and normative fundamentals. Built on the post-Keynesian and classical components, Pasinetti defined the structural change process as: the key source of long-run economic development. He supposed that under the conditions of full employment and stable prices, the structural change process prevails within a system of vertically integrated sectors, each sector of which leads to a particular final consumption good or set of such goods, by comprising all input combinations, which are calculated through an input-output system of horizontal relations. According to Pasinetti, the first force that derive the structural changes is the increasing productivity driven by learning in the production process. The second force is the changing consumer behavior driven by learning of new consumption patterns. These are accompanied by the evolution of population. Increasing productivity increases real income per capita the matter that changes the composition of the consumption expenditures due to the customer's basic needs/preferences' saturation and the desire for new goods and services according to Engel's law. Parallel to Fourastié's theory, Pasinetti ascribes the structural change process to the varying sectoral evolution rates of consumption patterns, which are exogenously

constant. In the same line, Pasinetti demonstrates parallels with Fourastié in that. For example, on the one hand the supply side is reflected by the increasing productivity growth and driven by the varying sectoral growth rates of technological progress, stimulates the process of the structural change. On the other hand, the demand side, is reflected by the sectoral and time differences in incomes' elasticities and determines the direction of the structural changes (Pasinetti, 1981). Pasinetti's assumption of considering each sector is populated by a single representative firm, which had been criticized by different approach based on the replicator dynamics mechanism of evolution.

2.1.4.3. The Three-Sector Hypothesis

The three-sector hypothesis is associated with dividing the economy into three main sectors which are: the primary, the secondary and the tertiary sector. The classification of these sectors has been discussed using different criteria. For example, dividing the economic sectors according to the hierarchy of needs is one criterion by which the primary sector includes the goods that meet the basic human needs. The secondary sector includes the standardized goods. And the tertiary sector includes the new goods (Fisher, 1939). Another criterion is classifying the main sectors according to their common characteristics. The primary sector for example includes agriculture, forestry, and fishery. The secondary sector includes all goods-producing and processing industries, and the tertiary sector includes construction, transport, communication, finance, public administration, personal services, etc. (Clark, 1957). Another different criterion is classifying the main sectors according to the same prevalent production factor that fosters their economic growth. Correspondingly, the primary sector includes industries which are based on natural growth factors, the secondary sector includes industries which are based predominantly on mechanical growth factors, and the tertiary sector includes industries which are based principally on the human skills (Wolfe, 1955). Finally, Fourastié divides the main sectors based on the technological progress. The primary sector includes industries with a medium rate of technological progress; the secondary sector includes industries with a high rate of technological progress, and the tertiary sector includes industries with a low rate of this progress. Fourastié claims that the economies pass through three stages of economic development. These are: the traditional civilization, the transitional period, and the tertiary civilization. In the first stage, the primary sector becomes increasingly important with respect to employment and value added, more than those of the secondary and tertiary sector. In the second stage: with the advent of industrialization driven by technological progress, per capita incomes increase leading to the transformation of consumers' preferences. These are concomitant with surplus labor from the primary sector to the secondary one. Put it simply,

saturation in primary sector, expansion in secondary, and stagnation in tertiary take place in the transitional period. In the third stage: with further income increasing, the secondary sector gains importance, accompanied by sustained intra-sectoral structural change that occur within each of the three sectors (Fourasti'e, 1949/1969).

2.1.4.4. Models Related to the Three-Sector Hypothesis

By the models related to the three-sector hypothesis, those that built on standard general equilibrium models according to Solow (1956), Ramsey (1928), Cass (1965) and Koopmans (1965), the economic growth can be derived by the non-homothetic preferences and exogenous technological progress. For example, Echevarria (1997) reveals that there is a mutual nexus between aggregate economic evolution and composition of the economic sectors. The structural change process, according to Echevarria, occurs when the composition of economic sectors changes. The mentioned change takes place through one dominant sector and governs the economy as a whole, decreasing the shares of the other sectors. This takes place regardless of that sector's rate of exogenous technological progress (Echevarria, 1997). Another model divides the economy into primary and secondary sectors. While land represents an important factor input in the primary sector, the capital is an important production factor in the secondary sector. Over time, the capital factor gains in importance versus a minor significance of the land factor: the matter that increases the average propensity to save. Through time, GDP per capita increases due to technological progress, leading to a transformation in demand from primary to secondary sector due to non-homothetic preferences according to Engel's law. Resultantly, share of primary sector in total output converges to zero and share of secondary tends to unite as its limit (Laitner, 2000). Kongsamut et al. (2001) also created a model that divides the economy into three sectors under the hypotheses of exogenous technological progress and non-homothetic preferences. They supposed that while the real interest rate is fixed, a decrease in the employment share of primary sector along with an increase in the employment share of tertiary sector and stagnation in secondary sector take place in the economy (Kongsamut, Rebelo, & Xie, 2001).

2.1.4.5. Multisector Growth Models

The multisector endogenous evolution models refer to those in which the number of sectors can be arbitrary or even a continuum. The fundamental instances of such models are Aghion & Howitt (1992) and Grossman & Helpman (1991). These endogenous growth models are considered as the seminal works of Schumpeter's (1942) creative-destruction theory, in

which increasing the aggregate productivity growth is mainly based on supplying new technology in order to create new products and new types of organizations far from the historical equilibrium paths. The industrial innovation endogenous evolution models of Grossman & Helpman in 1991 and Aghion & Howitt in 1992 also reported that there is a need to increase the spend on R&D activities to improve quality of capital goods, which in return increases the total factor productivity. This is achieved by providing the incentive for innovation, by which the old innovations are replaced in favor of new ones. Accordingly, the more productive firms increase their R&D expenditures on innovation and imitation, to introduce incremental improvements of products and processes that enables them to achieve more profits, invest more, grow faster, and increase their market shares. Consequently, the low productive firms will be forced to either improve their productivity or exit the market due to their lack of knowledge or their limited capacity to process the available information when making their decisions (Aghion & Howitt, 1992) and (Grossman & Helpman, 1991).

2.1.4.6. Emergence of New Sectors

One of the realistic aspects of the structural changes is the emergence of new sectors, or to put it simply, increasing the number of industries and sectors as Pasinetti (1981) reported. The sectors in such analysis are defined based on the concept of product space or product topology far from the official statistics. The product space or the product topology concept is based on the idea that the maximum level of the possible demand for each industry must not be constant. In order to increase the saturation level, firms must work to strengthen competitiveness by increasing the productive efficiency. This improves the product quality and investment in R&D activities the matter that leads to incremental innovations, which fills a niche in the product space. Thus, the competition plays an important role within one industry and between industries. Within industry, the intensity of competition is based on the density of firms and the degree of relatedness between their various products. Between industries, it is based on pairwise distance between them. When a niche in product space is filled by a new innovation, initial innovator enjoys monopoly and gains larger profits. With the entering of new firms, the entrepreneur's profits are eroded by the imitators, but the production capacity is increased to close the gap between the supply and the demand. This continues until the demand for the product of each sector becomes saturated. Eventually, the propensity to entering decreases due to increasing intensity of competition. On the contrary, firms tend to exit and search for a new niche. Searching for a new niche or an emerging new industry is mainly based on the productivity growth that ensures the necessary sources acquired in developing the new products, according to Fourastié's theory. The heterogeneous structure of the product space has

significant impacts on the structural change process. The variety of the economic system has importance on the economic growth since it reflects the scale of the technological progress. This reinforces the process of the structural change and leads to foster the learning process leading to the emergence of new industries (Saviotti & Pyka, 2004).

2.1.5. Evaluation

Innovation is the principal dynamic behind long run economic development. Without innovation, the economy will descend to a halt. However, innovation vanishes when imitators enter the scene. As stated by Schumpeter, this interdependence between innovation and imitation also induces growth. The “swarming” of imitators denotes that the evolution of the sector or industry in which the innovation takes place will, for a while, be quite high. Therefore, the more innovation, the higher creation of novelty and the more motivated the economy will be. It opens up “a window of clustering” that predominantly accelerates the development of products sharing the same space. Innovation may be set out by two mechanisms.

- 1- The first one is incremental learning pioneered by Lucas (1988, 1993).
- 2- The second one is investment in R&D advocated by Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992).

No precise prescriptions to be given. However, two main mechanisms give the opportunity to conclude whether or not the economic system is accomplishing in a satisfactory way.

- 1- The first mechanism is increasing the ability of the economic system to create new variety; in the sense that it is better for the entire economy to employ the resources into new types of activities, even with the predication that these would not do extremely well, than supporting R&D in well- instituted firms in traditional sectors.
- 2- The second mechanism is to increase the “carrier capacity” of the economic system for absorbing innovations to succeed in dealing with the “resistance to new ways” as Schumpeter formulated.

2.2. Empirical Review

2.2.1. Empirical studies

Economic evolution that stemmed from resource shifts are strictly ignored in old and new growth and development theories, despite the enormous resources transformation symbolized, by declining the share of agriculture and the enlargement of the shares of modern sectors, in overall output and employment. During the 1990's, numerous empirical studies stated that the importance of resource allocation to productivity growth was lower than expected. The main ingredient for such results is the applied weighting schemes that was utilized to quantify the evolution of a population as an aggregate process. Economists have only recently begun to systematically explore the developmental implications of structural change, by addressing the connections between the evolution at the microstructures and higher-level changes. For developed countries such as Japan, Germany, Britain, USA, Taiwan and South Korea, the involvements of the selection and within sectors productivity growth to overall aggregate productivity growth, have been well documented. However, only a small number of empirical studies measured the selection for the developing countries. To fill this gap, some recent studies have been conducted to investigate the magnitude of the selection effect in developing countries. For example, an edited book by Rodrik and McMillan (2011) that contain a collection of case studies about selection in some Asian, African, and Latin American developing countries was recently published.

By and large, the results of these and other case studies broadly distinguish between growth, based on fundamentals (Latin American case), and growth driven by structural change (African case). Only in East Asia was growth based on both, namely fundamentals and structural change (Rodrik, McMillan, & Sepulveda, 2015). McMillan and Rodrik (2011) reported that if structural or labor transformations occur as a result of the shifts from labor-intensive to capital-intensive sectors, then real output per worker will undergo an increase. Consequently, total evolution in real output per person will increase, due to a decline in the cost of production; the matter that involves the aggregate productivity growth even with no production increase within sectors. If labor productivity is constant, but relative prices increase over time, then firms' market shares of resources will increase. However, evolution of labor productivity adjusts relative prices. This implies that improvements in productivity reduce relative prices. Finally, one of the earliest and most significant components of literature on economic evolution is that economic development is inevitably associated with the process of the structural change. The nations that remain poor were the countries that were unable to shift their resources away from primary sectors to modern ones (Lin, 2012).

Today's developed countries are those which undergo a successful process of structural change in transforming their structure from resource based low productivity activities, to high productivity ones. Developing countries need to move away from lower to higher value-added and from lower-productivity to higher-productivity activities, sectors, or industries in order to change their structure and provide more welfare to their citizens. Promoting this type of evolution-enhancing selection leads to significant contributions to aggregate economic growth. Additionally, there is a relationship between the selection effect and the income levels. As incomes grow, traditional sectors' share of GDP shrinks dramatically, concurrently with an inverted U curve in manufacturing sector, and increase in service sector's share of GDP. As countries become richer, the natural resource endowments and the population size play leading role in the reallocation of resources between main economic sectors. However, the matter is different for the large economies, in which the manufacturing sector demonstrates a much higher share of GDP due to their larger domestic markets.

Developing countries witnessed a decrease in agriculture's share of GDP from 40% in 1950 to just 16% in 2005; but a temporally increasing manufacturing's share of GDP from 12% in 1950 to about 17% in the early 1980s. Turkey, for example, showed a significant decrease in agriculture's share of GDP from 49% in 1950 to 11% in 2005; accompanied by a growth in manufacturing's share of GDP from 11% in 1950 to 22% in 2005 (UNIDO, 2013). Additionally, the results of empirical studies assert that the patterns of structural changes can be recognized also by observing the differing significance of economic sectors at different moments of time. Manufacturing sector's value added has increased 11% during the period of (1950-2005) in Indonesia, the Republic of Korea, China, Thailand, and Malaysia. However, an inverted U-shaped curve has symbolized the nexus between manufacturing' output share and GDP per capita in Argentina, Brazil and Mexico. Even with initially similar stages of development, structural and compositional heterogeneities occur after a certain period such as the case of the Republic of Korea and Ghana. Despite the initial similitude in their structures in 1950; they had varied completely. The Republic of Korea decreased agriculture's portion by expanding that of manufacturing, but in Ghana the agricultural sector persisted to have the largest share.

Anderson & Holm (2014) emphasize that the analysis of the traditional directional selection can be systematized with analyses of the stabilizing selection and the diversifying selection; utilizing Price's equation which had been considered as useful in analyzing the different types of selection. On the contrary to the directional selection, the stabilizing and the diversifying selections change the variance without necessarily changing the average. While the stabilizing selection represents the negative change, the diversifying selection represents the positive change of the variance of the frequency distribution. The stabilizing selection eliminates any outliers, but the diversifying selection fosters the coexistence of behavioral

deviations. Anderson & Holm emphasizes the necessity of analyzing the three types of selection comprehensively to determine the signs of change in the economic evolution. Andersen (2004) argued that there is a necessity in the branch of evolutionary economics, to comprehensively analyzing the impacts of the change in the characteristic of populations. He argued that economists can apply the evometrics's tools to analyze the economic evolution such as the method of Price equation, which decomposes the short-term evolutionary change into two effects: the selection effect and the innovation effect.

The empirical literature makes use of many decomposition methods that measure the contribution of selection to overall productivity evolution at the firm level. For example, establishment-level data for the U.S. manufacturing establishments and selected service industries had been utilized to synthesize the literature on the nexus between micro and macro productivity evolutions; utilizing decomposition technique which weighted by inputs and outputs (Foster, Haltiwanger, & Krizan, Aggregate productivity growth: Lessons from microeconomic evidence, 1998). The results show that the entry of the high productive firms forces the low productive ones to exit the market, concurrently with reallocation of inputs and outputs towards the more productive establishments. Foster et.al. (1998) also presented alternative decomposition methodologies to explain the sensitivity to measurement methodology. The first methodology is that which is utilized by Baily, Hulten, and Campbell (1992) as follows:

$$\begin{aligned}
 \Delta P_{it} = & + \sum_{e \in C} s_{et-1} \Delta P_{et} (\text{within} - \text{growth}) \\
 & + \sum_{e \in C} (p_{et-1} - P_{it-1}) \Delta s_{et} (\text{between} - \text{growth}) \\
 & + \sum_{e \in C} \Delta p_{et} \Delta s_{et} (\text{cov arience} - \text{growth}) \\
 & + \sum_{e \in N} s_{et} (p_{et} - P_{it-1}) (\text{entry} - \text{effect}) \\
 & - \sum_{e \in X} s_{et-1} (p_{et-1} - P_{it-1}) (\text{exit} - \text{effect})
 \end{aligned} \tag{2.25}$$

where, P_{it} represents an index of industry productivity, s_{et} represents the share of plant e in industry i , and p_{et} represents an index of firm-level productivity. This equation distinguishes between three sets of firms: the continuing plants (C), the entrants (N) and the exiters. The equation decomposes the aggregate productivity growth into five ingredients: the first term is the within firm effect built on firm-level changes, leaden by initial shares in the industry. The second term represents the between-firm effect that shows changing shares, leaden by deviation of initial firm's productivity from initial industry's productivity. The between firm effect can positively alter the aggregate productivity growth only if the plants' initial productivity is higher than the mean productivity of the industry in the pre-evolution population.

Moreover, the third effect represents the covariance effect. The fourth represents the entry effect leaden by the deviation of firm's productivity, in post-evolution from industry's initial productivity. The entrants impact the aggregate productivity growth positively, only if the firm's productivity in the post evolution population is higher than industry's initial productivity. The fifth term represents the exit effect leaden by the deviation of firm's initial productivity in the pre-evolution from the industry's initial productivity. The exiting firms affect positively the overall productivity evolution, only if the firm's productivity in the pre-evolution population is lower than the industry's productivity in this. The equation suggested by Baily, Hulten, and Campbell can be considered as a comprehensive technique which determines the key ingredients of the aggregate productivity growth for the following reasons: distinguishing between the continuing firms, new entrants and the exiting firms; in addition to distinguish between within and between effect from one side and the cross/covariance effect on the other side.

1. Over the period from 1977 to 1987, the results of decomposition multifactor productivity at the industry-level for the U.S. manufacturing sector (under the method suggested by Baily, Hulten, and Campbell) showed that the within-firm effect accounted for approximately half of mean industry productivity evolution, the between-plant effect was negative but relatively trivial, and the cross effect accounted for about a third of mean industry evolution. Net entry effect accounted for 26% of mean industry evolution.
2. The results of labor productivity decomposition at the industry-level weighted by output per man-hour over the period from 1977 to 1987 for the U.S. manufacturing sector under same method showed that the within-firm effect accounted for 77% of mean industry productivity evolution. The between-plant effect was positive but relatively trivial (8 percent), and cross effect was negative and accounted for about 14% of mean industry evolution. Net entry effect accounted for 29% of mean industry evolution. The results of decomposition at labor productivity industry-level weighted by output per worker over the period from 1977 to 1987 for U.S. manufacturing sector showed that within-firm effect accounted for 74% of mean industry productivity evolution, the between-plant effect was positive but relatively trivial (8 percent), and the cross effect was negative and accounted for about 11% of mean industry evolution. Net entry effect accounted for 29 % of the mean industry evolution.
3. The results of decomposition multifactor productivity at industry-level over the period from 1977 to 1982 for U.S. manufacturing sector showed that within-firm effect was negative and accounted for 9% of mean industry productivity evolution, the between-plant effect was negative and accounted for about 33% of mean industry productivity

evolution (for shorter period between term became more significant), and the cross effect accounted for 1.16% of the mean industry evolution. Net entry effect accounted for 25% of the mean industry evolution.

4. The results of decomposition labor productivity at industry-level weighted by output per man-hour over the period from 1977 to 1982 for U.S. manufacturing sector showed that within-firm effect accounted for 1.22 of mean industry productivity evolution, the between-plant effect was positive and accounted for 85% of mean industry productivity evolution (for shorter period between term was more predominant), and the cross ingredient was negative and accounted for about 1.27 % of the mean industry evolution. Net entry effect accounted for 20% of the mean industry evolution.

The second methodology represented by Foster, Haltiwanger and Krizan is the one that had been used by Griliches and Regev (1995) as follows:

$$\begin{aligned}
 \Delta P_{it} = & + \sum_{e \in C} \bar{s}_e \Delta P_{et} (\text{within} - \text{growth}) \\
 & + \sum_{e \in C} (\bar{p}_e - \bar{P}_i) \Delta s_{et} (\text{between} - \text{growth}) \\
 & + \sum_{e \in N} s_{et} (p_{et} - \bar{P}_i) (\text{entry} - \text{effect}) \\
 & - \sum_{e \in X} s_{et-1} (p_{et-1} - \bar{P}_i) (\text{exit} - \text{effect})
 \end{aligned} \tag{2.26}$$

where the $(-)$ over the icon means its mean over the initial and post years. This equation distinguishes also between three sets of firms: the continuing plants (C), the entrants (N) and the exiters. The equation decomposes the aggregate productivity growth into four effects: the first term is within firm effect interpretable as the leaden sum of productivity with the weights equal to the mean shares. The second term represents between-firm effect that shows changing shares, measured by deviations of mean firm level productivity from mean overall industry level productivity. The third term represents the entry effect that indexed by deviations of entering firm's productivity from mean overall industry level productivity. The entrants impact the aggregate productivity growth positively only if entrants' productivity is higher than industry's mean productivity. Finally, the fourth term represents the exit effect that indexed by deviations of the exiting firm's productivity from mean overall industry level productivity. The exiters impact the aggregate productivity growth positively only if exiters' productivity is lower than industry's mean one. This method distinguishes between the continuing firms, the entrants and the exiters. The shortcoming of it is that the cross/covariance effects will be reflected by the within and between effects. The method suggested by Griliches and Regev seems to be less sensitive to measurement error in outputs and inputs comparing with that of Baily, Hulten, and Campbell. Consider, for instance, that output weights are utilized for the decomposition of multifactor productivity. An error in output would yield a positive covariance between productivity evolution and alterations in shares leading to a low within-firm impact according

to the method suggested by Baily, Hulten, and Campbell. Conversely, under the method suggested by Griliches and Regev, the within ingredient would not be affected by errors in output or inputs, the averaging will soften impact of the error. Similarly, imagine that labor productivity is computed as the output per worker-hour and there is an error in measured worker-hours. Such an error would lead to low measured productivity leading in turn to high within firm effect under method suggested by Baily, Hulten, and Campbell.

1. The results of decomposition multifactor productivity at industry-level over the period from 1977 to 1987 for U.S. manufacturing sector under the method suggested by Griliches and Regev exhibited that the within-firm effect accounted for 65% of mean industry productivity evolution, the between-firm ingredient was 10%. Net entry ingredient accounted for 25% of the mean industry evolution.
2. The results of decomposition labor productivity at industry-level weighted by output per man-hour over the period from 1977 to 1987 for U.S. manufacturing sector under the method proposed by Griliches and Regev presented that the within-firm effect accounted for 70% of mean industry productivity evolution, the between-plant effect was trivial. Net entry effect accounted for 30% of the mean industry evolution. The consequences of decomposition at industry-level labor productivity measured by output per worker over the period from 1977 to 1987 for the U.S. manufacturing sector under the method recommended by Griliches and Regev exposed that the within-firm effect accounted for 69% of mean industry productivity evolution, the between-plant effect was trivial. Net entry effect accounted for 30% of the mean industry evolution.
3. The outcomes of decomposition multifactor productivity at industry-level over the period from 1977 to 1982 for the U.S. manufacturing sector under the method recommended by Griliches and Regev displayed that the within-firm effect was positive and accounted for 49% of mean industry productivity evolution, the between-plant effect was positive and accounted for about 26% of the mean industry efficiency evolution (for shorter period between term became more significant). Net entry effect accounted for 25% of the mean industry evolution.
4. The results of decomposition labor productivity at industry-level weighted by output per man-hour over the period from 1977 to 1982 for the U.S. manufacturing sector under the method advised by Griliches and Regev presented that the within-firm effect accounted for 59% of mean industry productivity evolution, the between-plant effect was positive and accounted for 21% of mean industry productivity evolution (for shorter period between term was more predominant). Net entry effect accounted for 20% of the mean industry evolution.

Foster, Haltiwanger and Krizan (1998) shed some lights on the variations between the

magnitude of these effects across different methods by examining simple correlations of firm level growth rates upon the periods of (1977-1987) and (1977-1982). An inverse correlation signified the relationship between productivity- and labor- evolution, and underscored negative cross effect using employment or man-hours weights upon the period 1977-1987. Likewise, there was a positive nexus between productivity- and output- evolution which underscored the positive cross effect in the decompositions employing output weights. Regardless of the decomposition method, the net entry plays an eminent role in accounting for overall productivity evolution. Entering firms' shares of output in 1987 were 21%, their shares of employment were also 21%. Exiting firms' shares of output in 1977 were 22 percent, their shares of employment were 25 percent. The entrants' productivity in 1987 was higher than exiters' and continuing ones in 1977. The continuing firms increased their productivity during the period from 1977 to 1987. Also, the continuing firms' productivity in 1977 was higher than that of the exiters in 1977.

Another point of view, 25 percent of multifactor productivity growth is responsive to the net entry effect; despite that exiters' share of output is 22 percent and the entrants' share of output is 21 percent. Likewise, about 30 percent of labor productivity growth is responsive to the net entry effect; notwithstanding that exiters' share of output is 25 percent and the entrants' share of output is 21%. This can be ascribed to the fact that the productivity's gap between entrants and exiters is higher than the gap among continuing firms across time.

The third methodology represented by Foster, Haltiwanger and Krizan is the one that had been used by Olley and Pakes (1996) as following:

$$P_{it} = \bar{P} + \sum_{e \in C} (s_{et} - \bar{s})(p_{et} - \bar{P}) \quad (2.27)$$

where, the (-) over the icon means the cross-sectional average across all firms in the same industry. This decomposition offers insights whether allocation of activity becomes either more or less productivity augmenting. The method of Olley and Pakes does not take the entry and exit effects into consideration and it is less sensitive to the measurement errors. The corollaries of decomposition at industry-level multifactor productivity for the U.S. manufacturing sector revealed that the overall productivity increased from 1.62% in 1977 to 1.73% in 1987. Additionally, the consequences discovered that an increase from 1.57% in 1977 to 1.67% in 1987 in unweighted average productivity, across firms accompanying with an increase in cross ingredient from 5 percent in 1977 to 6 percent in 1987. The corollaries of decomposition at the industry-level labor productivity computed as the output per worker-hour for the U.S. manufacturing sector revealed that the overall productivity increased from 4.12% in 1977 to 4.37% in 1987. In addition, the outcomes uncovered that an increase from 4.01% in 1977 to 4.21% in 1987 in the unweighted mean productivity across firms accompanied by an increase in

the cross ingredient from 11 percent in 1977 to 15 percent in 1987. The corollaries of decomposition at the industry-level labor productivity computed as the output per worker for the U.S. manufacturing sector, revealed that the overall productivity increased from 4.80% in 1977 to 5.06% in 1987. Additionally, the effects showed that a rise from 4.67% in 1977 to 4.90% in 1987 in the unweighted average productivity across firms accompanying with an increase in cross ingredient from 13 percent in 1977 to 16 percent in 1987. Such results entail that during the period between 1977 and 1987 the reallocation of both outputs and inputs was productivity enhancing.

In a similar manner using the methods of Bailey, Hulten and Campbell (1992), Foster, Haltiwanger and Krizan (1998) and Griliches and Regev (1992); Disney, Haskel & Heden (2003) utilized the UK (1980-92) manufacturing data to investigate the credence of the 'internal' and the 'external' restructuring to the aggregate productivity evolution at the establishment level. They thought of within firm ingredient as the "internal restructuring" effect, and the rest of the ingredient as the "external restructuring" effects. In general, the results show that 50% of establishment labor productivity evolution and 80-90% of the establishment "TFP" evolution can be ascribed to the entering of the more productive multi-establishment firms and exiting of the less productive ones. The entering establishment had the ability to compete with the existing firms, due to the innovations in terms of new technology adoption and the organizational changes among survivors. More particularly, based on the method of Bailey, Hulten and Campbell; the between ingredient was 38 percent but it was smaller under other methods (4 percent based on the method of Foster, Haltiwanger and Krizan and -1 percent under the method of Griliches and Regev). The net entry effect was large under the method of Foster, Haltiwanger and Krizan (49 percent) and the method of Griliches and Regev (53 percent); but it was minor under the approach of Bailey, Hulten and Campbell (14 percent). Disney, Haskel & Heden (2003) suggested that the evaluation of the restructuring effects using the method of Bailey, Hulten and Campbell maybe problematic based on Haltiwanger (1997) observation and the small contribution of the net entry is an evidence of that.

In other words, as the exiters' market share is larger than the entrants, the net entry becomes smaller and the continuing firms' market shares improves. Disney, Haskel & Heden also reported that both methods of Bailey, Hulten and Campbell and Foster, Haltiwanger and Krizan give same figure of the internal restructuring effect. Under the method of Griliches and Regev, the effect of the internal restructuring effect is larger because it embraces some of the between/cross effect. So, 50 percent of the overall labor productivity evolution rate had been accredited to the net entry effect. The results from decomposing TFP are as follows: negative contribution of the net entry effect under the method of Bailey, Hulten and Campbell, the internal restructuring contributes only between 5% and 18% of the productivity growth under

the methods of Foster, Haltiwanger and Krizan and Griliches and Regev respectively. The between and the cross effects were approximately 20% and 26% respectively under the method of Foster, Haltiwanger and Krizan. Disney, Haskel & Heden (2003) concluded that the external restructuring comprises around 50 percent of labor productivity growth during the period of (1980-1992). Conversely, the net entry comprises over half of TFP growth and the within effect is, at most, 18%. Thus, external restructuring comprises over 80% of TFP growth. Albeit one counts the cross effect as an internal ingredient, external ingredients still comprise 70% of TFP growth. Disney, Haskel & Heden (2003) dig deeper into decompositions and divides the ingredients into those due to firms that are singles and those where firms are multi-establishment during the interval of (1980-1992), under the method of the Foster, Haltiwanger and Krizan. Their results from decomposing the aggregate labor productivity showed that, whereas the surviving multi-establishment firms were responsible for 44.6 percent of inclusive productivity growth, the surviving single firms' contribution was negligible. Additionally, while the net entry by surviving single firms comprised about 16% of overall productivity evolution; the net entry by the surviving multi-establishment firms were responsible for about double this amount.

The results from decomposing the TFP showed that the net entry by the surviving multi-establishment firms were responsible for 41% of productivity growth with very little contribution of the within effect. Disney, Haskel & Heden (2003) assess the strength of these outcomes and ascribe the measurement error to three causes which are: first, classical measurement error in employment overstates the within-plant effect; second, the capital employment ratios, thus if small firms have lower capital employment ratios, too much capital is allocated to smaller firms and too little to larger ones; third, overstating (understating) the within and cross effect at a boom (recession) due to mismeasurement of hours. They concluded that measurement error gives large external impacts due to overstating the within effects for the labor productivity growth and giving offsetting effects for the growth of total factor productivity.

Furthermore, Disney, Haskel & Heden explored the sensitivity of entry, exit and survival to the length of intervals chosen. They utilized data for labor productivity and total factor productivity evolution which resulted by applying the methods of Foster, Haltiwanger and Krizan and Griliches and Regev over three sub periods, two slumps: (1980-1982) and (1989-1992) and one boom (1982-1989). The results of decomposing labor productivity are constant, illustrating that the net entry effect persists at over 40% irrespective of the interval chosen.

The results of decomposing total factor productivity revealed that the net entry effect is lower when the interval shortened. Disney, Haskel & Heden (2003) suggest three causes for this. First, the underestimation of hours over the boom leads to overstating the within effect and

decreasing the net entry effect over the chosen period. Second, the mismeasurement problems are prone to be strict over the shorter periods. Third, their results cope with those from the US that claim that within effects are more significant in booms.

Kruger (2008) utilized the decomposition formula offered by Baily et al. (1996) to explore the effects of overall productivity evolution employing detailed data for the four-digit US manufacturing industries during the period of (1958– 1996) as follows:

$$\begin{aligned} \frac{\Delta \bar{a}_{t+1}}{\bar{a}_t} = & + \frac{\sum_{i=1}^N s_{it} \Delta a_{it+1}}{\bar{a}_t} \text{ (within - growth)} \\ & + \frac{\sum_{i=1}^N \Delta s_{it+1} (a_{it} - \bar{a}_t)}{\bar{a}_t} \text{ (between - growth)} \\ & + \frac{\sum_{i=1}^N \Delta s_{it+1} \Delta a_{it+1}}{\bar{a}_t} \text{ (covariance - effect)} \end{aligned} \quad (2.28)$$

where, s_{it} symbolizes the share that industry i has in total employment or value added in period t and a_{it} symbolizes productivity level of industry i in period t (which may be labor productivity or multi factor productivity). The aggregate productivity growth during the period of $(t-t+1)$ is symbolized in the left side equation (2.28).

The first term on the right-hand side of the decomposition equation represents within effect, which can be defined as the share-weighted mean internal productivity evolution of the individual industries. Moreover, the second term represents between effect; which positively concern the overall productivity evolution if the industries' above-average productivity levels are accompanied by increasing shares during the interval from t to $t+1$ on average; and the industries' below-mean productivity levels are accompanied by decreasing shares during interval from t to $t+1$ on average. There is a close correspondence of between effect to a discrete-time version of the familiar replicator dynamics mechanism. This mechanism correlates firm productivity levels above (below) the share-weighted mean in the industry to growing (shrinking) shares. It can be formalized as:

$$\Delta s_{it} = \lambda s_{it} - k (a_{it} - \bar{a}_{t-k}^s) \quad (2.29)$$

where, $\lambda > 0$ signposts the velocity of the selection. When the between effect is positive then above-mean productivity levels in period $t-k$ tend to be concomitant with positive share evolution during periods t and $t-k$ and below-mean productivity with negative share growth.

In contrast to this, if below-mean productivity plants tend to grow in terms of shares and above-mean productivity firms tend to shrink in terms of shares; the between effect will be negative, thus contradicting the replicator mechanism. The third term represents the covariance-type term, positively concern the overall productivity growth if evolution of

industries' shares and the evolution of industries' productivity have the same trends. The selection effect symbolized the sum of the between effect and the covariance one. Kruger (2008) applied the decomposition formula using the data of more than 450 manufacturing industries at the four-digit level to determine the sources of the overall labor productivity evolution with utilizing either value-added or employment shares. He calculated the labor productivity as real value added divided by the total number of hours worked in the industry at certain year. He examined key sources of the aggregate labor productivity growth over the entire period of (1958–1996), sub periods before and after the first oil crisis means (1958-1973) and (1974-1996) and the sub period before the computer revolution means (1958-1990). Additionally, he classified the four-digit manufacturing industries into two groups: the high-technology industries and the low-technology industries based on the classification suggested by Hadlock et al. (1991). By high technology industries, he is referring to those that have an intensity of R&D employment equal to the mean proportion for all industries surveyed. Whereas the other industries are classified as low technology. Kruger also classified the four-digit industries utilizing another two criteria: the first one classified them into durable goods producing and nondurable goods producing industries; and second criteria classified them into industries with increasing and industries with decreasing shares. Furthermore, he investigates the patterns of the overall labor productivity evolution when excluding industries that are associated with the computer revolution. When decomposing aggregate productivity growth utilizing the value-added shares; findings exhibited that productivity's average annual rate during the entire period of (1958–1966) is 6.3 percent. The key source of the labor productivity during this period was the within effect which was responsible for about two thirds of the aggregate growth. While the between was close to zero, the covariance effect was positively responsible for the remaining third. As the selection effect is computed by summing the between and the covariance effect; it concerns productivity evolution in a way that industries with increasing labor productivity tend to be concomitant with increasing value-added shares. Before the first oil crisis, the results exhibited that the aggregate productivity's average annual rate is 3.9 percent. The key source of the labor productivity during this period was the within ingredient (4.02 percent). While the between was negative (-0.2 percent), the covariance effect was positive (+0.1 percent). The selection ingredient affected negatively (-0.2+0.1=-0.1) the aggregate labor productivity growth. This signposts that the overall labor productivity evolution during the entire period is driven by growth accomplished in the period after the first oil crisis, due to computer revolution by which information technology becomes dominant for all parts of economic life. From another point of view, the aggregate productivity growth was more responsive to the selection implied by the covariance effect for high-tech industries and durable goods producing industries than low-tech industries and non-durable goods producing

industries. Furthermore, although a large positive covariance effect affects the aggregate productivity growth for the industries with increasing value-added shares show, a smaller covariance effect influences aggregate growth for the industries with decreasing value-added. The within effect was responsible, to a large extent, for the aggregate labor productivity for the latter industries. When decomposing the aggregate productivity growth utilizing the employment shares, the results exhibited similar patterns to those with value added shares. There were however some exclusions related to lower aggregate labor productivity growth for most sub periods and industry subgroups from one side and on the other, the substantially attenuated contribution of the covariance ingredient. Kruger wrote that it is natural that overall productivity evolution is smaller when employment shares are utilized in place of the value-added shares. However, the selection effect in the manufacturing sector is more robust in terms of value added than employment. Kruger also discussed an extended version of the productivity decomposition formula of Baily et al. (1996) as following:

$$\begin{aligned}
 \frac{\Delta \bar{a}_{t+1}}{\bar{a}_t} (\text{Productivity} - \text{growth}) = & \\
 & \left[\frac{\sum_{j=1}^n \Delta s_{jt+1} (\bar{a}_{jt} - \bar{a}_t)}{\bar{a}_t} (\text{Between} - \text{growth}) + \right. \\
 & \left. \frac{\sum_{j=1}^n \Delta s_{jt+1} \Delta \bar{a}_{jt+1}}{\bar{a}_t} (\text{Covariance} - \text{growth}) + \right] \text{2digit} \\
 & \left[\frac{\sum_{j=1}^n s_{jt} \sum_{i=1}^{nj} s_{it}^j \Delta a_{ijt+1}}{\bar{a}_t} (\text{Within} - \text{industry}(4 - \text{digit})) + \right. \\
 & \left. \frac{\sum_{j=1}^n s_{jt} \sum_{i=1}^{nj} \Delta s_{it+1}^j (a_{ijt} - \bar{a}_{jt})}{\bar{a}_t} (\text{Between} - \text{industry}(4 - \text{digit})) + \right] \text{[2digit (within} - \text{growth)]} \\
 & \left[\frac{\sum_{j=1}^n s_{jt} \sum_{i=1}^{nj} \Delta s_{it+1}^j \Delta a_{ijt+1}}{\bar{a}_t} (\text{Cross} - \text{industry}(4 - \text{digit})) \right] \tag{2.30}
 \end{aligned}$$

where, s_{ijt} symbolizes the share that four-digit industry $i \in \{1, \dots, n_j\}$ has in inclusive employment or value added, pertaining to the two-digit major group $j \in \{1, \dots, n\}$ in period t . This can be rephrased as the product of the share of the share of the two-digit major group j in the total s_{jt} and the share of the four-digit industry i in the two-digit major group j , s_{it}^j , therefore

$$S_{ijt} = S_{jt} \cdot S_{it}^j \quad (2.31)$$

Simultaneously, a_{ijt} symbolizes the productivity level of the four-digit industry i pertaining to the two-digit major group j in period t .

Then;

$$\bar{a}_{jt} = \sum_{i=1}^{nj} S_{it}^j a_{ijt} \quad (2.32)$$

which represents the (share-weighted) mean productivity level of the two-digit major group j

$$\text{and } \bar{a}_t = \sum_{i=1}^{nj} S_{it}^j a_{ijt} = \sum_{j=1}^n \sum_{i=1}^{nj} S_{ijt} a_{ijt} \quad (2.33)$$

which denotes the overall productivity level of manufacturing sector in period t . The first term on the right-hand side of the decomposition equation represents between effect for the two-digit level. The second term represents the covariance effect for the two-digit level. The sum of the remaining three terms represents within effect for the two-digit level. This consists of within-, between-, and cross-industry covariance effect at the four-digit industries. According to this equation, the within effect at the two-digit level is more controlling than it is at the four-digit level. Additionally, as Kruger stated, the selection effect seems to be noticeably less pronounced at the two-digit level compared to the four-digit. The within-industry effect is ruling, but between-industry effect is trivial.

Bottazzi et.al. (2010) exploited Italian and French industrial firms' panel data to examine the dynamics of the structural change through examining the nexus linking productivity, profitability, and evolution at the firm level. The results suggested a much weaker selection effect due to the weak connections of corporate evolution, with either productivity or profitability, despite the fact that heterogeneity in productivity produces persistent profitability differentials. They decompose aggregate productivity evolution at three-digit levels as following:

$$\begin{aligned} \Delta \Pi_{j,t} &= \Pi_{j,t+1} - \Pi_{j,t} = \\ &+ \sum_i \Delta \Pi_i S_i(t) (\text{within} - \text{growth}) \\ &+ \sum_i \Delta S_i \Pi_i(t) (\text{between} - \text{growth}) \\ &+ \sum_i \Delta \Pi_i \Delta S_i(t) (\text{covariance} - \text{growth}) \end{aligned} \quad (2.34)$$

where the overall labor productivity of sector j can be symbolized as

$$\Pi_{j,t} = \frac{\sum_{i \in j} VA_{i,t}}{\sum_{i \in j} L_{i,t}} = \sum_{i \in j} \Pi_{i,t} S_{i,t} \quad (2.35)$$

$L_{i,t}$ symbolizes the number of employees, $VA_{i,t}$ symbolizes the value added of establishment i at time t .

And

$$s_{i,t} = L_{i,t} / \sum_{i \in j} L_{i,t} \quad (2.36)$$

which symbolizes employment share of firm i in its sector j . The first term on the right-hand side of the decomposition equation represents within effect. The second term exemplifies between effect. Finally, the third term signifies an interaction effect capturing the co-variations between firm productivities and shares. Bottazzi et.al. concluded that the within effect was responsible for most of the overall productivity evolution, and dictated over between effects. They reported that the generally negative impact of the covariance effects cast further light on the low efficiency of selection dynamics; accompanied by the traditional wisdom that the firms which raise their efficiencies tend to undergo a decrease in shares. Bottazzi et.al revealed that the persistent inter-firm heterogeneity can be connected to different degrees of efficiencies, idiosyncratic learning, innovation and adaptation. Various degrees of productivities seem to produce persistent profitability differentials. In other words, contemporary markets do not seem to be overly efficient selectors regarding the relative sizes or shares, according to differential productivities. Selection takes place as the chief effect of industrial dynamics among diverse alternatives of a technology, vintages of equipment and lines of production. Nevertheless, it materializes within establishments, motivated by replacement of older processes of production and the application of more productive ones.

Holm (2014) utilized Danish data for the period of (1992–2010) to decompose the overall productivity evolution using Price equation by which the levels of the selection process had taken into consideration concurrently with the roles of the learning, the entry and the exit of the firms as following:

$$\begin{aligned} \Delta Z = & + \sum_{i \in C} s_i (z_i - Z) (\textit{selection} - \textit{effect}) \\ & + \sum_{i \in C} s'_i \Delta z_i (\textit{learning} - \textit{effect}) \\ & + \sum_{i \in N} s'_i (z'_i - Z) (\textit{entry} - \textit{effect}) \\ & - \sum_{i \in X} s_i (z_i - Z) (\textit{exit} - \textit{effect}) \end{aligned} \quad (2.37)$$

where, s_i symbolizes the firm size in the pre evolution population, z_i symbolizes firm's productivity in the pre evolution, s'_i symbolizes firm size in the post evolution population, z'_i symbolizes firm's productivity in the post evolution population and Z represents the population productivity on average. This equation also distinguishes between three sets of firms: the

continuing plants (C), the entrants (N) and the exiters (X). The equation splits the overall productivity evolution into four effects: selection-, learning-, entry-, and exit-impact respectively. It had been comprehended as the single level Price's equation. Holm expanded single level to the multilevel decomposition of aggregate productivity evolution by replacing the symbol i for firms with the symbol j for industries as following:

$$\begin{aligned}
 \Delta Z &= \sum_j \Delta s_j (z_j - Z) (\text{industry - selection - effect}) \\
 &+ \sum_j s'_j \sum_{i \in C_j} \Delta s_{ij} (z_{ij} - z_j) (\text{firm - selection - effect}) \\
 &+ \sum_j s'_j \sum_{i \in C_j} s'_{ij} \Delta z_{ij} (\text{learning - effect}) \\
 &+ \sum_j s'_j \sum_{i \in N_j} s'_{ij} (z'_{ij} - z_j) (\text{entry - effect}) \\
 &- \sum_j s'_j \sum_{i \in X_j} s_{ij} (z_{ij} - z_j) (\text{exit - effect})
 \end{aligned} \tag{2.38}$$

The equation splits the overall productivity evolution into five effects: industry selection-, firm selection-, learning-, entry-, and exit-impact respectively. The advantage of utilizing the multilevel method correctly captures the industrial dynamics of structural transformation away from high-labor productivity and capital-intensive manufacturing, towards low-labor productivity. Therefore, this results in and thus less capital-intensive services. Holm decomposed the aggregate productivity growth over the entire early period (1992-1999) and the entire latter period (2000-2010) by means of both single and multilevel techniques. Moreover, he compared the results from decomposing the aggregate productivity growth over the periods of (1993-1997) and (2003-2007) because they are equal in length and comparable in terms of the business cycle stage. Furthermore, he assessed outcomes over entire periods with ones over sub periods, as a result of decomposing the entire period and then summing results. For example, he utilized the data of 1992-1998 which enables comparison of the impacts of studying a period of 6-year period versus to two sub periods of three years, three periods of two years and six individual years. Likewise, 2000-2008 data enables for comparison of the impacts of studying a single 8-year period versus to those subdivided into two four-year brackets, four two-year brackets, and eight individual years. Moreover, he divided the period of 2000-2010 into three stages: the trough stage during the period of 2000-2003, the expansion stage during the period of 2003-2007 and the contraction stage during the period of 2007-2010.

The results exhibited that the aggregate productivity's growth rate during the entire period of (1992-1999) is 3.42 percent. The key sources of labor productivity during this period according to the multilevel technique was responsive to three effects: the selection effect, which was responsible for 64 percent of the evolution, the entering of the high productivity firms

which was responsible for 34 percent and the exiting effect which was responsible for 30 percent. The industry selection effect was negatively responsible for 22 percent. The negative industry selection effect signals favoring the low productivity industries. When decomposing the aggregate productivity growth according to the single level technique, the results showed that the selection, entry, and the exit effects were lower from those resulting from utilizing the multilevel technique. This result is accompanied by a process of selection which takes place towards labor-intensive service industries. Holm concluded that the single-level technique underestimates the effects of reallocation, entry and exit because that it does not consider the process of structural transformation of the economy. The industry selection effect affects the overall productivity evolution positively during period of (2000-2010) meaning that the labor transformation occurs from the labor-intensive industries to those which were capital-intensive. Holm concluded that the single level technique overestimates the effect of selection. During this period, the entry and the exit effects were low, meaning that despite industry selection favoring capital intensive industries, entrants lean towards setting up in labor intensive industries. When analyzing the results over shorter periods, the entry effect becomes smaller; but this does not mean that the value of the entry effect will approach zero as the period becomes shorter. The entry effect contributes negatively to the aggregate productivity growth during the periods of (1992-1998) and (2000-2008); meaning that the productivity of the entrants doesn't distributed randomly around the average productivity of the industry they are entering.

Likewise, over shorter periods, the exit effect becomes larger; meaning that the exiters lean towards having low productivity. Additionally, the firm selection effect becomes more robust over shorter periods. Holm reported that the firm selection effect becomes stronger when the two intervals are closer to each other; determining that the nature of liaison between the industry selection effect and time is problematic. In the 1992-1998 period, the selection effect is more closely captured when the period is shortened, and it approaches zero as short periods are studied. When observed from a different perspective, one notices that the industry selection ingredient affects overall productivity evolution positively in the trough and the contraction time, although it contributes negatively to the total productivity evolution in the expansion time. This implies that the allocation of sources takes place towards the lower-skill industries in the expansion time; but in the trough and the contraction time, it takes place towards the capital-intensive industries. The firm selection effect contributes more robustly to the total productivity evolution during the trough time; stemmed from the firms' inability to produce using their full capacity. The exit effect was lower in the expansion time. This indicates that during the trough and contraction, the exiters from the low productivity industries don't have low productivity comparing to the rest of their industry. The entry effect was lower in the

expansion and the contraction time; but entrants' productivity in the trough time are closer to the average of their industry's distribution. Holm reported that the service sector grew at the expense of manufacturing during the studied intervals of 1990s and 2000s. The sharing of manufacturing sector was low in 1990s but high in 2000s. The lethargy of the manufacturing sector in the 1990s stems from the decrease in the highly productive dairy, and the production and processing of meat industries. Additionally, Holm attributed the high involvement of manufacturing in the 2000s to the decrease of low productivity furniture manufacturing and the increase of high productivity pharmaceutical manufacturing. In a like manner, the negative industry selection from services is stemmed from lessening high productivity services particularly shipping, growing low productivity services particularly retail, and growing high productivity services, particularly software.

Baldwin & Gu, (2006a) utilized Canadian manufacturing industries data to examine the impact of the firm turnover occurred as the market share transferred from one firm to another. The results show that the competition is the patterns of the total productivity evolution because the competitive process is responsible for the entering of the more productive firms and exiting of the less productive ones. Baldwin & Gu utilized the data of an average 4-digit SIC Canadian manufacturing industry during the intervals of (1979-1989) and (1989-1999). They split the within shift effect into two effects: the first one is the effect stemmed from the growth of the continuing firms that expand their market shares, and the second one is the effect of the continuing firms that decrease their portion in the market. They revealed that the plants that win in the productivity race are responsible for most of the within-plant's effect.

Baldwin & Gu reported that the overall labor productivity evolution is responsive to selection of output and firm turnover more than the within growth effect. During both studied intervals of (1979-1989) and (1989-1999); 70% of overall labor productivity evolution is responsive to net entry effect and the continuing firms that expand their market portions. During both the studied intervals, 40% of the 70% of the overall labor productivity is responsive to the continuing firms' market portions' reallocation; 24% of the 70% of the overall labor productivity is receptive to the merger and acquisition, and 5% of the 70% of the overall labor productivity is approachable to the greenfield entrants and close-down exits. The residual 30% is reactive to the continuing firms' productivity growth. Baldwin & Gu claimed that the reallocation of the output is responsible for much of the overall labor production increase more than the net entry effect. They reported that the entrants that build new firms are less significant to the overall productivity growth than those entrants who merge and acquire the plants of the exiters. Furthermore, they claimed that the contribution of the between firm effect will decrease from 70% to 50% when transferring the merger effect to the within firm effect. They concluded that during the interval of (1979-1989) growing firms which expand their

market portions contributed 23.8% to the overall labor productivity growth and declining firms which losing their market portions contributed 4.0% to the overall labor productivity growth. They attribute this consequence to the competitive process that takes place between the growing firms. Baldwin & Gu distinguish between the firm turnover and the plant turnover in terms of that the firms reinvent themselves by opening and closing plants. During the interval of (1989-1999), the sources of market share gains in incumbents were: a gain of (14.4 %) from growing plants, a gain of (15.2%) from new plants, a loss of (1.6 %) from declining plants, and a loss of (3.3 %) due to closed plants. The sources of market share losses in incumbents during the same interval were a loss of (7.0%) from deteriorating plants and a loss of (9.5 %) due to closed plants. Baldwin & Gu concluded that the contribution of the across-plant reallocation is smaller than that of cross-firm. The former is accounted for 68.4% and 65.0% of the overall labor productivity growth during the intervals of (1979 -1989) and (1989 - 1999) respectively. The decomposition technique utilized by Baldwin & Gu is of great interest, thus it is beneficial to analyze.

$$P_t = \sum s_{it} p_{it} \quad (2.39)$$

Differentiated:

$$dP_t = \sum s_{it} dp_{it} + \sum ds_{it} p_{it} + \sum ds_{it} dp_{it} \quad (2.40)$$

Rewritten

$$P_t - P_{t-\tau} = \sum s_{it-1} (p_{it} - p_{it-1}) + \sum (s_{it} - s_{it-1}) p_{it-1} + \sum (s_{it} - s_{it-1}) (p_{it} - p_{it-1}) \quad (2.41)$$

The labor productivity evolution:

$$\Delta P_{t,t-\tau} = \sum_i s_{it} p_{it} - \sum_i s_{it-\tau} p_{it-\tau} = \sum_{i \in C} (s_{it} p_{it} - s_{it-\tau} p_{it-\tau}) + - \sum_{i \in X} (s_{it-\tau} p_{it-\tau}) \quad (2.42)$$

The counterfactual value of output:

$$\hat{y}_{it} = s_{it-\tau}^y Y_t, \text{ for } i \in C \text{ and } i \in X \quad (2.43)$$

The counterfactual value of employment:

$$\hat{l}_{it} = \hat{y}_{it} / p_{it} = \left(\frac{s_{it-\tau}^y}{s_{it}^y} \right) l_{it} \text{ for } i \in C \text{ and } \hat{l}_{it} = \hat{y}_{it} / p_{it-\tau} = \frac{Y_t}{Y_{t-\tau}} l_{it-\tau} \text{ for } i \in X \quad (2.44)$$

When the counterfactual overall labor productivity is calculated:

$$\hat{P}_t = \sum_{i \in C} \hat{s}_{it} p_{it} - \sum_{i \in X} \hat{s}_{it} p_{it-\tau} \quad (2.45)$$

Where \hat{s}_{it} symbolizes the counterfactual employment share:

$$\hat{s}_{it} = \frac{(s_{it-\tau}^y / s_{it}^y) l_{it}}{\sum_{i \in C} (s_{it-\tau}^y / s_{it}^y) l_{it} + \sum_{i \in X} (Y_t / Y_{t-\tau}) l_{it-\tau}} \text{ for } i \in C, \text{ and} \quad (2.46)$$

$$\hat{s}_{it} = \frac{(Y_t / Y_{t-\tau}) l_{it-\tau}}{\sum_{i \in C} (s_{it-\tau}^y / s_{it}^y) l_{it} + \sum_{i \in X} (Y_t / Y_{t-\tau}) l_{it-\tau}} \text{ for } i \in X \quad (2.47)$$

The difference between the overall labor productivity and the counterfactual one:

$$P_t - \widehat{P}_t = (\sum_{i \in C} s_{it} p_{it} + \sum_{i \in E} s_{it} p_{it}) - (\sum_{i \in C} \widehat{s}_{it} p_{it} + \sum_{i \in X} \widehat{s}_{it} p_{it-\tau}) \quad (2.48)$$

Rearranged:

$$P_t - \widehat{P}_t = \sum_{i \in C} (s_{it} - \widehat{s}_{it})(p_{it} - p_{xt-\tau}) + \sum_{i \in E} s_{it} (p_{it} - p_{xt-\tau}) \quad (2.49)$$

$$(P_t - P_{t-\tau}) - (P_t - \widehat{P}_t) = \widehat{P}_t - P_{t-\tau} \quad (2.50)$$

Add the within firms' productivity growth:

$$P_t - \widehat{P}_t = \sum_{i \in C} (s_{it} - \widehat{s}_{it})(p_{it} - p_{xt-\tau}) + \sum_{i \in E} s_{it} (p_{it} - p_{xt-\tau}) + (\widehat{P}_t - P_{t-\tau}) \quad (2.51)$$

Substitute (2.45) in (2.51):

$$\begin{aligned} P_t - \widehat{P}_t &= (\sum_{i \in C} \widehat{s}_{it} p_{it} + \sum_{i \in X} \widehat{s}_{it} p_{it-\tau}) - (\sum_{i \in C} s_{it-\tau} p_{it-\tau} + \sum_{i \in X} s_{it-\tau} p_{it-\tau}) \\ &= \sum_{i \in C} 0.5(\widehat{s}_{it} + s_{it-\tau})(p_{it} - p_{it-\tau}) \\ &+ \sum_{i \in C} 0.5(p_{it} + p_{it-\tau})(\widehat{s}_{it} - s_{it-\tau}) \\ &+ (\sum_{i \in X} \widehat{s}_{it} p_{it-\tau} - \sum_{i \in X} s_{it-\tau} p_{it-\tau}) \end{aligned} \quad (2.52)$$

Simplified:

$$P_t - \widehat{P}_t = \sum_{i \in C} 0.5(\widehat{s}_{it} + s_{it-\tau})(p_{it} - p_{it-\tau}) + \sum_{i \in C} (0.5(p_{it} + p_{it-\tau}) - p_{xt-\tau})(\widehat{s}_{it} - s_{it-\tau}) \quad (2.53)$$

The first effect in the right hand of the equation symbolizes the pure productivity growth. The second effect symbolizes the covariance effect resulted from substituting 2.8 in 2.14:

$$\begin{aligned} P_t - \sum_{i \in C} (0.5(p_{it} + p_{it-\tau}) - p_{xt-\tau})(\widehat{s}_{it} - s_{it-\tau}) = \\ \sum_{i \in C} (0.5(p_{it} + p_{it-\tau}) - p_{xt-\tau}) \left(\frac{(p_{it-\tau} / p_{it}) l_{it-\tau}}{\sum_{i \in C} (p_{it-\tau} / p_{it}) l_{it-\tau} + \sum_{i \in X} l_{it-\tau}} - s_{it-\tau} \right) \end{aligned} \quad (2.54)$$

Compiled:

$$\begin{aligned} \Delta P_{t,t-\tau} &= \sum_{i \in C} (s_{it} - \widehat{s}_{it})(p_{it} - p_{xt-\tau}) \\ &+ \sum_{i \in E} s_{it} (p_{it} - p_{xt-\tau}) + (\widehat{P}_t - P_{t-\tau}) \\ &+ \sum_{i \in C} 0.5(\widehat{s}_{it} + s_{it-\tau})(p_{it} - p_{it-\tau}) \\ &+ \sum_{i \in C} (0.5(p_{it} + p_{it-\tau}) - p_{xt-\tau})(\widehat{s}_{it} - s_{it-\tau}) \end{aligned} \quad (2.55)$$

Equation (2.55) symbolizes the decomposition equation of the overall labor productivity growth. Then modify it to let more than one type of entrant

$$\begin{aligned}
P_t - P_{t-\tau} &= \sum_{i \in C} (s_{it} - \widehat{s}_{it})(P_{it} - P_{xt-\tau}) \\
&+ \sum_{i \in E1} s_{it}(P_{it} - P_{x1t-\tau}) \\
&+ \sum_{i \in E2} s_{it}(P_{it} - P_{x2t}) \\
&+ (\widehat{P}_t - P_{t-\tau})
\end{aligned} \tag{2.56}$$

Baldwin & Gu discriminate between greenfield entrants and merger ones and between close-down exiters and divestiture exiters. The greenfield entrants relocate close-down exits and merger entrants relocate divestiture exits. Based on more complicated replacement:

$$\begin{aligned}
P_t - P_{t-\tau} &= \sum_{i \in C} (s_{it} - \widehat{s}_{it})(P_{it} - P_{Dt-\tau}) \\
&+ \sum_{i \in E1} s_{it}(P_{it} - P_{D1t-\tau}) \\
&+ \sum_{i \in E2} s_{it}(P_{it} - P_{D2t}) \\
&+ (\widehat{P}_t - P_{t-\tau})
\end{aligned} \tag{2.57}$$

where, D_1 symbolizes the firms that greenfield entrants relocate, D_2 the firms that are replaced by merger entrants, $D_{1tp-\tau}$ and $D_{2tp-\tau}$ are the D_1 & D_2 firms' mean labor productivity, and $D_{tp-\tau}$ is the displaced firms' mean labor productivity.

On other hand, the plant turnover in the Canadian manufacturing sector makes a dominating contribution to the total labor productivity evolution rate during period of (1973 to 1979) but a negligible contribution during the periods of (1979-1988) and (1988-1997) due to the higher productivity of the foreign-controlled firms versus the domestic-controlled ones (Baldwin & Gu, 2006b). Plant-level data for the U.S. and other countries' non-manufacturing establishments had been utilized to examine the relationship between the micro and macro structure evolution. The results show that during the 1990s, the total productivity evolution in U.S. retail trade sector was responsive to entering of the more productive establishments, and the exiting of the less productive ones. The importance of such study comes from that the retail trade sector is the heart of that time technological advances (Foster, Haltiwanger, & Krizan, 2002).

The data for German manufacturing industries data at the two-digit level had been used during the period of (1981-1998) in order to split the overall labor productivity evolution into the effects of selection, entry and exit; resulted in a considerable impact of selection on the total productivity evolution (Cantner & Kruger, 2008). Utilizing longitudinal data, Baldwin (1995) conducted a comprehensive analysis based on comparisons of the productivity of exiters, the entrants, the growing and declining incumbent firms as well as the new surviving firms over time. He revealed that economic selection is a vital effect for the productivity growth in North

America.

2.2.2. Empirical studies on the Turkish economy

Akkemik (2006) investigated the importance of selection effect to the aggregate productivity growth utilizing the static shift-share method employed by Timmer and Szirmai (2000) which can be seen as follows:

$$\begin{aligned} \frac{LP_1 - LP_0}{LP_0} = & \frac{\sum (LP_{i,1} - LP_{i,0})s_{li,0}}{LP_0} (\text{int ra} - \text{industry} - \text{effect}) \\ & + \frac{\sum (s_{li,1} - s_{li,0})LP_{i,0}}{LP_0} (\text{static} - \text{shift} - \text{effect}) \\ & + \frac{\sum (s_{li,1} - s_{li,0})(LP_{i,1} - LP_{i,0})}{LP_0} (\text{dynamic} - \text{shift} - \text{effect}) \end{aligned} \quad (2.58)$$

The elements on the right side of the equation symbolize the intra-industry productivity effect, the static shift effect, and the dynamic shift effect, individually. The sum of the static shift and dynamic shift effect represents the selection effect. Akkemik conducted the shift share analysis for 19 Turkish manufacturing industries under the assumptions that all workers are homogenous and have the same efficiency at the same industry meaning that average productivity stays unaffected by inter-industry employment transformations. Additionally, Akkemik shows that the effects of the decomposition are connected to the average productivity, not to the marginal product of labor. The results exhibited that for the total period of (1970-2000); the selection effect contributed negatively to the aggregate productivity growth (-11.7%-1.5%=-13.2%). The selection effect symbolizes the sum of the static and dynamic effects. Furthermore, the weight of the dynamic shift effect is trivial for all the studied intervals (-1.3% for 1970-79; -0.2% for 1980-88; -0.1% for 1989-94; -0.8% for 1995-2000 and -1.5% for the overall period of 1970-2000). Therefore, the selection effect is majorly responsive to the static shift effect. During the import substitution era (1970-79), the static shift effect accounted for 30.7% of the overall productivity evolution. The static shift effect contributed negatively to aggregate labor productivity during the export-orientation (1980-88) and liberalization (1989-94) periods, (-5.7% and -7.0% respectively). Its contribution to the aggregate labor productivity was largely negative (-29.7 percent) during the years of instability (1995-2000).

Akkemik (2006) reported that during different periods, certain key industries were supported under different industrialization strategies. For instance, during the import

substitution period (1970-79), the government protected and nurtured the industries of: rubber and plastics, metal products, non-electrical and electrical machinery, non-metallic minerals, basic metals, and transport equipment. During this period, much of the intra-industry productivity growth stemmed from the aforementioned industries, except the basic metal industry. Textiles, chemicals, and transport equipment industries are considered as main leaders in labor productivity. Throughout this time, the labor transformations across industries were responsible for 30% of the aggregate labor productivity growth. Throughout the phases of export-orientation (1980-88) and liberalization (1989-94), the government applied the strategy of direct export price subsidies for the industries of: food; textiles; clothing; chemicals; refined oil products; basic metals; and non-electrical machinery industries. In these two periods, the intra-industry productivity growth was mainly responsive to the mentioned key export industries. The heavy industries' contribution to the aggregate productivity growth increased largely between the two periods of export-orientation. All through the instability period (1995-2000), the key industries that were responsible for the majority account of the aggregate productivity growth were: textiles; electrical machinery; and transport equipment. Akkemik concluded that import-substitute industries were responsible for much of the total shift effects. The negative overall shift impacts of industries involving metal products, rubber and plastics and non-electrical machinery were also notable. He stated that while all industries had trivially small contributions to overall change effects during the period of 1980-1988; the industries of food, non-metallic minerals and basic metals had momentous contributions to overall shift effects during the period of 1989-1994. Through the period of 1995-2000, food, clothing and printing industries contributed significantly to the overall productivity evolution. But contributions of the textiles and heavy industries (excluding the iron and steel industries) were negative and had a negative impact on the total shift effect. Akkemik claimed that the negative total shifts in the post-1980 era took place due to the adverse structural change process towards the labor-intensive industries in the Turkish manufacturing sector. Despite the superior labor productivity in the heavy and chemical industries compared to other sectors in the post-1980 period, their employment shares did not increase. Akkemik also concluded that the food, textiles, and clothing industries maintained their labor shares with their relatively low productivity. He states that despite the competition, the traditional industries i.e. food, textiles and clothing could not, couldn't improve their laborers' skills. Finally, Akkemik emphasizes the necessity to improve the skills of laborers for promoting global competitiveness. Furthermore, he argues that the labor transformation from the labor intensive to the capital intensive contributes positively to the overall productivity evolution, leading to creation of more jobs; but such transformations did not happen in Turkey due to a lack of necessary labor skills required to increase the productivity rates.

Tuncer & Moalla (2020a) make use of the traditional shift share analysis to scrutinize the momentousness of the selection process in the Turkish manufacturing industries and the entire economy on the overall productivity growth during the periods of (2003-2017) and (2004-2017) respectively. They reported that the within growth effect and the structural change effect must go hand in hand to attain feasible and rapid growth, led by the rapid flow of resources toward capital intensive sectors, along with the accumulation of the necessary skills, knowledge, and other competences. At the same time, it is possible to implement strategies that make structural changes without investment in fundamentals and vice versa. The results suggest that there was a drag on the aggregate productivity evolution in the Turkish manufacturing industries (% -2.42) during the period of (2003-2008) which stemmed from the within growth effect. However, the within growth effect was responsible for the bonus of the aggregate productivity growth (5.87%) during the period of (2010-2017). During the same period, the structural change effect was negative but had a negligible effect. During the entire period of (2003-2017), the aggregate productivity growth (1.84%) was responsive to the within growth effect in the Turkish manufacturing industries. When investigating the momentousness of the selection process in the Turkish overall economy, during the period of (2004-2017), Tuncer & Moalla (2020a) concluded that the selection effect in all the sub intervals have a negative impact on overall labor productivity growth for the overall Turkish economy. Moreover, they reported that as the dynamic shift effect contributed negatively to the total productivity evolution in the Turkish whole economy, high productive industries were not able to maintain their labor shares during all the studied intervals. Furthermore, they state that applying the strategies that advance the economic structure hand in hand with the high schooling rate, the high female labor force contribution rate and the labor mobility from rural areas resulted in employment transformations towards the capital intensive industries which is evidenced by the positive contribution of the static shift effect. However, inverse structural changes had been experienced in Turkey during the period of (2010-2017) due to the increasing informality and the effects of active employment policies which resulted in misallocations of resources.

Tuncer & Moalla (2020b) employ the 3-digit 185 sub industries data that are classified according to (NACE Rev.2) for the period of 2003–2017 to split the overall productivity evolution into three effects which are: within-, between- and covariance-growth. They determined that during the period of (2003-2008), all of these effects negatively contribute to the overall productivity growth (-18.06 %) in the Turkish 3-digit non-farm business industries. The positive overall productivity growth (27.9%) during the period of (2010-2017) stems from the within shift effect (30.6%); but the between and covariance effect were negative and only accounted for (-2.76%) from the overall aggregate productivity growth.

Very low overall productivity growth (0.25%) stemmed from the within shift effect taking place during the whole interval of (2003-2017). The selection effect had a negative impact on the overall productivity evolution in the total interval as well as the sub periods. The results show that the nonfarm business industries' real value added a mean annual growth of (7.02%) and is responsive to the employment growth by 6.72% and only 0.31% stemmed from the labor productivity growth on an annual basis. They concluded that increasing the employment shares took place in the industries with below average productivity, which is what reduced the overall growth. They attribute the inverse structural changes to the micro and macro policies that reallocate the sources towards the low productive industries. Likewise, they claimed that the trivial selection process can take place if the economy gets close to the optimal structure. They asserted that the micro policies or the non-selective macro policies in Turkey were responsible from the adverse selection of the 3-digit industry and service sectors. The overall productivity growth decreased from the within shift effect which originated from R&D activities, innovations, and better physical and human capital. In Turkey, a competitive or undervalued real exchange rate is crucial to achieve growth enhancing selection. In other words, the misalignments of the exchange rate concomitant with the intensive import competition, force the firms who have a productivity rate that is below average, to exit the market. Additionally, they reported that the non-selective policies and the incentive system had a negative effect on the total productivity evolution. Finally, they decided that the total factor productivity is a better tool for measuring the importance of structural change to productivity evolution. Tuncer & Altıok (2011) also tested the significance of the selection process to the overall labor productivity evolution of the manufacturing industries, in the Province of Mersin, the Mediterranean Region of the country and the Turkish economy for the period between 1980 and 2000. In addition, they concluded, using the traditional shift-share analysis, that, the selection process accounts for a small portion of the overall labor productivity growth.

Rodrik revealed an important and positive impact of the selection effect on the overall labor productivity in Turkey during the 1990s and 2000s. Atiyas & Bakış' findings (2013) validated Rodrik's result utilizing both micro and macro data. At the macro level, they reported that the inputs and outputs' higher growth rates are responsive to the productivity improvements stemming from the selection process. They investigated the evolution of GDP's composition and revealed that the share of agricultural sector decreased concomitantly with the increasing share of manufacturing sector. Meanwhile, the industry's share of GDP increased from (16-17%) in 1968 to (22-23%) in the new millennium. The industry's share of GDP reached (28 %) in 1998; then it decreased to about (22-23 %) during the 2000s. During the period of (2005-2011), manufacturing's share of GDP was about 17-18%. The financial intermediation's share of GDP during the period of (1998-2011) decreased from around (8-

10%) to (4%) due to the impact of the 2000-2001 crisis. Home ownership and dwelling's shares of GDP increased from about (4-5%) to about (10-12 %). The transport, storage and communication's share of GDP increased from (12%) to (14%). Atiyas & Bakış reported that investigating the evolution of GDP's composition at a constant price, painted a different picture. The industry's share of GDP increased from (18%) during the 1960s to about (26-27%) during the interval of (2005-2011). The manufacturing's share of GDP remained around (23-24%). Home ownership and dwelling's share of GDP remained around 4-5%. The evolution of the GDP's composition was accompanied by the evolution of the employment composition. The employment in agriculture decreased from (47%) in 1988 to (25-26%) in 2010. The employment in services steadily increased from (40%) in 1988 to (55%) in 2010. The employment in industry increased from (16%) during the 1980s to (20%) in the mid-2000's. Atiyas & Bakış utilized data from the Turkish statistical institute, classified according to NACE Rev.1 for the interval of (1988-2009), and NACE Rev.2 for the 2000s interval. They matched the sectors between the two classifications and regrouped them into 9 sectors. The consequences of decomposing the overall productivity growth prove a growth enhancing selection process towards the capital-intensive sectors. Atiyas & Bakış compared the results of the intervals of the 1990s and 2000s and they revealed that the selection was responsible for the overall labor productivity during the interval of 1990s; and for more than half of the overall labor productivity during 2000s. They concluded that Turkey is similar to the Asian countries where the selection effect is positive; rather than the Latin American countries where the selection effect is negative. They demonstrate that the mean of the labor productivity differs between the sectors. In addition, they showed that the sectors' productivity variance had decreasing trends. They concluded that during the interval of (1990-2001), the manufacturing sector was responsible for the highest contribution to the total productivity growth. By the same token, the manufacturing sector and finance, insurance, real estate, and business services were responsible for the highest contribution to the overall labor productivity during the period of the 2000s. The positive contribution of finance, insurance, real estate, and business services to the overall labor productivity growth stemmed from selection effect. The positive contribution of manufacturing to the overall labor productivity evolution stemmed from within shift effect. As a result, the selection effect affects the overall productivity evolution by decreasing the value-added and the employment share in the agriculture sector and increasing them in manufacturing and services.

2.2.3. Criticism and evaluation

As the selection process is fundamental for economic growth, researchers work to address the significance of this effect to overall labor productivity growth. They try to test this by utilizing different methods over different timespans. Perhaps one cannot criticize their different time spans' use due to data limitation. However, application of the traditional weighting schemes in a constantly changing is a matter that is fair to criticize. The micro-level is one of the foundational pillars for any economy. In other words, the macro-evolution is the result of the population mean's change at the micro-level. Especially in Turkey's case, the aggregate labor productivity has been decomposed into three effects as follows:

First: The static shift effect which can be defined as the contribution of changes in the employment shares of sectors with different productivity levels to overall productivity evolution. It will be positive if industries with above average productivity attract more labor resources, and vice versa, it will be negative if high labor productivity industries attract less labor resources. In other words, the significance of the selection effect to the total labor productivity growth had been measured utilizing the "structural bonus and burden" hypothesis which expects a positive contribution of static shift effect. That means that:

$$\left(S_i^{fy} - S_i^{by}\right)LP_i^{by} > 0. \quad (2.59)$$

Our critique here is that this part of the "structural bonus and burden" hypothesis is far from reality because it takes labor productivity into consideration only in the base year. But, for whatever reason, if the labor productivity decreases in later years, it will affect economic growth negatively.

Second: The dynamic shift effect which can be defined as the contribution of changes in the employment shares of sectors with different productivity growth rates to overall productivity evolution. It will contribute positively to economic growth if labor force flows towards industries with high productivity evolution; but it will contribute negatively if high labor productivity firms cannot sustain their shares in total employment. Put another way, "structural bonus and burden" hypothesis expects that labor transformations take place from capital- to labor- intensive sectors. That means that the dynamic shift effect is expected to have a negative sign i.e.:

$$\left(S_i^{fy} - S_i^{by}\right)\left(LP_i^{fy} - LP_i^{by}\right) < 0. \quad (2.60)$$

Our critique here is the failure to observe the evolution of productivity and labor shares over the studied years. This hypothesis does not consider economic fluctuations. The empirical evidence of the previous two issues is as follows: let us take the manufacturing sector(C) which comprises 17.6% of the total Turkish employment in 2017. The difference between labor

productivity in the post year 2017 (57095) and the labor productivity in the pre-year 2004 (34527) after scaling by the aggregate labor productivity in the initial year 2004 was positive. However, the employment shares between the two years decreased about (-1.4%). Based on this data, the within growth contributed positively to productivity evolution in the sector of manufacturing (11.8) during the period of 2004-2017. The contribution of selection effect to productivity evolution in this sector was negative (-1.21 for the static shift effect and -0.79 for the dynamic shift one). The productivity evolution of manufacturing sector during the period of 2004-2017 was positive (9.08). It should be noted that this method of analysis takes into account only the first and the final year but if one takes into consideration all the studied years, the results will change and figure 2-8 exhibits the evolution of labor productivity in the manufacturing sector with two positive Gaussian peaks:

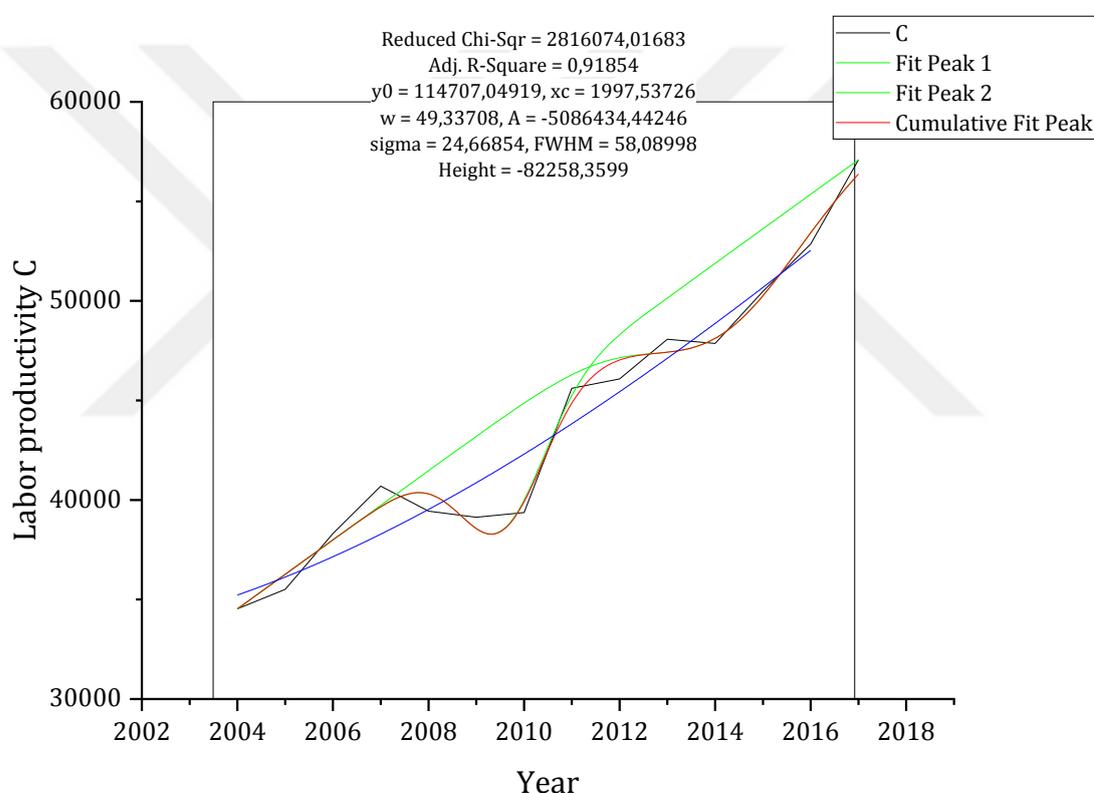


Figure 2.8. Labor productivity in the Turkish manufacturing industry

Source: Author’s preparation based on TSI.

Finally: The within effect which can be defined as the contribution of productivity growth within sectors to overall productivity evolution- will affect productivity growth positively if firms maintain the same share in total employment all along the studied interval. When discussing this, it is very important to figure out that this assumption cannot be taken as evidence because the micro- heterogeneity can be found when looking at many other activities, even if all positive and negative structural effects net out. This does not undermine that there is

no relationship between the employment shares and the labor productivity growth. The nexus between the change in employment share and log (sectoral productivity/the initial total productivity) differ between the economic sectors. For example, there was a negative correlation (Pearson corr.=-0.83) between the change in the employment share and log (sectoral productivity/the initial total productivity) during the period of 2004-2017 in the sector of manufacturing (p-value= 4,96464E-4) as shown in figure 2-9:

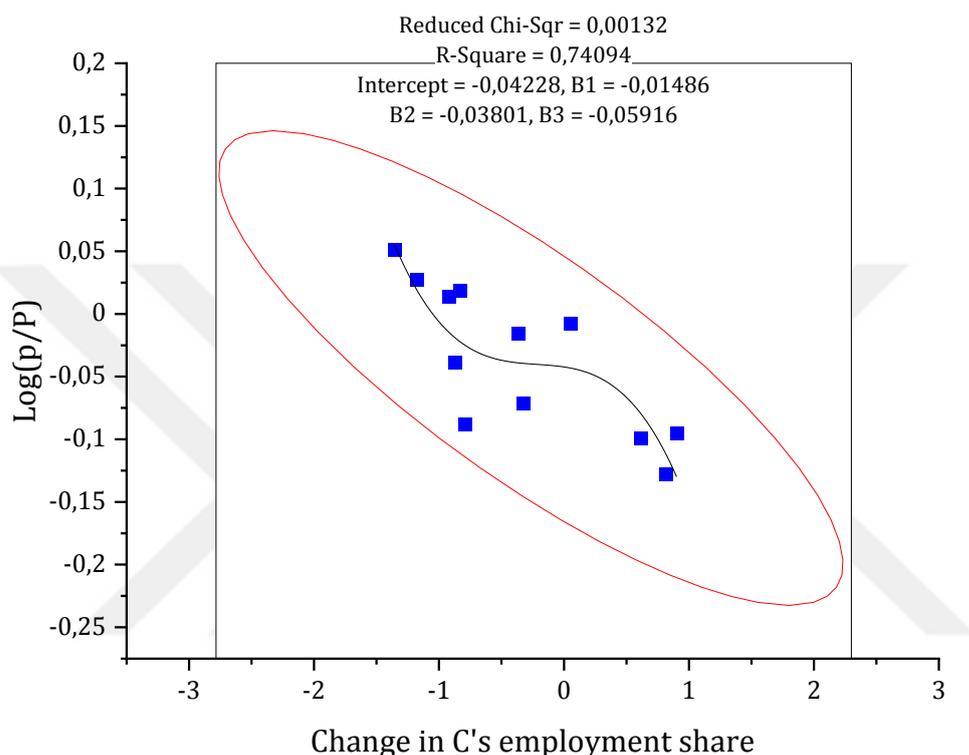


Figure 2.9. Correlation between the productivity and the change in the employment share in C during 2004-2017

Source: Author’s preparation based on TSI.

Similar results had been provided for the whole economy’s sectors and manufacturing industries’ sub-sectors and they are available upon request. From another point of view, the traditional shift share analysis could not take the role of the entering and exiting firms into account and that may affect the accuracy of the results. Furthermore, it could not investigate the importance of the structural changes to productivity growth at the disaggregated level. For these reasons we tried to utilize an evolutionary technique known as the “Price Equation” in order to avoid the aforementioned shortcomings. It is useful to analyze the importance of the selection effect utilizing Price’s equation which had been derived from the statistical analysis of directional evolution that had been signaled by Schumpeter and provided by the biologist Fisher

(1930).

The classical economists not only have difficulty solving the problems that hamper economic growth and disturb the national development process but also struggle with understanding them. They cared only about the immediate actions. We thought that earlier economists were not able to explore the now rapidly changing world to solve its problems or achieve the wellbeing of humans. Economists must think of ways about how to exploit the resources more intensively without decreasing returns to scale and push growth forward. However, one may wonder how this may be possible? The first step to innovate is not only to give new thoughts or new combinations, but also to change the way of thinking as well as using new analytical tools which can simply explain the complex macro-economic conditions. The aggregate growth could be achieved by merging the vertical and horizontal growth. Firstly, investing in fundamentals and structural changes must go hand in hand in every sector concomitant with the application of the technological progress. This cannot be achieved by merely applying random technological progress without analyzing the economic structure of the sector or increasing the research and development activities and vice versa. Secondly, technological progress creates a butterfly effect; we have to think about that this effect can spread from every sector, activity or organization etc... so as to analyze the pros and cons of applying the technology to a certain sector and the other ones.

3. METHODOLOGY, DATA & HYPOTHESIS

3.1. Methodology

In this study, we will examine the significance of selection to labor productivity evolution in the Turkish manufacturing industries (at two- and four- digit level) and the entire economy (at two-digit level). In this respect, we will employ of the shift share² and Price Equation methodologies to compare and contrast different sources of overall labor productivity evolution. **Firstly**, we examine the “structural bonus” hypothesis which postulates a positive nexus between selection and economic evolution; in other words, “structural bonus and burden” hypothesis assume that if labor transformations oriented from low productivity (high labor intensity) to high productivity (high capital intensity) sectors, then these shifts will positively drive economic growth and vice versa. The aggregate labor productivity (LP) at time t can be written as:

$$LP^t = \sum_{i=1}^n \frac{Y_i^t}{L_i^t} \frac{L_i^t}{L^t} = \sum_{i=1}^n LP_i^t S_i^t \quad (3.61)$$

Where, subscript i represent industries ($i=1, \dots, n$), S_i is the employment share of sector i in total

² We also examined another version of the shift share analysis which is the one used by McMillan and Rodrik (2011). They split the aggregate productivity evolution into two terms: the within- and the selection- effect. The effect of structural change did not be separated into the static and dynamic shift effects because of two reasons: First, the process of the structural change itself is a dynamic process, second, the dynamic effect term is hard to interpret. In other words, the aggregate labor productivity (LP) at time t can be written as:

$$P^t = \sum_{i=1}^n \theta_i^t p_i^t$$

Where, subscript i denote economic sectors ($i=1 \dots n$), P^t is total labor productivity in year t , θ_i, t the share of sector i in total Turkish employment at time t , and p_i, t denotes labor productivity in sector i at time t . Taking the difference in aggregate labor productivity levels between t and $t-k$ (ΔP^t) can be resulted as:

$$\Delta P^t = \sum_{i=1}^n \theta_i^{t-k} \Delta P_i^t + \sum_{i=1}^n \Delta \theta_i^t P_i^t$$

Where, the change in level of the productivity or employment shares between $t-k$ and t is shown by Δ operator, the economy wide labor productivity is shown by P^t and the sectoral labor productivity level is shown by p_i . The first term is known as the “within-sector” component. The second term refers to selection component which refers to the contribution of the labor transformations across sectors to the overall labor productivity. The contribution of the structural change component to overall productivity evolution will be positive if the changes in employment shares of economic sectors are positively correlated with productivity levels. Put it differently, McMillan and Rodrik (2011) split the labor productivity growth into two components: the first one is the within growth effect which has been derived from the neo-classical model in which the growth is based on accumulating the physical and human capital, and endogenizing the technological change. The second component is the effect of the structural change that has been derived from the dual economy approach characterized by the labor reallocation across sectors that diverge in their labor productivity. Combining results from the two components may provide us distinct predictions that help achieving feasible and rapid growth by ensuring the rapid flow of resources toward the high value-added sectors and by accumulating the necessary skills and improving the institutional capabilities in order to achieve the maintained productivity gains across economic sectors.

employment at time t and LP is the labor productivity in sector i at time t . Taking the difference in aggregate labor productivity levels at the final (f_y) year and base year (b_y) and dividing both sides by base year labor productivity LP^{b_y} :

$$\begin{aligned} \frac{LP^{f_y} - LP^{b_y}}{LP^{b_y}} (\text{labor} - \text{productivity} - \text{evolution}) = & \\ + \sum_{i=1}^n \frac{(LP_i^{f_y} - LP_i^{b_y}) S_i^{b_y}}{LP^{b_y}} (\text{within} - \text{growth}) & \quad (3.62) \\ + \sum_{i=1}^n \frac{(S_i^{f_y} - S_i^{b_y}) LP_i^{b_y}}{LP^{b_y}} (\text{static} - \text{shift} - \text{effect}) & \\ + \sum_{i=1}^n \frac{(S_i^{f_y} - S_i^{b_y})(LP_i^{f_y} - LP_i^{b_y})}{LP^{b_y}} (\text{dynamic} - \text{shift} - \text{effect}) & \end{aligned}$$

Where, LP is the labor productivity of the whole manufacturing industry, LP_i represents labor productivity in any sub-manufacturing industry i , S_i symbolizes the employment share of the i^{th} sub-manufacturing industry in total manufacturing, f_y is the final year and b_y represents the base year in the studied period. The within growth effect can be defined as the contribution of productivity growth stemmed from within the sub industry to overall labor productivity evolution. The static shift effect can be defined as the contribution of changes in the employment shares of sectors with different productivity levels to overall labor productivity evolution. The dynamic shift effect can be defined as the contribution of changes in the employment shares of sectors with different productivity growth rates to overall productivity evolution.

Secondly, we will prove -using Price equation which decomposes the evolution process into multiple levels- that the above-mentioned results will change if the role of entry and exit at the enterprise level have been taken into account. The reference of Price's equation is the branch of biology by Price (1970). In doing so, we expect to derive a deeper understanding of the sources of productivity evolution in the Turkish manufacturing industry and the Turkish economy. Moreover, the results of a one long period will be compared with the results of splitting and summing up the results from sub-periods. In other words, we will examine the importance of the labor transformation to overall productivity evolution using data of periods of (2010-2015), (2010-2011), (2010-2012), (2011-2015), (2012-2013), (2013-2015) and (2014-2015). (2010-2015) data allow for a comparison of the effects of studying one period of six years versus three periods of two years (2010-2011), (2012-2013) and (2014-2015). Only the results of the period of (2011-2015) will be reported in our thesis. At the same time, it allows for a comparison of the effects of studying one period of six years versus two periods of three years (2010-2012) and (2013-2015). For this purpose, we had to distinguish between three sets of firms which are: first, Continuing firms: firms those are exist in the pre- and post-evolution

populations, second, the eXiters: firms those are exist only in the pre-evolution population and third, the eNtrants: firms those are exist only in the post-evolution population. The elements of “Price’s equation” are given in Table (3-1). A single level Price’s equation takes the form of equation (3-2). The multiple level decomposition of evolution takes the form of the equation (3-3).

Table 3.1. Elements of Price’s equation

Component	Formal Description	
x_i		Firm size
z_i		Firm productivity
X	$= \sum_i x_i$	Population size
s_i	$= x_i / X$	Firm share
w_i	$= x'_i / x_i$	Firm fitness
Δz_i	$= z'_i - z_i$	productivity evolution
Z	$= \sum_i s_i z_i = E(z_i)$	Population productivity
ΔZ	$= Z' - Z$	Evolution of L. productivity
W	$= X' / X$	Population fitness
$Cov(w_i, z_i)$	$= \sum_i s_i (w_i - W)(z_i - Z)$	Cov of fitness & productivity

Table 3.2. Equation (2) a single level decomposition of evolution by means of Price’s

$\Delta Z = \sum_{i \in C} (\Delta s_i)(z_i - Z)$	(Selection effect)
$+ \sum_{i \in C} s'_i \Delta z_i$	(Learning effect)
$+ \sum_{i \in N} s'_i (z'_i - Z)$	(Entry effect)
$- \sum_{i \in X} s_i (z_i - Z)$	(Exit effect)

Table 3.3. Equation (3) A multiple level decomposition of evolution by means of Price’s equation

$\Delta Z = + \sum_j \Delta s_j (z_j - Z)$	(Industry selection effect)
$+ \sum_j s'_j \sum_{i \in C_j} \Delta s_{ij} (z_{ij} - z_j)$	(Firm selection effect)
$+ \sum_j s'_j \sum_{i \in C_j} s'_{ij} \Delta z_{ij}$	(Learning effect)
$+ \sum_j s'_j \sum_{i \in N_j} s'_{ij} (z'_{ij} - z_j)$	(Entry effect)
$- \sum_j s'_j \sum_{i \in X_j} s_{ij} (z_{ij} - z_j)$	(Exit effect)

where, Z and Z' denotes the average labor productivity in the pre and post evolution respectively. The selection i.e. inter-firm or reallocation term is defined as the covariance

between evolution and productivity. It is divided into inter-industry effect and intra-industry selection effect. Whereas inter-firm selection is driven by the process of competition, inter-industry selection is the process of structural changes. The Learning effect i.e. intra-firm or innovation effect; is defined as the portion of productivity evolution that may be attributed to processes internal to firms (Holm, 2014). To derive Price equation, we will start from the general form of Price equation which is:

Evolution = Selection (i.e. inter firm effect) + Learning + Entry + Exit. It can be written as a mathematical equation as:

$$Z = Cov(wi, zi)/W + E(wi, zi)/W \quad (3.63)$$

Z represents evolution of labor productivity in the studied period. The first term in the right side symbolizes the covariance between evolution and productivity that is the selection effect. The second term in the right-hand side represents the intra-firm effect.

If we multiply the two sides of equation (3.63) by W, we can get an alternative form of the equation which is:

$$WZ = Cov(wi, zi) + E(wi, zi) \quad (3.64)$$

Here, we want to refer to the advantage of this equation; as we can see the right side represents the firm level, but the left side represents the population level, this means that this equation can be used in various studies as the researcher desires. The mentioned equation's two terms refer to firms which continue to exist all along the evolutionary process. To implicit the role of firms that entry and exit, covariance and expectation terms must be expanded to:

$$\Delta Z = (\sum_i si(wi - W)(zi - Z))/W + (\sum_i siwi\Delta zi)/W \quad (3.65)$$

$$\Delta Z = (\sum_i si(wi/W - 1)(zi - Z)) + (\sum_i si(wi/W)\Delta zi) \quad (3.66)$$

By substituting the following equation into the above one:

$$siwi/W = (xi/X) * ((xi'/xi)/(X'/X)) = si' \quad (3.67)$$

The subsequent equation could be attained:

$$\Delta Z = (\sum_i (si' - si)(zi - Z)) + \sum_i si' \Delta zi \quad (3.68)$$

We can write it in another form in order to get the effects of pre- and post- evolution:

$$\Delta Z = (\sum_{i \in C} (\Delta si)(zi - Z)) + \sum_{i \in C} si' \Delta zi \quad (3.69)$$

By adding the firms' entry and exit effects, we will obtain the single level decomposition technique of Price equation which is:

$$\Delta Z = (\sum_{i \in C} (\Delta si)(zi - Z)) + \sum_{i \in C} si' \Delta zi + \sum_{i \in N} si'(zi' - Z) - \sum_{i \in X} (zi - Z) \quad (3.70)$$

The first effect in the right side is selection component, the second one is learning component, the third one is entry and the fourth one is exit component. Here, it is important to figure out that we take the entire learning effect which had been divided it into two terms: within- and cross- level effect by Foster and colleagues i.e.:

$$+ \sum_{i \in C} s_i' \Delta z_i = \sum_{i \in C} s_i \Delta z_i (\text{within}) + \sum_{i \in C} \Delta s_i \Delta z_i (\text{cross}) \quad (3.71)$$

In order to get the multilevel decomposition technique of Price equation; we will use equation (3.64) after replacing subscript i for firms with subscript j for industries such as:

$$WZ = Cov(w_j, z_j) + E(w_j, z_j) \quad (3.72)$$

After adding subscript j to equation (3.70), we will substitute it for Δz_j expectation term in equation (3.72) will be:

$$E(w_j, \Delta z_j) = \sum_j s_j w_j \left[\sum_{i \in C_j} \Delta s_{ij} (z_{ij} - z_j) + \sum_{i \in C_j} s'_{ij} \Delta z_{ij} + \sum_{i \in N_j} s'_{ij} (z'_{ij} - z_j) - \sum_{i \in X_j} s_{ij} (z_{ij} - z_j) \right] \quad (3.73)$$

If we substitute equation (3.73) into equation (3.72) and multiply it by $1/W$, we will get the multilevel decomposition technique of Price equation which is:

$$\begin{aligned} \Delta Z &= \sum_j \Delta s_j (z_j - Z) (\text{industry - selection - effect}) \\ &+ \sum_j s'_{ij} \sum_{i \in C_j} \Delta s_{ij} (z_{ij} - z_j) (\text{firm - selection - effect}) \\ &+ \sum_j s'_{ij} \sum_{i \in C_j} s'_{ij} \Delta z_{ij} (\text{learning - effect}) \\ &+ \sum_j s'_{ij} \sum_{i \in N_j} s'_{ij} (z'_{ij} - z_j) (\text{entry - effect}) \\ &- \sum_j s'_{ij} \sum_{i \in X_j} s_{ij} (z_{ij} - z_j) (\text{exit - effect}) \end{aligned} \quad (3.74)$$

The first effect in the right side is industry selection effect, the second one is firm selection effect, the third one is learning effect, the fourth one is entry effect and the fifth one is the exit effect. It is important here to figure that equation (3.74) is an identity equation while still accounting for the dynamics in sub-populations. Decomposing the evolution process into multiple levels has been confirmed by Rice (2004) and Morris and Lundberg (2011). Holm (2014) also confirms that adding inter-industry selection in the multiple level of Price equation will change the magnitudes of the inter-firm selection, learning, entry and exit effects. In other words, multiple level of Price equation will improve the measurement of these effects.

3.2. Data

The microdata employed in our thesis were the Annual Industry and Service Statistics compiled by the TurkStat. All calculations had been implemented in Regional Directorate of Turkish Statistical Institute headquartered in Adana. Three variables from the databases are being used, namely total value added of the firms (VA), total full-time equivalent employment for the firms over the years and industry classification. Moreover, we will eliminate the effect of inflation by using the Producer Price Index (PPI) (2003=100).

3.3. Hypotheses

We will test two hypotheses. *The first one predicts that applying the Price equation at the firm level will demonstrate the significance of selection to productivity evolution better than applying the traditional methods. The second hypothesis predicts that the results of decomposing one long period will change if splitting up that period over shorter ones and summing the effects.* In the light of these two hypotheses and based on the decomposition equation that splits the overall productivity evolution into the effects of industry selection, firm selection, learning, entry and exit at the disaggregate level; our expected results will be as follows:

First: If firms enter industries with low mean productivity concomitant with increasing their relative size, then the single-level technique would quantify this entry as a negative entry effect, while the multilevel technique would account for it with a positive entry effect and a negative industry selection effect. Second: If exiting firms' productivity is lower than the productivity of industry, then both the single level and the multilevel techniques suggest that exiting firms will positively impact the overall productivity evolution. Third: The single and the multilevel techniques are expected to give the same learning effect. Fourth: if resources are reallocated decreasing the labor productivity compared to the productivity of industry, then single-level technique predicts a negative inter-firm effect; while multilevel technique predicts a positive inter-firm effect and a negative industry-selection effect. The firms that enter the market have different levels of productivity, but only the firms that survive until the end year are included in the entry effect (Jovanovic, 1982). So, longer interval between t and t' will cause a survivor effect, this means that the low productivity entrants will not be considered in the decomposition process because they have exited from the market before the end year. So, we predict that: *Fifth: Industry and firm selection effects of a single decomposition period will be smaller compared to these effects if they are summed up over shorter periods. Sixth: The exit and entry effect are predicted to be smaller when taken as sums over sub-periods.*

4. EMPIRICAL APPLICATION AND RESULTS

4.1. The Structural Change of the World Economy at a Glance

Since 1970, a significant increase in the share of services in the world's GDP is accompanied with decreases in the shares of agriculture and industry. In developed countries, the share of the industrial sector has decreased from % 36.68 in 1970 to % 22.72 in 2018, but the share of the service sector increased from % 58.89 in 1970 to % 76.01 in 2018. In turn, in developing countries the GDP share of industrial sector increased from % 33.10 in 1970 to % 36.18 in 2018 concurrently with an increase in the share of service sector from % 42.94 in 1970 to % 55.69 in 2018 (Figure 4-1). The decrease in the share of agricultural sector in developing countries was small (%3-%1=%2) when comparing with that in the developed countries (%16-%8=%8) during the same period (Figure 4-1).

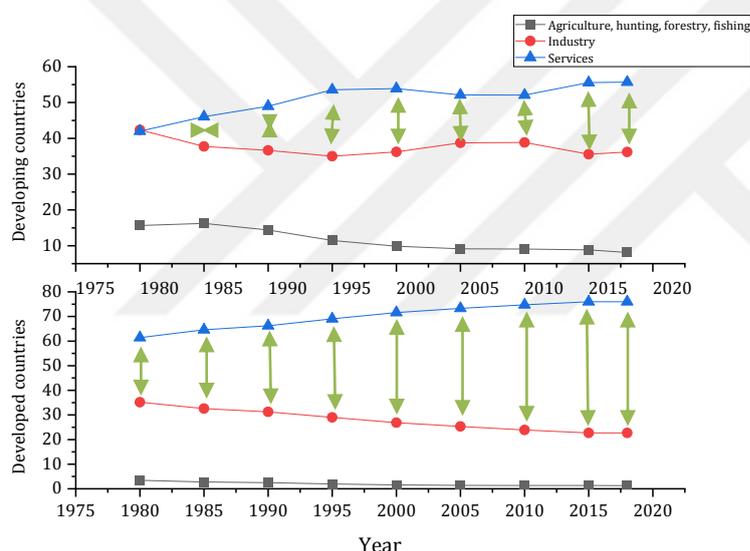


Figure 4.1. Economic sectors' share of GDP (%)

Source: UNCTAD

During the period of (1970-2018), the share of manufacturing sector decreased in developed countries but increased in developing countries concurrently with increasing the share of service sector in both developed and developing countries. However, the increase of the service sector's share differs between the developed and the developing countries in terms of the industrial sector's share. The difference between service and industry sectors' shares in developed countries is higher than that in developing countries, the matter that indicates the suppression of the service sector. The suppression of the share of service sector on manufacturing sector refers to the developed countries' premature deindustrialization. As a result of the deindustrialization, the central developed countries such as England, Germany,

France, Netherlands, Belgium, as well as the US and Japan transferred the production to some developing countries that could be able to achieve the economic success by decreasing the cost of production. In turn, there are also negative deindustrialization experiences in some developing countries. In other words, the low productivity in the poor countries decreases the share of the manufacturing sector. In just case, even the increase in the service sector's share provided in such process an indicator of negative economic progress.

One of the most significant dynamics that influence economic transformation or structural change is the income distribution. This issue had been treated by Kuznets (1955) and subsequently, in the vast literature on the Kuznets curve. Based on some developed countries' development experience, Kuznets (1966) claimed that there is a positive nexus between overall income inequality and industrial transformation.

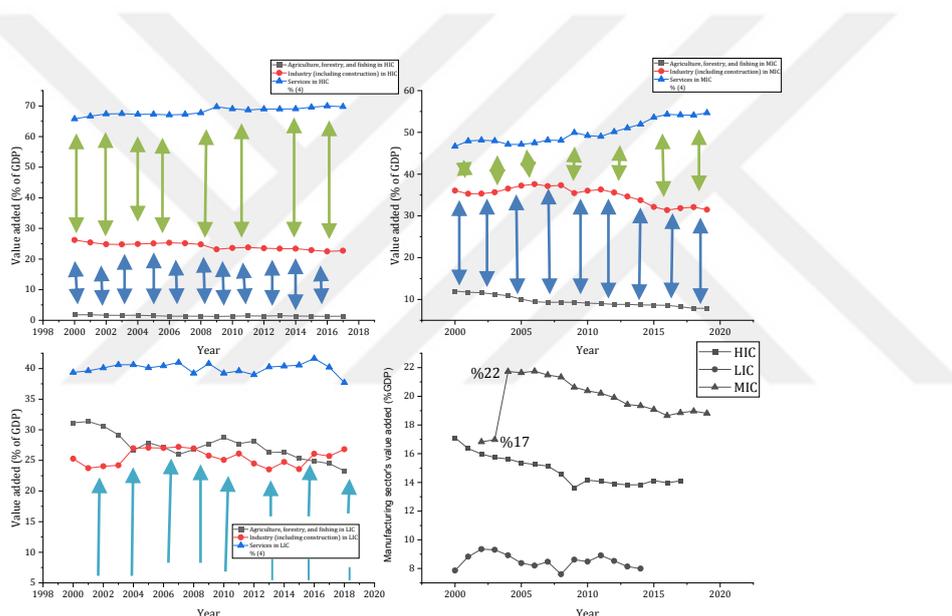


Figure 4.2. Value added of economic sectors (% of GDP)

Source: World Bank, 2020

Figure 4-2 shows that the agricultural sector's share in GDP was small in both high- and middle-income countries but in the low-income countries, it had a fair percentage of GDP even proceeded the industrial sector's share during the period from 2008 to 2016. The service sector showed an important suppression especially in the high-income countries. Figure 4-2 shows also the suppression of the manufacturing sector in the middle-income countries comparing with that in the high- and low-income countries. The highest increase in the manufacturing sector's share in the middle-income countries was from about 17% in 2001 to about 22% in 2002. We will give more details about the economic sector's value added (% of GDP) in the high-

, middle- and low-income countries. The high-income countries (HIC) experienced decreasing shares of agriculture in terms of overall output and employment along with increasing weight of the industrial sector. As soon as the industrial transformation was well proceeding, the service sector became progressively significant. In more details, the share of agricultural sector has been decreased from 1.8 % in 2000 to 1.3 % in 2018, the share of manufacturing sector has decreased from 17% in 2000 to 14% in 2018, the share of the industrial sector has decreased from 26% in 2000 to 23% in 2018, but the share of the service sector has increased from 66% in 2000 to 70% in 2018. We can notice the suppression of the service sector in the high-income countries comparing with the agricultural sector and the industrial one (for example, whereas the agriculture's value added was 1.8% in 2000 and the value added of the industrial sector was about 17%, the services' one was 66 at the same year). The matter in the low-income countries (LIC) is to some extent different from that in the high-income countries. The share of agricultural sector has been decreased from 31% in 2000 to 23% in 2018, the share of manufacturing sector stayed about 8% during this period, the share of the industrial sector has increased from 25% in 2000 to 27% in 2018. The share of service sector in the GDP shows periodic ups and downs. It reached its highest value (about 42%) in 2016 and then decreased to about 38% in 2018. Moving to describing the structural changes in the middle-income countries (MIC), the share of agricultural sector has been decreased from 12% in 2000 to 8% in 2018, the share of the industrial sector has decreased from 36% in 2000 to 31% in 2018, but the share of the service sector has increased from 47% in 2000 to 55% in 2018. The share of manufacturing sector has increased from 17% in 2002 to 21% in 2008 and then decreased to 19% in 2018.

The above-mentioned patterns of economic development had been associated with transformation of labor force from the primary sectors to the modern ones. Figure 4-3 shows the main sectors' employment shares during the period from 1990 to 2018. Whereas the gap between the service and industrial sectors' employment shares shows an increase in the high-income countries; a decrease in the difference between the service and agricultural sectors' employment shares had been witnessed in the low-income countries. In other words, in the high-income countries an increase in the service sector's employment share is associated with a decrease in the industrial sector's employment share during the period from 1990 to 2018. But, in the low-income countries, the majority of the employment shares is accounted for the agricultural sector comparing with the service sector's employment share but the difference between the two sectors in terms of employment share decreases after 2010. The decreasing difference in employment shares between the agricultural and the service sector in the low-income countries is associated with an increase in the difference between the industrial and service sector in terms of employment shares during the mentioned period. In turn, in the high-

income countries, the increasing difference between the service and industrial sectors' employment shares is associated to some extent with a fixed difference between the industrial and agricultural sectors' employment shares.

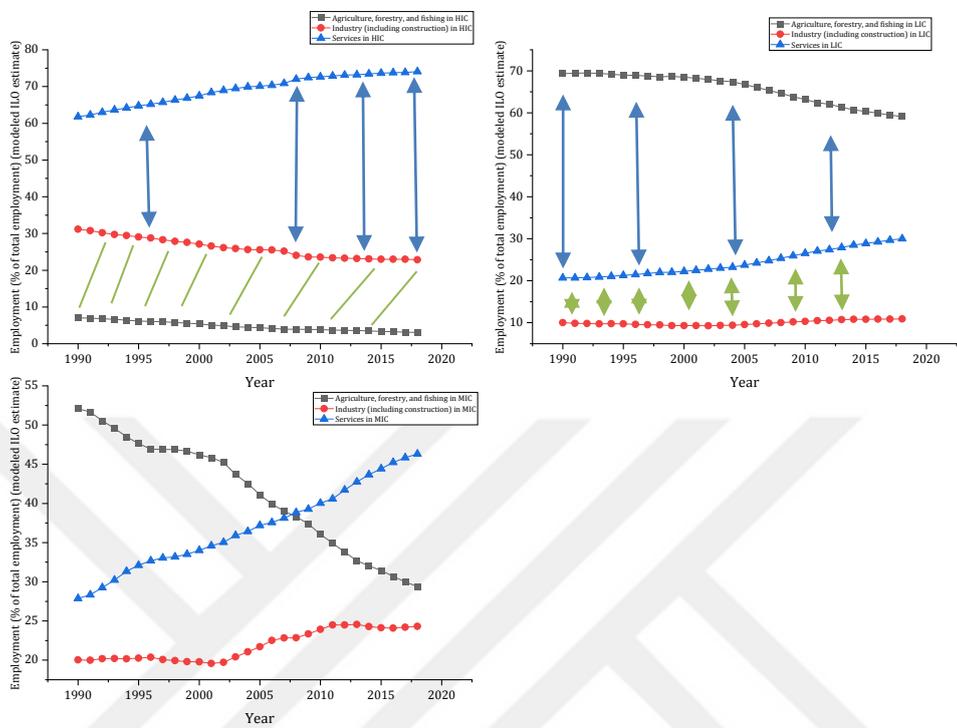


Figure 4.3. Economic sectors' employment shares

Source: World Bank, 2020

In the middle-income countries, the decrease in the agricultural sector's employment shares is associated with an increase in the service sector's employment share. In turn, the industrial sector's employment shares start to increase after 2000. In the high-income countries, the agricultural sector's employment share in the total employment has been decreased from 7% in 1990 to 3% in 2018, the industrial sector's employment share has decreased from 31% in 1990 to 23% in 2018, but the service sector's employment share has increased from 62% in 1990 to 74% in 2018. In the low-income countries, the agricultural sector's employment share in the total employment has been decreased from 68% in 2000 to 59% in 2018 but the industrial sector's employment share has increased from 9% in 2000 to 11% in 2018 and the service sector's employment share has increased from 22% in 2000 to 30% in 2018. In the middle-income countries, the agricultural sector's employment share in the total employment has decreased from 52% in 1990 to 29% in 2018 but the industrial sector's employment share has increased from 20% in 1990 to 24% in 2018 and the service sector's employment share has increased from 28% in 1990 to 46% in 2018. Finally, based on the previous analysis we concluded that structural change in terms of output and employment leads to service-

orientation rather than industrial transformation takes place during the studied interval.

4.2. Structural Change in the Turkish Economy

To promote our understanding of the structural change process in the Turkish economy, we focus on two-time period. The first one is the pre 1980 era and the second one is the post 1980. The structural changes in the first stage can be described as growth-enhancing process resulted from import-substitution strategy of development beginning in the late 1950's by replacing the imports of non-durable consumer goods the matter that transforms the Turkish economy from the primarily agricultural to one based on industrialization generating substantial production capacity till the mid 1970's. One of the direct results of the import substitution or the inward oriented strategy is increasing growth rates of GNP from 4.8 percent in (1953-1963) to 7.2 percent in the mid of 1970s (Celasun, 1983). Then, Turkey applies industrial strategies to domestically produce and replace imported durable and capital goods. However, because of the external shocks Turkey suffered aggregate growth losses were estimated to be around 3.6 percent during this period (1977-1979).

The second stage of the structural change started in 1980 when Turkey tried to preserve its growth momentum by promoting a balance between introducing new structural adjustment program (SAP) along the lines approved by the IMF and the World Bank on one hand and on the other hand conducting a wide range of reforms including liberalization of external trade, flexibility of the tariff system and deregulation of the financial system and foreign investment regulations. These structural changes contribute negatively to the aggregate productivity growth in the post-1980 known as the outward oriented era (Akkemik, 2006). The main reasons of the adverse structural change were: the unplanned capital liberalization, the high interest rates and large amounts of capital inflows moved into the Turkish economy made it suffers from vulnerability to financial crisis.

Consequently, a drag on the Turkish economy takes place due to the sharp and rapid capital outflows transform the financial market crisis to the real sectors of the economy (Balkır, 1993). Following the financial crisis of 2001 under the auspices of the IMF and the World Bank, the Turkish government worked to restore confidence by creating a new economic program that aims to repair the wreckage in the banking system and stabilize inflation. In the aftermath of its severe financial crisis in 2001, the Turkish economy enjoyed five years of rapid economic growth driven by productivity growth and structural change. These structural changes include increasing the capital flows in the emerging markets, strengthening the regulatory infrastructure, the independence of the Central Bank, transparency, and privatizations. Such reforms came to be reversed in the aftermath of the 2008 global financial crisis. However, the

low-quality growth reflected by shifting towards discretion, the deterioration of the macroeconomic framework and the low or negative real interest rates led to a relatively large current account deficit and a higher inflation (Acemoğlu & Üçer, 2015). Shortly, tremendous structural changes over the past four decades have led to transform the Turkish economy from the primary and secondary sectors towards the tertiary sectors. This claim supports Fourastié's theory. Fourastié's theory of economic development is linked to the idea of splitting the economy into three sectors which are primary, secondary, and tertiary. Fourastié supposes that the mentioned three main sectors differ in their labor productivity growth rates in a market with sufficient competition. The heterogeneities in labor productivity arise from the technological progress that changes the costs, prices, and profits. The velocity and the direction of the changing costs, prices and profits can be considered as the determinant that accelerates or decelerates economic growth achieved by the structural change. In other words, high rates of technological progress contribute positively to the aggregate labor productivity and vice versa. As a result, small expansion of the traditional sector accompanying with a large expansion of the secondary and a decline of the tertiary sector take place in the economy. On the demand side, as GDP per capita increases the preferences of the consumers will shift, according to Engel's law, from the primary to the secondary sector till it reaches the saturation limit. Further income increasing transforms the demand from the primary and secondary sectors to the tertiary one which grows in importance in terms of employment and value-added concomitant with sustained intra-sectoral structural change occurs within each of the three sectors. It is the core of Fourastié's theory, whereas supplying technological progress reinforces the process of the structural changes, the demand side determines the direction of it (Kruger, 2008). In the Turkish case, the agricultural sector's share of GDP decreased from 26% in 1980 to 5.8% in 2018, the share of industry (including construction) increased from 23% in 1980 to 29% in 2018 and the share of the services increased from 49% in 1980 to 54% in 2018 as shown in Figure 4-4. The manufacturing sector draws the same route as the industrial sector. Its share of GDP increased from 13% in 1960 to about 19% in 2019. The empirical results support Fourastié's theory means that the decrease of the value added in the primary sector and the increase of it in the secondary and tertiary sectors indicates the co-evolution of the three sectors in the Turkish economy during the period of (1980-2018) despite the difficulties that had been suffered in Turkey to ensure industrial developments and achieve economic growth.

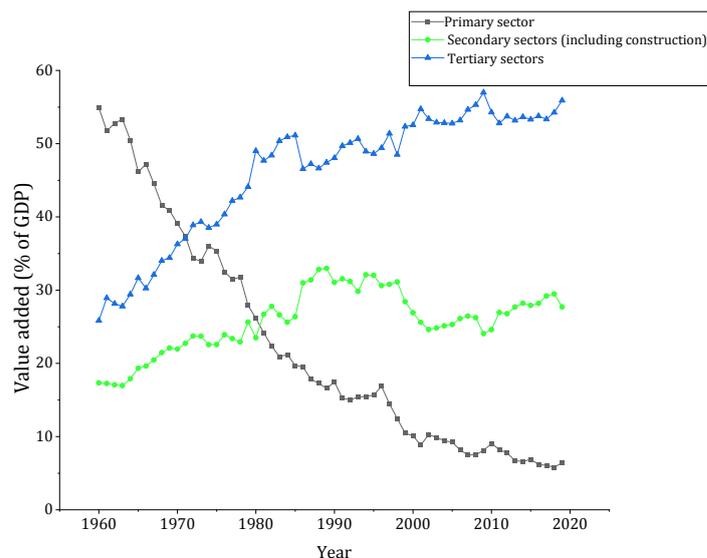


Figure 4.4. Primary, secondary, and tertiary sectors’ shares in the Turkish GDP

Source: World Bank, 2020.

The decline in the agriculture’s value added was accompanied with a decline in its employment share from 48% in 1990 to 18% in 2019. Conversely, the employment shares in the industrial sector increased from 20% in 1990 to 26% in 2019 which is in consistent with the increase in the employment share in the services from 32 to 55% during the same period. Figure 4-5 shows that the employment shares in the agriculture and service sectors like the jaws of the pliers. Whereas the difference between the two sectors’ employment shares decreases before 2000, it increases dramatically after 2000. The difference between the service sector and the industrial sector’s employment share continues to increase since 1990 till 2020. So, we can say that in the Turkish economy the service sector achieves suppression in terms of employment share and value added after 2000. In general, the co-evolution of the Turkish main sectors is in line with the co-evolution of the economic sectors in the middle-income countries.

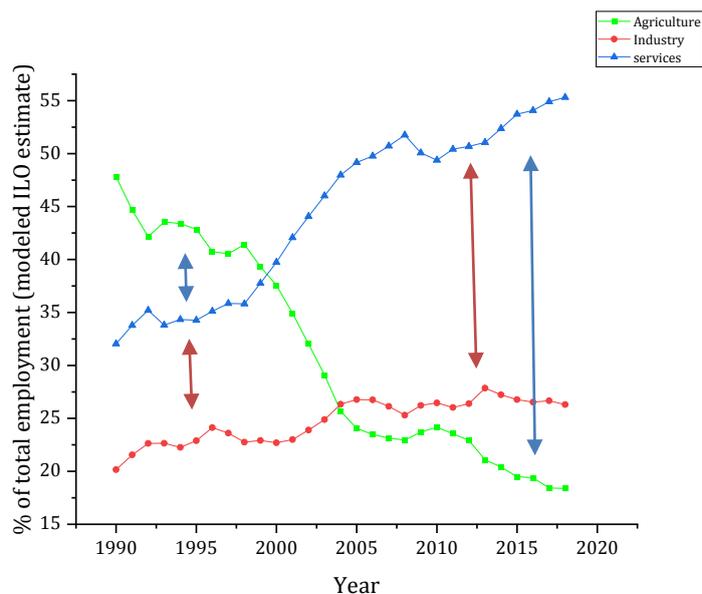


Figure 4.5. Main sectors’ employment shares in total employment

Source: World bank, 2020

As the labor productivity can be measured by dividing the sector’s value added by the number of workers employed in this sector, the increase in sector’s value added will increase the labor productivity and vice versa under the condition of little change in the number of workers of this sector. The increase in the number of workers with a little change in their value added will decrease labor productivity and vice versa. The most important result that we can infer from the previous analysis is the existing of the productivity heterogeneities among the main sectors in the Turkish economy, which can be considered as the key stimulator of structural change that accelerate or decelerate economic growth according to its velocity and direction. We tried to examine those gaps in the Turkish industries and Figure 4-6 shows those gaps:

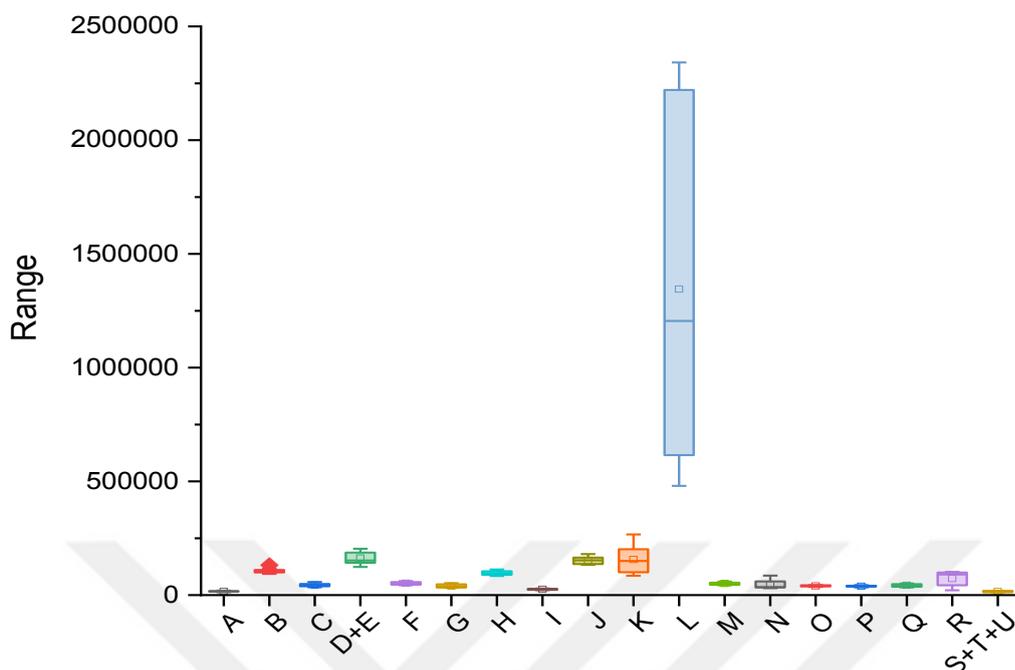


Figure 4.6. Productivity differences between sectors in the Turkish economy (2004-2017)

Note: A= agriculture, B= mining and quarrying, C = manufacturing, D+E= electricity gas steam and water supply and waste man., F= construction, G= whole sale and retail trade, H= transport and storage, I= accommodation and food services, J= information and communication, K= finance and insurance, L= real estate, M= scientific and technical activities, N= administrative and support activities, O= public administration, P= education, Q= health and social work, R= entertainment and recreation, S+T+U= other services.

During the period between 2004 and 2017, the sector of real estate activities (L) decreased noticeably its labor productivity comparing with the rest of the Turkish economy (from 2341777,6 in 2004 to 480112,5 in 2017). In other words, this sector’s labor productivity in 2017 was far from that in 2004 the matter that interpreted the large variance of this sector during this period. The higher coefficient of variation of the real estate activities (0.58) indicates larger amplitude of the short-run fluctuations. With the same respect, the labor productivities of the agricultural sector (A) and other services (S+T+U) distributed around the mean productivity during the period of 2004-2017. And this can be indicated by the small variance value of these sectors comparing with the rest ones. Table 4-1 depicts the mean, variance, coefficient of variation, the skewness and the kurtosis for the distribution of the labor productivity of the Turkish economic sectors during the period of 2004-2017:

Table 4.1. Statistics of labor productivity distribution in the Turkish economic sectors during 2004-2017

	Mean	Standard Deviations	Variance	Skewness	Kurtosis	Coefficient of Variation
A	16179	1907.35	3637999	0.47	-0.07	0.12
B	106569	9994.20	99883900	1.10	2.08	0.09
C	43932	6801.82	46264800	0.42	-0.75	0.15
D+E	162539	25415.6	645953000	0.33	-1.25	0.16
F	52535	5871.86	34478700	-0.26	-1.29	0.11
G	39900	7059.50	49836600	0.43	-1.32	0.18
H	96704	8626.96	74424500	0.43	-0.76	0.09
I	25698	2324.94	5405343	-0.47	-1.22	0.09
J	152370	15381.59	236593000	0.23	-1.03	0.10
K	156237	56815.53	3228000000	0.52	-0.73	0.36
L	1344916	777626.8	604703000000	0.14	-2.08	0.58
M	50601	5427.36	29456200	0.21	-1.49	0.11
N	45899	18397.73	338477000	1.25	0.30	0.40
O	40659	2463.58	6069233	-0.24	-1.40	0.06
P	39129	2617.19	6849674	-0.22	-0.19	0.07
Q	43141	5933.47	35206100	-0.41	-1.30	0.14
R	73168	30908.63	955343000	-0.69	-1.26	0.42
S+T+U	15387	2561.55	6561524	0.15	-2.05	0.17

We added the calculations of the skewness and kurtosis of the labor productivity to statistically explain their significant deviations from the normality. As the skewness of the sectors of mining & quarrying (B) and administrative support service activities (N) is greater than 1, the distribution of the labor productivity in these sectors is highly skewed. The positive values of these sectors' kurtosis indicate leptokurtic sharpness which shows that there are extreme values of labor productivity during this period. The distribution of labor productivity in the sectors of financial and insurance activities (K) (more than 0.5 and less than 1) and arts, entertainment, and recreation (R) (more than -1 and less than -0.5) is moderately skewed. The distribution of labor productivity in the rest Turkish economic sectors is approximately symmetric (between 0.5 and -0.5). The negative values of sectors' kurtosis indicate platykurtic distribution which shows that there are no extreme values of labor productivity during this period. It was an empirical evidence to reject the null hypothesis assumes that the means of the Turkish economic sectors' labor productivity are equal in favor of alternative hypothesis assumes that the mean of one or more sectors' labor productivity are different. Furthermore, at the level of 0.05, the means of Turkish economic sector's labor productivity are significantly different according to Tukey test. Furthermore, the variances of the Turkish sectors' labor productivity lack homogeneity at the level 0.05 according to Levene's absolute deviations test. Based on the traditional shift share analysis, the importance of the within, static, and dynamic effects to the overall labor productivity evolution had been determined. During the period of

2004-2008 the annual average evolution of overall labor productivity in Turkish economy was positive (3.33%) and the source of this bonus on productivity is the positive within growth effect (1.39) and the positive structural change effect (1.71 for the static shift effect and -0.32 for the dynamic shift effect). Figure 4-7 shows the sources of aggregate labor productivity evolution and the distribution of the Turkish economic sectors in terms of their contribution to the growth sources during the period of 2004-2008.

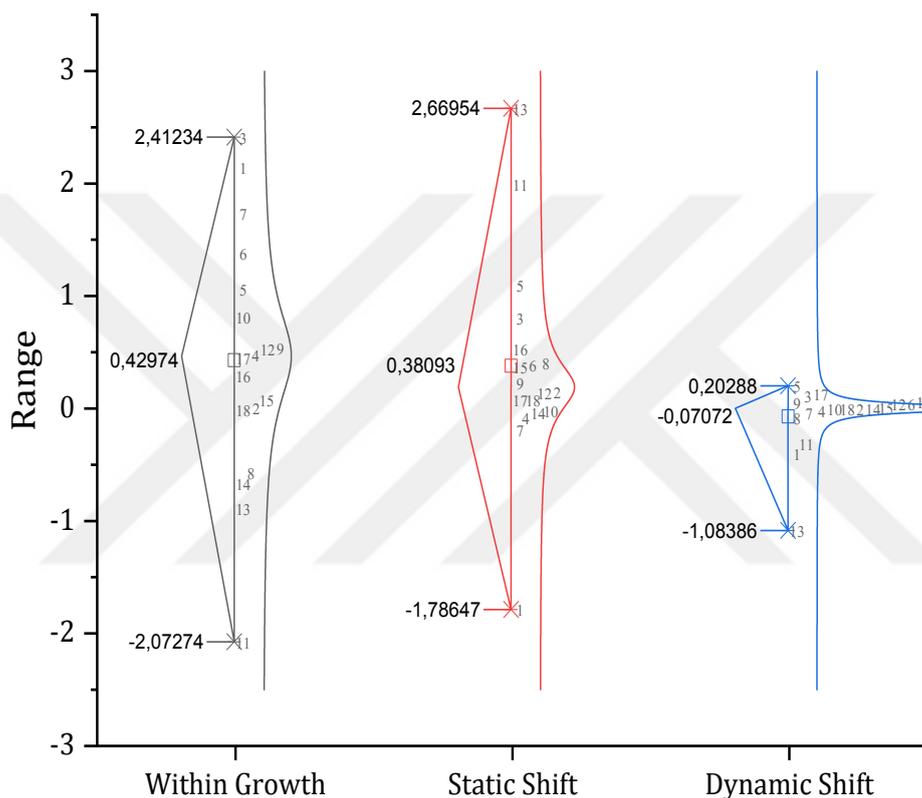


Figure 4.7. Decomposition of labor productivity in the Turkish economic sectors during 2004-2008

Note: 1=A, 2=B, 3=C,4=D+E, 5=F, 6=G, 7=H, 8=I, 9=J, 10=K, 11=L, 12=M, 13=N, 14=O, 15=P, 16=Q, 17=R, 18=S+T+U. A= agriculture, B= mining and quarrying, C = manufacturing, D+E= electricity gas steam and water supply and waste man., F= construction, G= whole sale and retail trade, H= transport and storage, I= accommodation and food services, J= information and communication, K= finance and insurance, L= real estate, M= scientific and technical activities, N= administrative and support activities, O= public administration, P= education, Q= health and social work, R= entertainment and recreation, S+T+U= other services.

On the other hand, the growth rate of labor productivity in Turkish economy during the period of (2010-2017) is 3.71% and the basic source of this productivity improvements originated from the positive within growth effect (2.37) and the positive structural change effect

(5.01 for the static shift effect and -3.66 for the dynamic shift effect) as shown in figure 4-8:

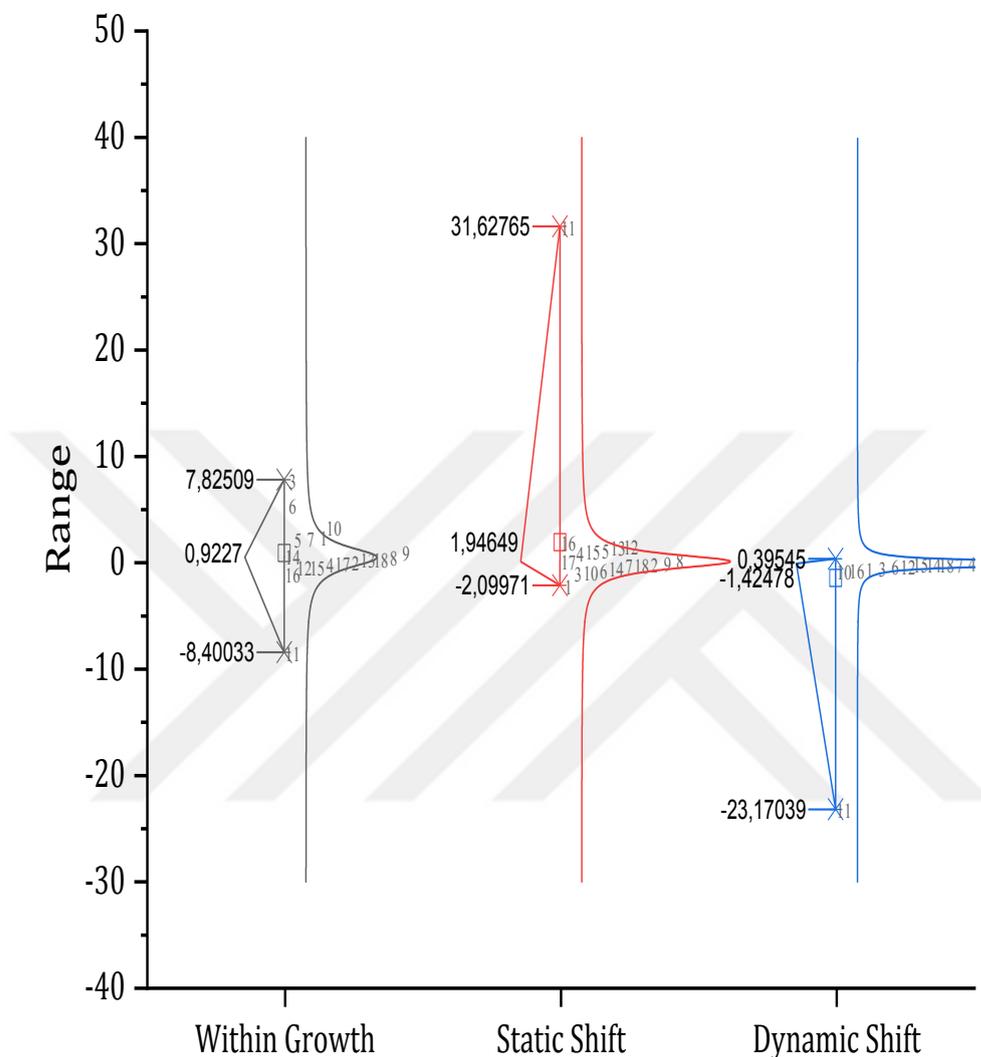


Figure 4.8. Decomposition of labor productivity in the Turkish economic sectors during 2010-2017

In the whole period of 2004-2017, the annual growth of labor productivity is 2.91%. The productivity improvements in the Turkish economy comes mainly from the within sector productivity improvements (1.91) and the positive impact of the structural change effect (4.77 for the static shift effect and -3.77 for the dynamic shift effect) Figure 4-9:

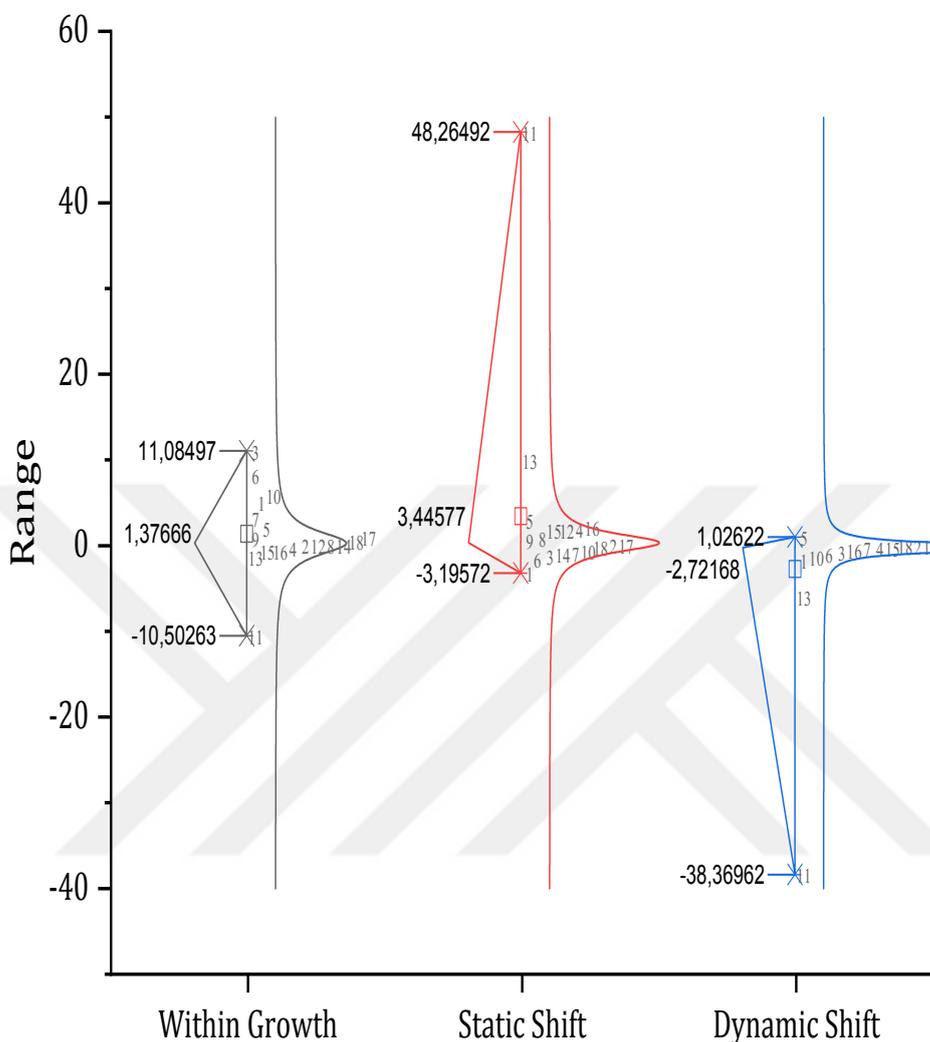


Figure 4.9. Decomposition of labor productivity in the Turkish economic sectors during 2004-2017

During all the studied intervals, we found that the manufacturing sector (C) had the highest within growth value. However, the most drop in labor productivity during the studied period was in the sector of real estate activities (L). The positive static shift effect during all the studied periods refers to the labor movements from less productive to more productive sectors, due to the policies that aimed to improve the economic infrastructure on one hand and on the other one; the high schooling rate, the high female labor force participation rate and the labor force migrating from rural areas. The negative dynamic shift effect in all the studied periods

refers to the inverse interaction between changes in employment shares and the industries' productivity evolution the matter that affects the aggregate labor productivity negatively. The interpretation for such inverse interaction may be the results of increasing informality which considered as a barrier to accumulate more experience. Another possible interpretation may be the side effects of the government's active employment policies during these periods resulted in some sorts of resource misallocations. The first column of Table 4-2 represents the annual evolution rate of labor productivity in the Turkish economy for the periods of 2004-2008, 2010-2017 and 2004-2017. The other columns show within-, static- and dynamic- evolution, respectively.

Table 4.2. Decomposition of labor productivity in the Turkish economy (Average annual growth rates)

	Labor Productivity Growth	Within Growth Effect	Static Shift Effect	Dynamic Shift Effect	Total Effect
2004-2008	3,33	1,93	1,71	-0,32	3,33
%		58,1	51,5	-9,6	100
2010-2017	3,71	2,37	5,01	-3,66	3,71
%		58,1	51,5	-9,6	100
2004-2017	2,91	1,91	4,77	-3,77	2,91
%		63,9	134,8	-98,6	100

Finally, economic growth can be achieved through the within sector enhancements in labor productivity and the reallocation of labor force towards the high value-added sectors. Put it differently, the sustained growth is the direct result of rapid flow of resources from labor intensive toward capital intensive sectors accompanying with accumulation of the necessary skills, knowledge, and other competences. The policies should be investigated towards promoting the investment in human capital from one side and the investment in the physical capital on another side. Whereas the human capital investment is achieved by developing the education and learning process, the physical capital investment (means the innovation) is achieved enhancing the total factor productivity through increasing the expenditure on the R & D activities (see Tuncer & Moalla, (2020a) for more details).

4.3. Structural change in the manufacturing industries

As we mentioned before, the selection effect is a key source of economic evolution and development. It had been considered as the anchor that determines countries' wealth or poverty level. The engine of the structural change process is the manufacturing sector. The so-

called Kaldor’s laws express the significance of the manufacturing sector as the engine of economic growth. The first law relates aggregate output growth rate with manufacturing’s growth rate. The second law, known as Verdoorn’s law, suggests that there is a strong connection between the rapid growth in the output of the manufacturing sector and the productivity of it. The third law claims that evolution of manufacturing sector impacts positively the productivity of the nonmanufacturing sectors. So, the manufacturing sector is a catalyst sector stimulates the growth of the whole economy and the productivity of the nonmanufacturing sectors.

4.3.1. Evolution of the Turkish Manufacturing Value Added

Since the average growth rate of the Turkish manufacturing value-added (6.5%) is higher than the growth rate of the Turkish gross domestic product during the period of (1980-2018) as shown in figure 4-10, the manufacturing sector had been acted as the engine that plays a key role in the Turkish economic growth and development.

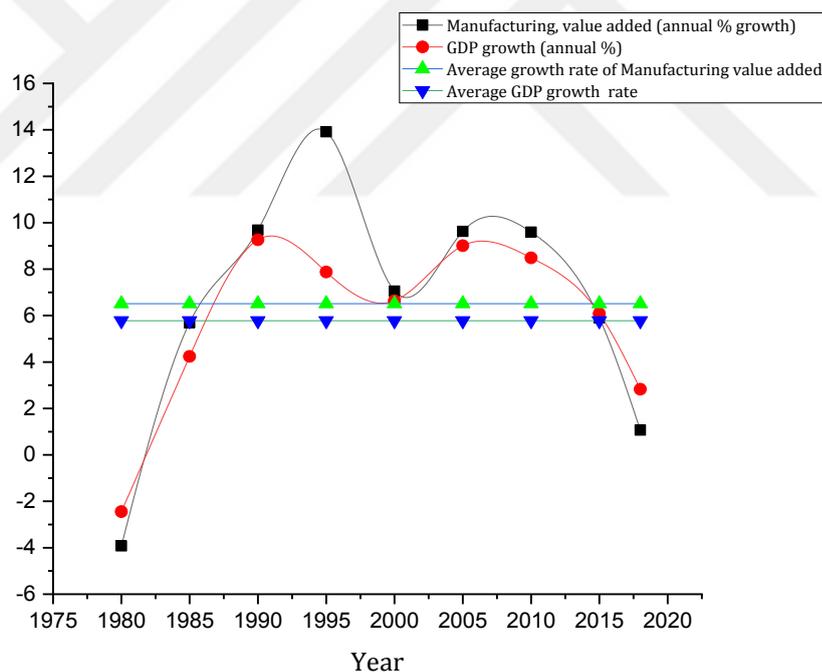


Figure 4.10. Annual growth rates of Turkish manufacturing value added and GDP

Data: UNIDO, 2019g. Note: All values are in constant 2010\$ prices.

The manufacturing sector’s share of the Turkish entire economy is also increased from 17.09% in 1980 to 19.04% in 2018 as shown in figure 4-11.

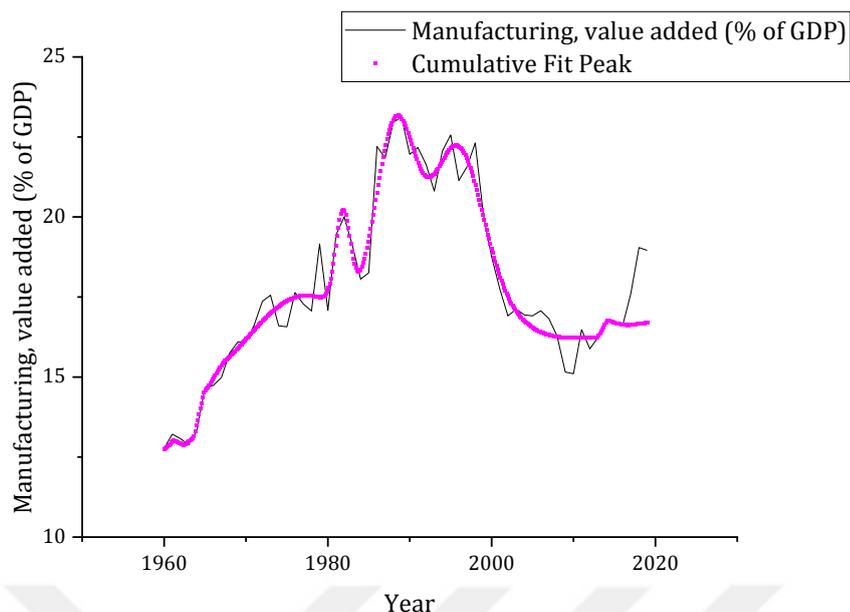


Figure 4.11. Share of manufacturing value added in GDP (%)

Data: world Bank, 2020.

The periodic ups and downs that have been noticed in the manufacturing sector's value added can be connected to those of the growth of GDP. But the manufacturing value added appears to be much more volatile than the GDP, because of the challenges Turkey faces in generating the expansion needed to enhance industrial developments and economic growth. For example, in the early 1990s, 2001 and 2009 Turkey has encountered unstable long-term economic growth caused by three economic crises followed by a short-lived economic recovery. Also, Turkey has been affected by the global financial crisis. The value added of the Turkish manufacturing sector increased in the post-2009 growth years despite of the 2015–2016 uncertainty caused by the Greek debt crisis, the EU referendum, and the refugee crisis. The above-average or the strong growth that the Turkish economy showed in the manufacturing sector reflects the solid growth in the global manufacturing sector. The increase in the share of the Turkish manufacturing value added in the world manufacturing production from 0.87% in 1990 to 1.52% in 2018 occurred concurrently with increasing in the shares of least developed countries³, emerging industrial economics (excluding China) and China in the world

³ UN list of least developed countries: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People's Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Timor-

manufacturing value added. At the same time, the industrialized economies' share declined from 78.9% in 1990 to 55.06% in 2018 as shown in figure 4-12. Between the upper middle income (UMI) countries, Turkey increases its manufacturing shares from 7.5% in 1990 to 14.9% in 2018.

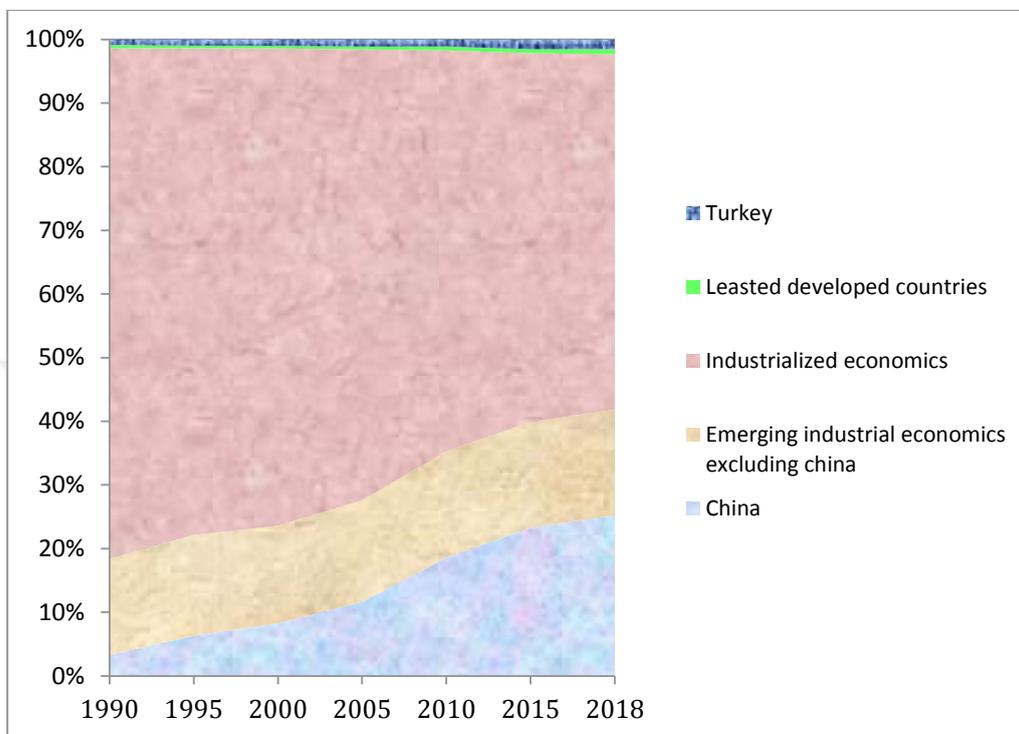


Figure 4.12. Shares of the world manufacturing value added by economy group.
Data: UNIDO, 2019g.

Such increase can be attributed to the production transformation from the high-income countries (HIC) to some developing countries such as Turkey in which the share of the world's manufacturing increases from 0.9% in 1990 to 1.5% in 2018. With numerical data, while the share of the high-income countries (HIC) was about 0.006% in average during the period of (1990-2018); the share of the upper middle-income countries (UMC) increased from 15% in 1990 to 35% in 2018.

4.3.2. Evolution of Turkish manufacturing employment

The increase in the Turkish manufacturing value added goes along with the decrease of the labor demand. During the period of (2004-2017), the employment in the Turkish

Leste, Togo, Tuvalu, Uganda, United Republic of Tanzania, Yemen and Zambia.

manufacturing was around 24.5% of the total employment on average. The share of the manufacturing employment in the total Turkish one decreased from 27% in 2004 to 23% in 2017 as shown in figure 4-13.

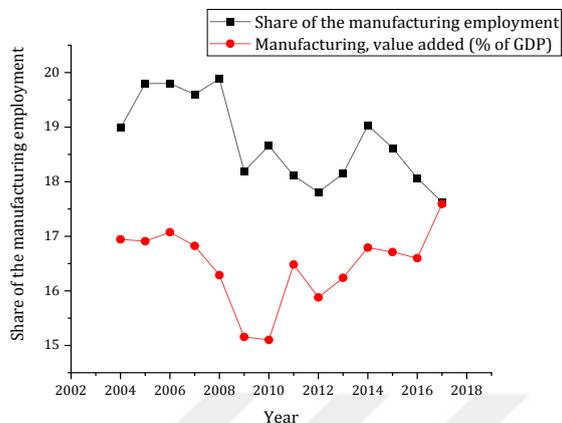


Figure 4.13. Value added and share of the manufacturing employment in the total Turkish employment

Data: Turkish Statistical Institute

The decrease in the Turkish manufacturing employment has been volatile. The volatility can be related to that in the value added. In other words, during the period of (2004-2017), the decrease of the employment in the Turkish manufacturing was accompanied with the increase of the sector’s value-added from 17% in 2004 to 19% in 2017. The connection between the sector’s employment and the value added seems to be dissatisfying. The concurrence of such dissatisfying can be attributed to the increase in the labor productivity, the matter that indicates the efficiency of adoption the new technologies during that period. With a global perspective during the period of (1990-2018) China increased its share in world’s manufacturing value added concurrently with increasing that in world employment. The leasted developed countries also increased its shares in the world’s employment and value added. On the contrary, the industrialized economies decreased their employment share in coincident with decreasing their share of the world manufacturing value added. The developing and emerging industrial economies (excluding China) held their share of the world manufacturing value added steady concurrently with growth in the manufacturing employment. So, the result that we can draw is that: not all the innovation platforms are the same.

4.3.3. Evolution of the Turkish Manufacturing Labor Productivity

The labor productivity denotes the value added per worker. So, the decreasing value added, and the increasing employment leads to the increase of labor productivity and vice versa, the increasing value added and the decreasing employment leads to the increase in labor productivity. The value-added of manufacturing sector expands faster than its employment during the period of (2004-2017), the matter that led to the increase of the manufacturing labor productivity as shown in figure 4-14. The manufacturing sector’s employment grew faster than the entire economy’s employment; so, the labor productivity in the manufacturing sector grew slower than the entire economy’s productivity because that it absorbs large amounts of labor from the market.

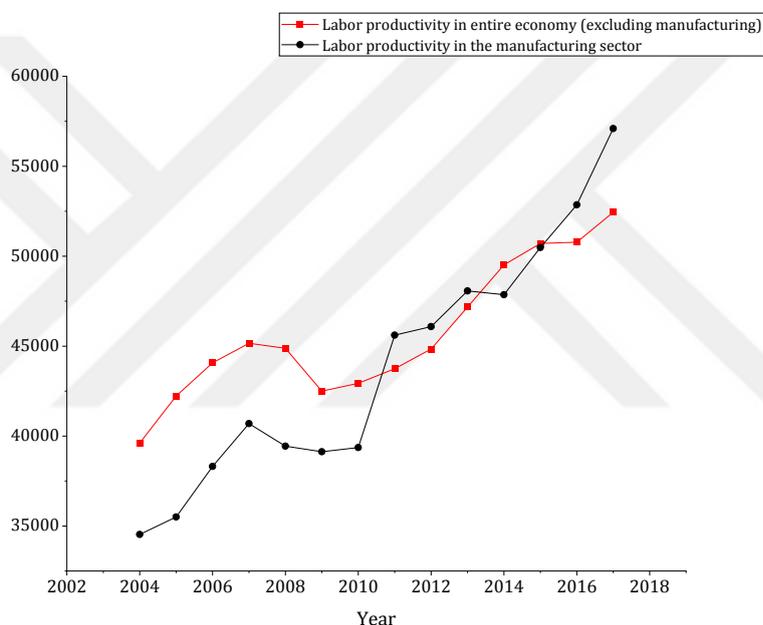


Figure 4.14. Turkish labor productivity in manufacturing and the entire economy

Data: Turkish Statistical Institute

The growth rate of the labor productivity in the Turkish manufacturing industries (%5.87) was higher than the labor productivity growth rate in the entire economy (%3.71) during the period of (2010-2017). The productivity always defines the degree of the innovation and technical change. Manufacturing’s higher productivity reflects the proxy role of the manufacturing sector in creating and adoption the new innovations and the technological changes. With a global perspective, the ability and velocity to create and adopt the new technologies and therefore increase the labor productivity differ between the countries. Whereas the developing and emerging industrial economies adopt the new innovations more

slowly because of the inability of their economic systems to redeploy resources away from inefficient uses; the industrialized economies increase their productivity by keeping the knowledge-intensive operations and transferring the labor-intensive ones to the developing countries. The success of creation or adoption the new innovations can be determined by the structural changes that can be taken in order to increase the labor productivity.

4.3.4. Digging deeper in the manufacturing sector

Since 1963, "industry-based growth" has been one of the central intentions in Turkey thru the five-year development plans periods. As we mentioned, the impacts of the strategies that had been implemented showed huge differences before and after 1980. However, the reforms of export-oriented industrialization after 1980 contributed significantly to the enthusiasm of the private sector and advanced the adaptableness of Turkish economy to the internal and external actions. Consequently, the Turkish industry showed a great performance in the recent years, excluding the years of economic crises. Significant increases were documented in industrial value added, in the volume of manufacturing industry's exports and in the imports for investment and intermediate goods. Following a stern shrinkage in industry in 2001 stemmed from the 2001 economic crises, signals of recovery was started in 2002 and continued with optimistic developments in the Turkish economy. Since then, there has been a significant raise in production and capacity utilization in the manufacturing industry owing to recovery in domestic demand and maintained export performance. Turkish industry essentially rests on the private sector activities.

Put it differently, the manufacturing industry's private sector is responsible for more than 80% of production and about 95% of gross fixed investment. The private sector gives prominence to investments and using the advanced technologies to generate high value added, boosting competitiveness, increasing productivity, and empowering development of applicable technologies.

Anyway, because that the manufacturing sector has been considered as the main engine which stimulates the maintainable growth according to the Kaldorian tradition, the patterns of the labor productivity evolution in the Turkish manufacturing industries during the period of (2003-2017) had been estimated. One of the most important keys that accelerate or decelerate economic growth is the productivity gaps between the Turkish manufacturing sub-industries. We tried to examine those gaps in the Turkish manufacturing industries. During the period of 2003-2017, the sector of tobacco industry (12) increases its labor productivity about 6 times (from 39642,3 in 2003 to 237114,8 in 2017). The sector of pharmaceuticals industry (21) increases its labor productivity about 2.6 times (from 86381,3 in 2003 to 221962,2 in 2017). The sector of computer, electronic and optical products industry (26) increases its labor

productivity about 2.1 times (from 51614,8 in 2003 to 109353,8 in 2017). The sector of other transport equipment industry (30) increases its labor productivity about 3.4 times (from 36352,13 in 2003 to 121918,4 in 2017). The sectors of coke and refined petroleum industry (19) and basic metals (24) industry decrease noticeably their labor productivities about 0.9 time during the period from 2003 to 2017. The labor productivity of the rest manufacturing sub-industries distributed around the mean in general. Figure 4-15 explains those gaps between the Turkish manufacturing sub-industries during the studied interval:

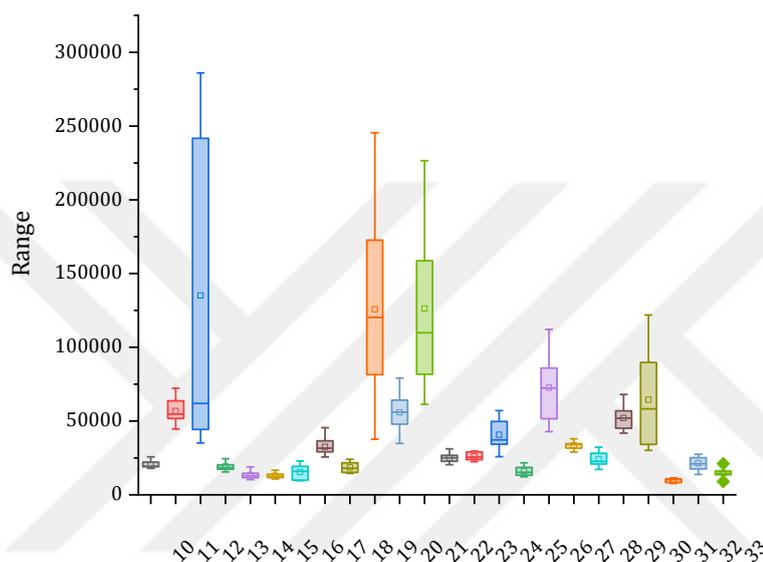


Figure 4.15. Productivity gaps between the manufacturing industries during the period of 2003-2017

Note: 10= food, 11= beverage, 12= tobacco, 13= textiles, 14= clothing, 15= leather, 16= wood, 17= paper and paper products, 18= recorded media, 19= coke and refined petroleum, 20= chemicals, 21= pharmaceuticals, 22= rubber and plastics, 23= non-metallic minerals, 24= basic metals, 25= fabricated metal products, 26= computer, electronic and optical products, 27=electrical equipment, 28= manufacturing n.e.c, 29= transport equipment, 30= other transport equipment, 31= furniture, 32= other industries, 33=Other manufacturing, and repair and installation of machinery and equipment.

The sectors that considerably increase their labor productivity are very spread out from the average the matter that indicates large variance values. On the contrary, the sectors that have labor productivities tend to be very close to the average labor productivity have small variance values. The higher coefficient of variation of the sector of tobacco industry (12) and the sector of other transport equipment industry (30) (0.76 and 0.48 respectively) indicates larger amplitude of the short-run fluctuations. Vice versa, the lower coefficient of variation of some sectors indicates the close dispersion of those sectors' labor productivity from the mean. We added the calculations of the skewness and kurtosis of the labor productivity to statistically explain their significant deviations from the normality. As the skewness of the sector of food

industry (10) is greater than 1, the distribution of the labor productivity in this sector is highly skewed. The positive value of food industry’s kurtosis indicates leptokurtic sharpness which shows that there are extreme values of labor productivity during this period. The distribution of labor productivity in the sectors of furniture industry (31) and other industries (32) (more than -1 and less than -0.5) is moderately skewed. The distribution of labor productivity in the sectors of beverage industry (11), textiles (13), clothing (14), leather (15), paper and paper products (17), pharmaceuticals (21), fabricated metal products (25), transport equipment (29) and other transport equipment (30) (more than 0.5 and less than +1) is moderately skewed. The distribution of labor productivity in the rest of Turkish manufacturing industries is approximately symmetric (between 0.5 and -0.5). The negative values of manufacturing industries’ kurtosis indicate platykurtic distribution which shows that there are no extreme values of labor productivity during this period. Table 4-2 depicts the mean, variance, coefficient of variation, the skewness, and the kurtosis for the distribution of the labor productivity of the Turkish manufacturing industries during the period of 2003-2017:

Table 4.3. Statistics of labor productivity distribution in the Turkish manufacturing industries during 2003-2017

Sector	Mean	Standard Deviations	Variance	Skewness	Kurtosis	Coefficient of Variation
10	20274	2076.45	5202805	1.43	0.27	0.11
11	56855	7610.34	57917200	0.63	-0.30	0.13
12	135113	102884.8	10585300000	0.37	-1.94	0.76
13	19222	2639.79	6968465	0.85	-0.08	0.14
14	13418	2478.04	6140665	0.95	0.49	0.18
15	12961	1780.31	3169498	0.81	-0.08	0.14
16	15485	4565.17	20840700	0.09	-1.25	0.29
17	32562	5710.09	32605100	0.88	0.36	0.18
18	18572	3393.26	11514200	0.46	-1.23	0.18
19	125778	59271.86	3513150000	0.27	-0.55	0.47
20	55867	11422	130462000	0.34	0.16	0.20
21	126312	53827.26	2897370000	0.84	-0.41	0.43
22	24984	3076.26	9463371	0.41	0.06	0.12
23	25988	2546.20	6483141	0.23	-1.51	0.10
24	40728	9673.19	93570700	0.13	-0.96	0.24
25	16047	3227.88	10419200	0.63	-0.91	0.20
26	72665	22694.96	515061000	0.39	-0.87	0.31
27	33509	2311.60	5343482	-0.23	0.16	0.07
28	24282	4531.48	20534300	0.29	-1.12	0.19
29	52037	7211.29	52002700	0.50	0.22	0.14
30	64452	31122.15	968588000	0.60	-0.84	0.48
31	9841	1179.45	1391109	-0.73	-0.93	0.12
32	21440	4114.95	16932800	-0.08	-0.81	0.19
33	14915	3302.93	10909300	0.30	0.22	0.22

It was an empirical evidence to reject the null hypothesis assumes that the means of the Turkish manufacturing industries' labor productivity are equal in favor of alternative hypothesis assumes that the mean of one or more sectors' labor productivity are different. Based on the traditional shift share analysis, the importance of the within, static, and dynamic effects to the aggregate labor productivity growth in the Turkish manufacturing industries had been determined during three periods (2003-2010), (2010-2017) and (2003-2017).

During the period of 2003-2008 the annual average growth of aggregate labor productivity in manufacturing industries of the Turkish economy was negative (%-2.42) and the source of this drag on the productivity is the within growth effect (-2.58). The effect of the static and dynamic shift effect is positive but negligible (0.12 and 0.04 respectively) as shown in figure 4-16. The negative within growth effect indicates that the sum of labor productivity changes of manufacturing industries weighted by the base year employment share of the industries is negative during the period of (2003-2008). The positive static shift effect indicates that the high labor productivity industries attract more labor resources. The positive dynamic effect indicates that the labor force shifts towards industries that were able to improve their productivity.

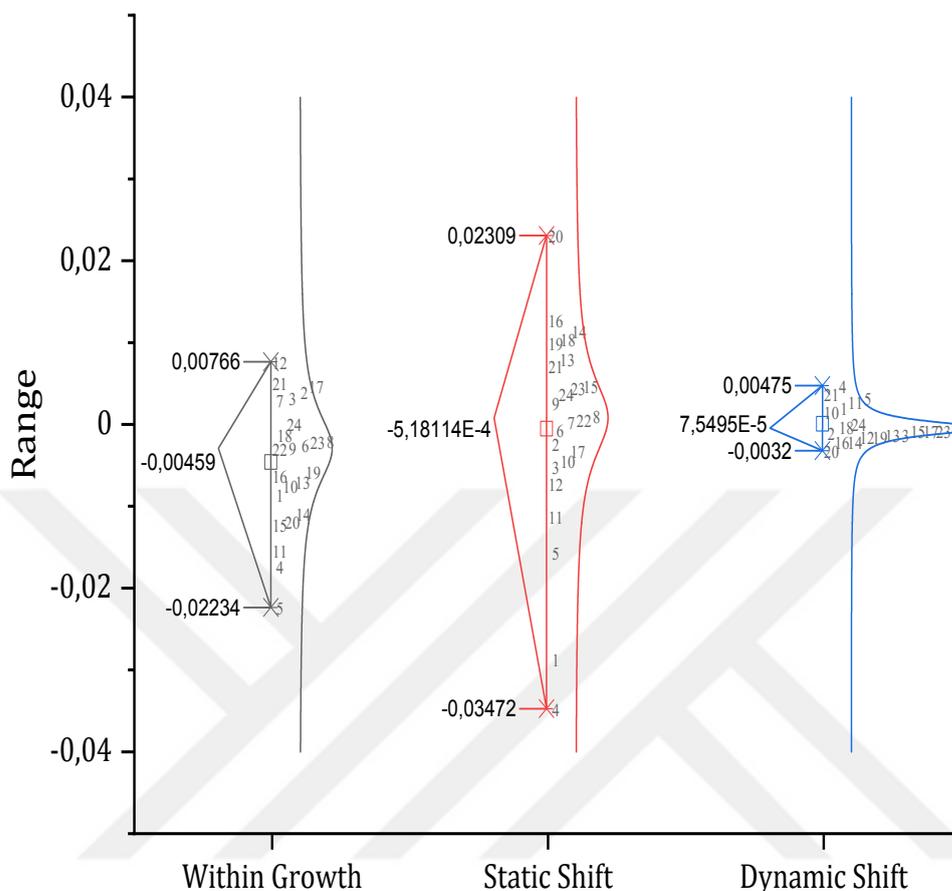


Figure 4.16. Decomposition of labor productivity in the Turkish manufacturing industries during 2003-2008

Note 1: 1=10, 2=11, 3=12, 4=13, 5=14, 6=15, 7=16, 8=17, 9=18, 10=19, 11=20, 12=21, 13=22, 14=23, 15=24, 16=25, 17=26, 18=27, 19=28, 20=29, 21=30, 22=31, 23=32, 24=32. Note 2: 10= food, 11= beverage, 12= tobacco, 13= textiles, 14= clothing, 15= leather, 16= wood, 17= paper and paper products, 18= recorded media, 19= coke and refined petroleum, 20= chemicals, 21= pharmaceuticals, 22= rubber and plastics, 23= non-metallic minerals, 24= basic metals, 25= fabricated metal products, 26= computer, electronic and optical products, 27=electrical equipment, 28= manufacturing n.e.c, 29= transport equipment, 30= other transport equipment, 31= furniture, 32= other industries, 33=Other manufacturing, and repair and installation of machinery and equipment.

The growth rate of labor productivity in the Turkish manufacturing industries during the period of 2010-2017 is 5.87% and the basic source of this productivity improvements originated from the within industry effect (6.29), the effect of structural change is negative but trivial (-0.11 for the static shift effect and -0.30 for the dynamic shift effect) as shown in figure 4-17. The positive within growth effect indicates that the sum of labor productivity changes of manufacturing industries leaden by the base year employment share of the industries is positive

during the period of (2010-2017). The negative static shift effect indicates that the high labor productivity industries attract less labor resources. The negative dynamic effect indicates that the labor force shifts towards industries that could not be able to improve their productivity.

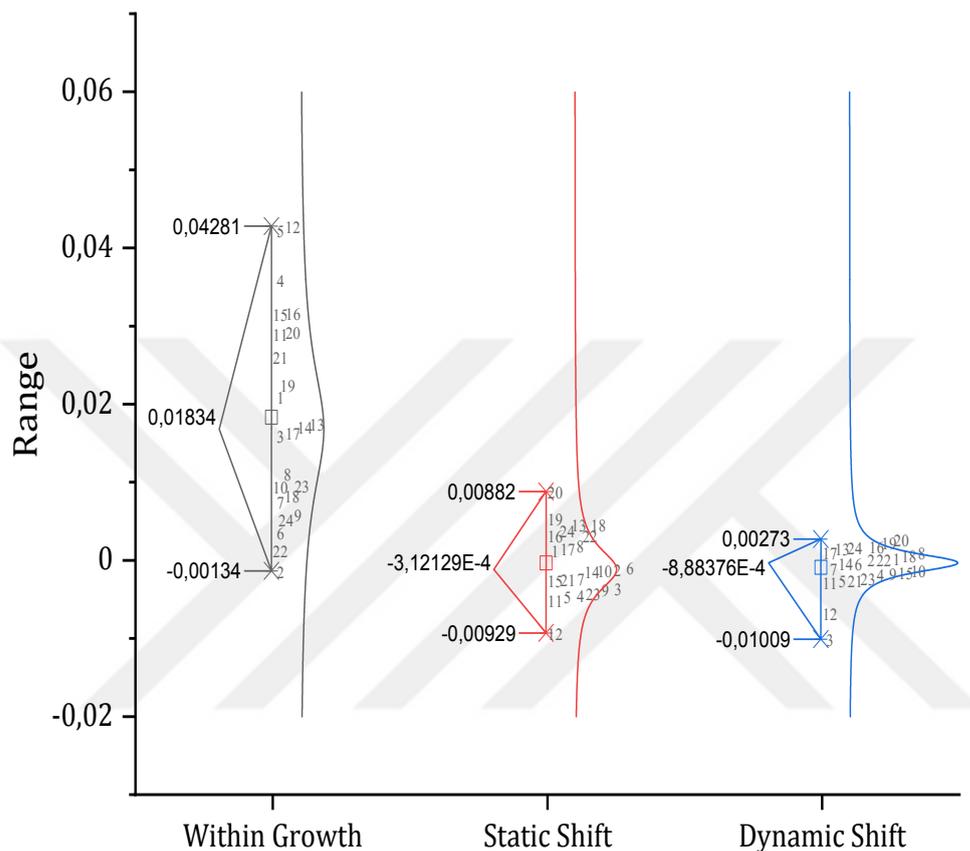


Figure 4.17. Decomposition of labor productivity in the Turkish manufacturing industries during 2010-2017

In the whole period of 2003-2017, the annual growth of labor productivity is 1.84%. The productivity improvements in the Turkish manufacturing industries comes mainly from the within sector productivity improvements (2.44). The impact of the static shift effect was trivial. The impact of the dynamic shift effect was negative (-0.61) as shown in figure 4-18:

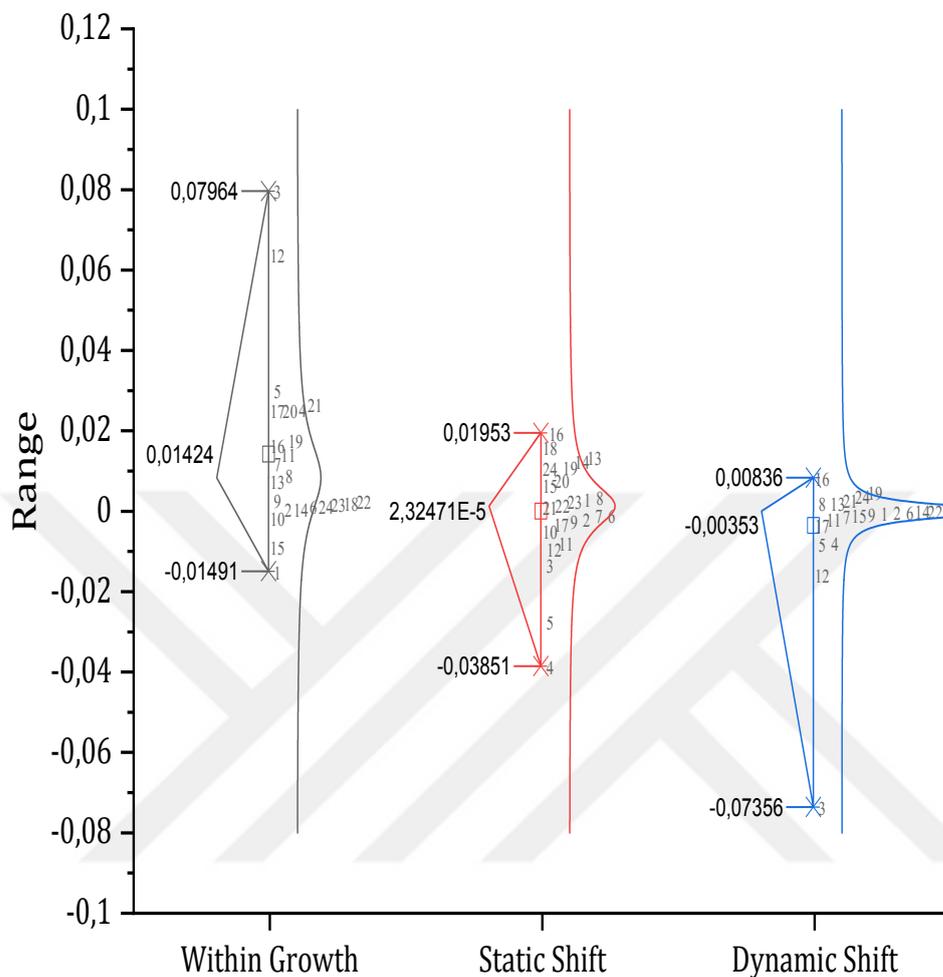


Figure 4.18. Decomposition of labor productivity in the Turkish manufacturing industries during 2003-2017

These results cope with the results of other studies. For example, the results of the study by Tuncer & Moalla (2020a) and Tuncer & Altuok (2011) which show that selection has made a very little contribution (positive or negative) to the overall evolution in labor productivity in Turkey. Like results of other studies, the within-sector effect was typically the main driving force of labor productivity improvements in manufacturing industries of the Turkish economy during the period of (2003-2017). The first column of Table 4-4 represents the annual growth rate of labor productivity in the Turkish manufacturing industries for the periods of 2003-2008, 2010-2017 and 2003-2017. The other columns exhibit within-, static shift- and dynamic shift-impact on the overall labor productivity evolution, respectively.

Table 4.4. Decomposition of labor productivity in the Turkish economy (Average annual growth rates)

	Productivity's growth rate	Within sector effect	Static shift effect	Dynamic shift effect	Total effect
2003-2008	-2.42	-2.58	0.12	0.04	-2.42
%		106.8	-5.1	-1.7	100.0
2010-2017	5.87	6.29	-0.11	-0.30	5.87
%		107.0	-1.8	-5.2	100.0
2003-2017	1.84	2.44	0.00	-0.61	1.84
%		132.7	0.2	-32.9	100.0

We reconcile our results with ones for Latin American countries. In more details, the results show that the dynamic industries that are more productive and increased their employment shares are transport equipment (29), other transport equipment (30), basic metals (24), paper and paper products (17) and electrical equipment (27). However, the employment share of these industries in total manufacturing is too low only around 13.2%. The sub industries that have a decline in employment shares and have a negative productivity growth during the period are textile (13), clothing (14), leather (15), wood (16) and recorded media (18). Interestingly the employment share of these low productivity industries in total manufacturing is around 40.5%. Industries with above average productivity but lose their employment shares are beverages (11), tobacco (12), coke and refined petroleum (19), chemicals (20), pharmaceuticals (21), computer and electronic and optical products (26). The employment share of this group is only 6.4% of total manufacturing employment at the end of the period. Overall, 80% of the manufacturing employment is in industries with below average productivity. Only around 20% of the employment in manufacturing are in high productivity sectors and only 13.2% of this employment are in dynamic industries that increase their employment share and has above average productivity. Looking across manufacturing industries, the general nexus between the labor productivity growth and the changes in employment shares is negative indicating that growth in employment stemmed from low productivity industries between 2003 and 2017. Finally, at the industry level, economic growth can be achieved through the within-sector enhancements in labor productivity and the reallocation of labor force towards the more productive sectors. In manufacturing, the within-sector effect accounts for the most part of aggregate productivity gains with a small structural change effect on the productivity growth. That means that the industrialization is an easy way to achieve the economic evolution which can be attained without forcing a cost disadvantage on an economy's fundamental capabilities. But this is not the rule and there is no standard list of policy recipes.

4.4. Structural Change at the Firm Level: From Evolutionary Perspective (The Price Equation)

The above-mentioned analysis had been conducted by using the industrial data compiled by the Turkish Statistical Institute (TSI) that classified according to NACE Rev.2 at two-digit level using the method of shift share analysis. There are no important differences between the employment shares and labor productivities at two-digit level manufacturing industries during the period of (2011-2015) but the matter is different at the four-digit level. Put it differently, during the period of (2011-2015) significant variations of labor productivity and employment shares take place at four-digit level. In this section we will measure the significance of the selection effect to productivity growth at the four-digit level from an evolutionary perspective by utilizing the single level as well as the multilevel decomposition of productivity growth that is the "Price equation" which based on the Schumpeterian notion of creative destruction. For this purpose, we had to distinguish between three sets of firms: first, firms those are exist only in the pre-evolution population (X), the firms those are exist only in the post evolution population (N) and the firms those are exist in both pre- and post-evolution populations (C). The Turkish Annual Industry and Services Statistics Data at the firm level had been aggregated into 213 sub sectors and the effect of selection on overall productivity evolution is being examined. Different sub periods had been analyzed which are: (2010-2011), (2010-2012), (2011-2015), (2012-2013), (2013-2015), (2014-2015) and (2010-2015); but only the results of the period of (2011-2015) had been reported in this thesis. The rest results are available upon request.

During the period between 2011 and 2015, as the number of the firms those are exist in the pre-evolution population, let us call them "Exiters". The number of "Exiters" were 21451 firms, the number of the firms those are exist in the post evolution population means the number of entrants was 25740 and the number of the firms those are exist in both pre- and post-evolution population was 18528; we conclude that the creation rate during this period was 39% from entrants and 28% from the continuing firms, in turn, the destruction rate was 33% at the same period. In 2011, almost 69% of the firms had labor productivity above the average productivity of the pre-evolution population ($Z_{2011} = 31498.04$). The highest labor productivity is counted for the firms of striking of coins (3211). Its labor productivity was about (270000). The firms of manufacture of beer (1105), and manufacture of precious metals production (2441) and manufacture of air and spacecraft and related machinery (3030) had also high labor productivity in 2011. The exports of firms of striking of coins increased from 1% in (2010) to 3% in (2015). The exports of firms of manufacture of beer decreased from 0.07% in (2010) to 0.04% in (2015). The exports of firms of manufacture of precious metals production increased

from 4% in (2010) to 7% in (2015). The exports of firms of manufacture air and spacecraft and related machinery increased from 0.4% in (2010) to 1% in (2015).

On the other hand, nearly 77% of the firms' employment share was above the average employment share of the pre-evolution population which was about (0.0047). Almost 59% of the firms with employment shares above the average employment share had labor productivity above the average labor productivity of the pre-evolution population. The firms of manufacture of other outerwear (1413) had the highest employment shares in 2011 which was (0.067) concurrently with labor productivity around 10000. The firms of manufacture of underwear (1414) had also high employment share in 2011 which was (0.052) concomitant with labor productivity around 10000. The employment shares of the firms of preparation and spinning of textile fibers (1310) was (0.031) accompanying with labor productivity around 10000. The result that can be drawn here is that the firms' low labor productivity is associated with their high employment shares in 2011. Pearson coefficient shows a negative relationship (-0.13) between the labor productivity and employment shares in 2011.

In 2015, almost 74% of the firms' labor productivity was above the average productivity in the pre-evolution population ($Z_{2011}= 31498.04$). At the same time, almost 69% of the firms had labor productivity above the average labor productivity of the post evolution population ($Z_{2015}= 35978.60$). The highest labor productivity is counted for the firms of striking of coins (3211). Its labor productivity was about (240000). The firms of manufacture of tobacco products (1200) and manufacture of air and spacecraft and related machinery (3030) had also high labor productivity in 2015. The exports of firms of manufacture of tobacco products increased from 0.28% in (2011) to 0.39% in (2015). On the other hand, nearly 76% of the firms had employment shares above the average employment share which was 0.0047. Almost 64% of the firms with employment share above the average employment share had productivity above the average labor productivity of the pre-evolution population and 57% of them had productivity above the average labor productivity of the post evolution population. The result that can be concluded here is that firms with low labor productivity is associated with high employment shares in 2015. Pearson coefficient shows a negative relationship (-0.12) between labor productivity and employment shares in 2015.

In order to smooth and confirm the results of firms' employment shares and labor productivities in the two years of 2011 and 2015, we utilize the method of Kernel density estimation which enables analyzing the structure of the manufacturing industries sectors and its groups. The following equation is employed to calculate the density values:

$$f(x, y, vX, vY, w_x, w_y) = \frac{1}{n} \sum_{i=1}^n \frac{1}{2\pi w_x w_y} \exp\left(-\frac{(x - vX_i)^2}{2w_x^2} - \frac{(y - vY_i)^2}{2w_y^2}\right) \quad (4.75)$$

where n is the number of subindustries in vector vX (employment shares) or vY (labor productivity), W_x and W_y denotes the values of optimal bandwidths which had been calculated based on linear diffusion process; and vX_i and vY_i denotes the employment share and the labor productivity, respectively. Figure 4-19 shows the density of the firms in 2011 and 2015 according to Kernel density estimator. Based on Kernel density estimator, the picture can be drawn about the structure of the manufacturing industries is that many of the firms has low labor productivity and this productivity decreases concurrently with the increase in employment shares. However, there are heterogeneities in labor productivities during this period. The most important key of the creation and destruction is the labor productivity heterogeneities. It had been considered as the key effect that stimulates the process of structural changes. To show the labor productivity heterogeneity between all firms' labor productivity in the Turkish manufacturing industries we calculate the standard deviations of those firms in different Turkish manufacturing industries (They are available upon request). The largest variances during the period of (2011-2015) are accounted for the sectors of precious metals production (2441), manufacture of tobacco products (1200), manufacture of pharmaceutical preparations (2120), manufacture of military fighting vehicles (3040) and manufacture of refined petroleum products (1920). However, the lowest variances are accounted for the sectors of manufacture of other outerwear (1413), manufacture of machinery for metallurgy (2891), manufacture of wine from grape, manufacture of wine from grape (1102), manufacture of doors and windows of metal (2512) and binding and related services (1814).

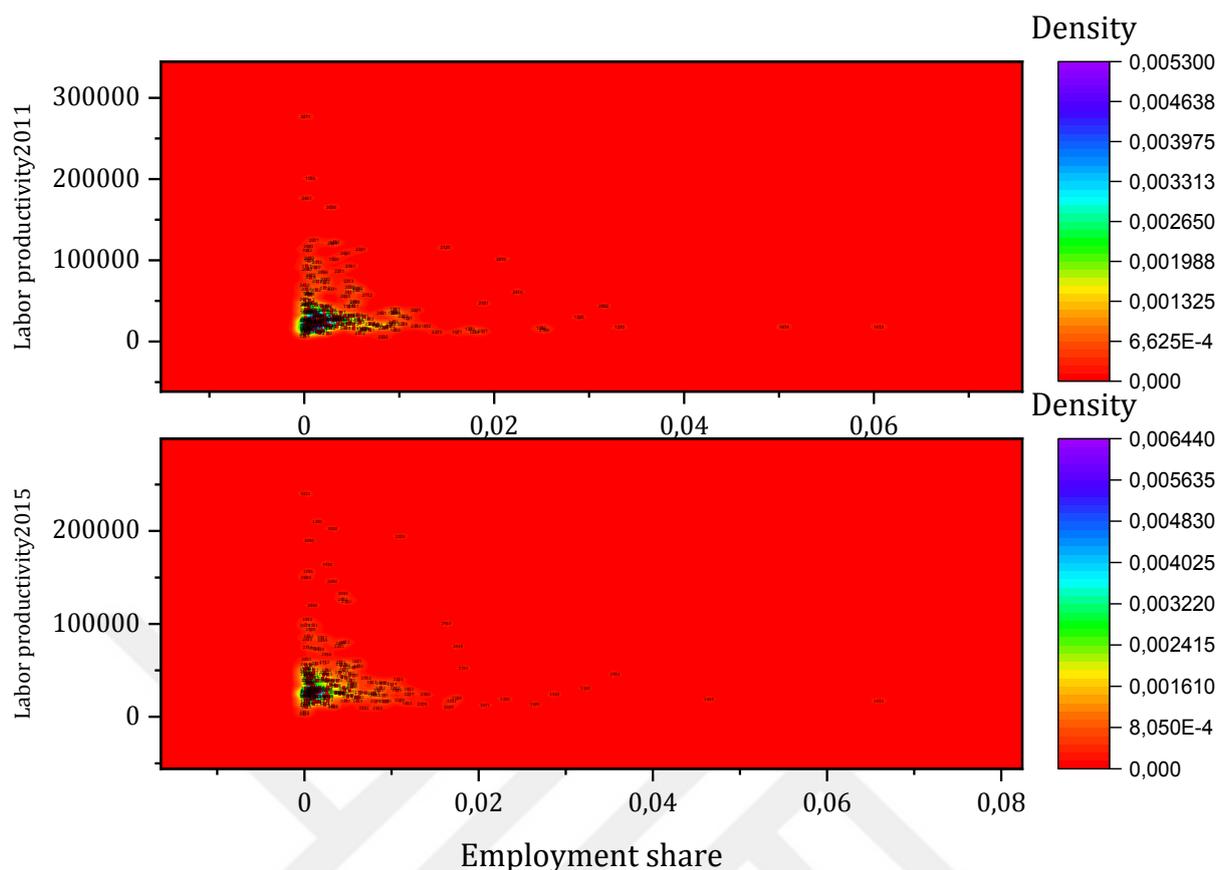


Figure 4.19. Firms' density during (2011-2015) achieved by bivariate Kernel density estimator

When examining the correlation between the change in employment shares and the labor productivity evolution during the period of 2011-2015 for all the firms, we find a positive correlation between them (Pearson corr.=0.0006 and p-value=0.99). The average labor productivity growth during the period of (2011-2015) was (0.17). In 2011, almost 59% of the firms that achieve positive labor productivity growth had productivity above the average labor productivity of the pre-evolution population. In 2015, almost 74% of the firms that achieve positive labor productivity growth had productivity above the average labor productivity of the pre-evolution population and 69% of them had productivity above the average labor productivity of the post evolution population. The highest rate of labor productivity growth (1.15) during the period of 2011-2015 had been achieved by the firms of manufacture of household and sanitary goods and of toilet requisites (1722) with positive change in employment share (0.49) of total employment of the Turkish manufacturing industries. These firms decreased their exports from 0.66% in (2011) to 0.63% in (2015).

The average change in employment shares during the period between 2011 and 2015 was 0.2. In 2011, almost 52% of the firms that increase their employment shares had labor productivity above the average labor productivity of the pre-evolution population. In 2015

almost 69% of the firms that increase their employment shares had labor productivity above the average labor productivity of the pre-evolution population and 64% of them had labor productivity above the average labor productivity of the post evolution population. The highest changes in employment shares were 2.15 and 0.98 for the firms of manufacture of mortars (2364) and manufacture of prepared meals and dishes (1085) respectively. Also, the labor productivity growth of these firms was positive 0.04 and 0.24 respectively. The exports of firms of manufacture of prepared meals and dishes decreased from 0.002% in (2010) to 0.001% in (2015)

Figure 4-20 presents the correlation between the change in employment share and the labor productivity growth at the firm level during 2011-2015. The dynamic industries that are more productive and increased their employment shares during the period from 2011 to 2015 are: manufacture of household and sanitary goods and of toilet requisites (1722) and processing and preserving of meat (1011). The employment shares of these sectors increased by 0.5 and 0.2 respectively. The sub-industries that decreased their employment share accompanying by declining in the labor productivity growth are manufacture of coke oven products (1910) and manufacture of power-driven hand tools (2824). The most decline in the labor productivity growth is in precious metals production (2441) but this industry increased its employment share during the studied interval by 0.74.

The firms of processing and preserving of meat increased their exports from 0.25% in (2010) to 0.39% in (2015). The exports of the firms of manufacture of coke oven products increased from 0.001% in (2011) to 0.02% in (2015). The exports of firms of manufacture of power-driven hand tools decreased from 0.02% in (2010) to 0.01% in (2015).

We can divide the firms into four groups; the firms those were able to increase their labor productivity concurrently with increasing their employment share, the firms those increased their labor productivity concurrently with decreasing their employment shares, the firms those decreased their labor productivity concurrently with increasing their employment shares and the firms those decreased their labor productivity concurrently with decreasing their employment shares. The dynamic firms those were able to increase their labor productivity concomitant with increasing their employment share; increased their employment shares from 35% in 2011 to 40% of total employment in the Turkish manufacturing industries in 2015. Almost, 52% of these firms had labor productivity in 2011 above the average labor productivity of the pre-evolution population ($Z_{2011}= 31498.04$). In 2015, about 69% of the firms in this group had labor productivity above the average one of the pre evolution population and Only 64% of them increased their labor productivity above the average labor productivity of the post evolution population ($Z_{2015}= 35978.60$). Those firms are available in table (7-3) in the appendix. The firms those decreased their labor productivity concomitant with decreasing their employment share; decreased their employment shares from 8% in 2011 to 7% of total employment in the Turkish manufacturing industries in 2015. Almost 87% of those firms had labor productivity in 2011 above the average labor productivity of the pre-evolution population. In 2015, almost 75% of those firms still had productivity above the average labor productivity in the pre-evolution population. But, only 73% of those firms had productivity above the average labor productivity in the post evolution population in 2015. Those firms are available in table (7-4) in the appendix. The firms those increased their labor productivity concomitant with decreasing their employment share; decreased their employment shares from 48% in 2011 to 43% of total employment in the Turkish manufacturing industries in 2015. Almost 65% of those firms had productivity above the average labor productivity of the pre-evolution population in 2011 ($Z_{2011}= 31498.04$). In 2015, almost 78% of those firms had productivity above the average labor productivity in the pre evolution population and only 74% of them had productivity above the mean productivity in the post evolution population ($Z_{2015}= 35978.60$). Those firms are available in table (7-5) in the appendix.

The firms those decreased their labor productivity concomitant with increasing their employment shares keep (in total) their employment shares around 9% during the period of 2011-2015. In 2011, almost 83% of those firms had productivity above the mean labor productivity of the pre-evolution population. In 2015, almost 73% of those firms had

productivity above the mean labor productivity in the pre-evolution population; but only 67% of those firms had productivity above the mean labor productivity in the post evolution population. Those firms are available in table (7-6) in the appendix.

According to the multi-level Price equation, the industry selection effect was (22.30). The industry selection effect or the inter-industry effect denotes the selection among industries. It will contribute positively to the aggregate productivity growth if the industries increase their labor productivity concomitant with increasing their labor shares at the expense of the other industries. The negative value of the firm selection effect indicates that the industries' productivity is less than the average population mean. Put it differently, those industries could not be able to increase their productivity concurrently with increasing their employment shares. So, we can distinguish between two groups of firms: those with positive industry selection effect and the firms with negative industry selection effect. The firms with positive industry selection effect decreased (in total) their employment shares from 54% in 2011 to 52% in 2015. Those firms increased (decreased) their labor productivity concomitant with increasing (decreasing) their employment shares. In 2011, almost 68% of the firms with positive industry selection effect had productivity above the mean labor productivity in pre-evolution population. In 2015, almost 72% of the firms with positive industry selection effect had productivity above the mean labor productivity in the pre-evolution population and about 68% of these firms had productivity above the average labor productivity of the post evolution population. The firms with negative industry selection effect increased (in total) their employment shares from 46% in 2011 to 48% in 2015. Those firms were not able to increase their labor productivity concurrently with expanding their employment shares. In 2011, almost 70% of the firms with negative industry selection effect had productivity above the mean labor productivity in pre-evolution population. In 2015, almost 75% of the firms with negative industry selection effect had productivity above the mean labor productivity in the pre-evolution population and about 70% of these firms had productivity above the average labor productivity of the post evolution population. It is important to remind here that in order to calculate the industry selection effect we utilize the data of all the firms during the period of 2011-2015 without distinguishing between three groups meaning C, X and N.

That was the industry selection effect. Moving to the firm selection effect, we will utilize the data of C firms meaning the firms those are exist in both pre- and post-evolution population. In 2011, almost 72% of C firms had productivity above the mean productivity in the pre-evolution population. The highest labor productivity in C group is accounted for the firms of manufacture of beer (1105). Its labor productivity was about (200000). The firms of manufacture of tobacco products (1200) and precious metals production (2441) had also high labor productivity in 2011. The firms of manufacture of underwear (1414) had high

employment share in 2011 which was (0.045) concomitant with labor productivity around 10000. The result that we can conclude here is that the firms' low labor productivity is associated with their high employment shares. Pearson coefficient shows a negative relationship (-0.11) between the labor productivity growth and the changes in employment shares in 2011.

In 2015, almost 79% of the C firms' had productivity above the average labor productivity in the pre evolution population. Additionally, almost 71% of the C firms had productivity above the mean labor productivity in the post evolution population. The firms of spacecraft and related machinery (3030), manufacture of pharmaceutical preparations (2120) and manufacture of refined petroleum products (1920) had also high labor productivity in 2015. The firms of manufacture of refined petroleum products decreased their exports from 4% in (2010) to 3% in (2015). The firms of manufacture of other outerwear (1413) had the highest employment shares in 2015 which was (0.052) concurrently with labor productivity around 10000. The result that we can conclude here is that the firms' low labor productivity is associated with their high employment shares. Pearson coefficient shows a negative relationship (-0.09) between the labor productivity and employment shares in 2015. To show the labor productivity heterogeneity between C firms' labor productivity in the Turkish manufacturing industries we calculate the standard deviations of C firms in different Turkish manufacturing industries (They are available upon request). The largest variances in C group during the period of (2011-2015) are accounted for the sectors of manufacture of precious metals production (2441), manufacture of pharmaceutical preparations (2120), manufacture of refined petroleum products (1920), manufacture of military fighting vehicles (3040) and manufacture of optical instruments and photographic equipment (2670). The lowest variances in C groups are accounted for the sectors of manufacture of other furniture (3109), manufacture of communication equipment (2630), manufacture of veneer sheets and wood-based panels (1621), manufacture of watches and clocks (2652) and manufacture of other machine tools (2849). When examining the correlation between the change in employment share and the labor productivity growth during the period of (2011-2015) for C firms, we find a positive correlation between them (Pearson corr.=0.38 and p-value=8,51466E-9). As we can notice the correlation coefficient between the change in employment share and the labor productivity growth at the C firms level is larger than that at all firms' level (Pearson corr.=0.0006). The average labor productivity growth during the period of (2011-2015) was (0.16). The labor productivity growth of about 24.17% of the firms was negative, but the labor productivity growth of about 77.88% of the firms was positive. The highest rate of labor productivity growth (4.63) during the period of 2011-2015 had been achieved by the firms of manufacture of coke oven products (1910) with positive change in employment share (1.65) of total employment of

the Turkish manufacturing industries. Similarly, the continuous firms of (1011) and (1722) had high labor productivity growth rates which were 1.27 and 1.97 respectively associated with positive changes in employment shares: 0.12 and 0.47, respectively. The lowest labor productivity growth (9.25) during this period is accounted for the firms of (3211). The average change in employment shares of C firms during the period of 2011-2015 was 0.04. The highest changes in employment shares were 1.95 and 1.65 for the firms of manufacture of mortars (2364) and manufacture of coke oven products (1910) respectively. Also, the labor productivity growth of these firms was positive: 0.30 and 4.63, respectively. Figure 4-21 presents the correlation between the change in employment share and the labor productivity growth at the C firm level during 2011-2015.



We can divide the C firms into four groups; (1) the firms those were able to increase their both labor productivity and employment shares, (2) the firms those increased their labor productivity concomitant with decreasing their employment shares, (3) firms those decreased their labor productivity concomitant with increasing their employment shares and (4) the firms those decreased both their labor productivity and employment shares.

The dynamic firms those were able to increase their labor productivity and employment shares concurrently; increased their employment shares from 36% in 2011 to 40% of total employment in the Turkish manufacturing industries in 2015. In 2011, almost 59% of the C firms that increased their labor productivity accompanying with increasing their employment shares had productivity above the average labor productivity of the pre-evolution population. In 2015, almost 77% of the C firms that increased their labor productivity accompanying with increasing their employment shares had productivity above the average labor productivity of the pre-evolution population and 65% of them had productivity above the average labor productivity of the post evolution population. Those firms are available in table (7-7) in the appendix. The firms those decreased their labor productivity concomitant with decreasing their employment share; decreased their employment shares from 8% in 2011 to 7% of total employment in the Turkish manufacturing industries in 2015. In 2011, almost 86% of the C firms those decreased their labor productivity concomitant with decreasing their employment shares had labor productivity above the average labor productivity of the pre-evolution population. In 2015, almost 79% of the C firms those decreased their labor productivity concomitant with decreasing their employment shares had labor productivity above the average labor productivity of the pre-evolution population and 71% of them had labor productivity above the average labor productivity of the post evolution population. Those firms are available in table (7-8) in the appendix. The firms those increased their labor productivity concomitant with decreasing their employment shares; decreased their employment shares from 50% in 2011 to 46% of total employment in the Turkish manufacturing industries in 2015. In 2011, almost 66% of the C firms those increased their labor productivity concomitant with decreasing their employment shares had productivity above the average labor productivity of the pre-evolution population. In 2015, almost 80% of the C firms those increased their labor productivity concomitant with decreasing their employment shares had productivity above the average labor productivity of the pre-evolution population and 74% of them had productivity above the average labor productivity of the post evolution population. Those firms are available in table (7-9) in the appendix. The firms those decreased their labor productivity concomitant with increasing their employment share; increased their employment shares from 6% in 2011 to 7% of total employment in the Turkish manufacturing industries in 2015. In 2011, almost 91% of the C firms those decreased their labor productivity concomitant with increasing their

employment share had labor productivity above the average labor productivity of the pre-evolution population. In 2015, almost 82% of the C firms those decreased their labor productivity concomitant with increasing their employment share had labor productivity above the average labor productivity of the pre-evolution population and almost 73% of them had labor productivity above the average labor productivity of the post evolution population. Those firms are available in table (7-10) in the appendix.

According to the multi-level Price equation, the firm selection effect was (1495.43). The firm selection effect denotes the selection among firms. It has a positive impact on the overall productivity evolution if the firms' those are exist in both pre- and post-evolution population increased (decreased) their labor productivity in the end year more than the average productivity of the sub population concurrently with increasing (decreasing) their employment shares during the studied interval. The negative value of the firm selection effect according to the multilevel Price equation indicates that the firms could not increase their productivity more than the average sub population mean concurrently with increasing their employment shares. With the single level of price equation, the firm selection effect was (662). It will contribute positively to the overall productivity evolution if the firms those are exist in both pre- and post-evolution population increase (decrease) their labor productivity more than the overall labor productivity concomitant with increasing (decreasing) their employment shares. The negative value of the firm selection effect according to the single level Price equation indicates that the firms could not increase their labor productivity more than the overall productivity concurrently with increasing their employment shares. We can distinguish between two groups of firms: those with positive firm selection effect and the firms with negative firm selection effect. The employment shares of the firms with positive firm selection effect decreased from 69% in 2011 to 66% in 2015; but the employment shares of the firms with negative firm selection effect during the period of 2011-2015 increased from 31% in 2011 to 34% in 2015 according to the multilevel Price equation. Similarly, according to the single level Price equation the employment shares of the firms with positive firm selection effect increased from 70% in 2011 to 71% in 2015. But the employment shares of the firms with negative firm selection effect decreased from 30% in 2011 to 29% in 2015.

When calculating the firm selection effect based on the single Price equation; we concluded that in 2011 almost 61% of the firms with positive firm selection effect had productivity above the labor productivity of the pre evolution population, but in 2015, almost 74% of the firms with positive firm selection effect had productivity above the labor productivity of the pre evolution population and almost 63% of them had productivity above the labor productivity of the post evolution population. Furthermore, when calculating the firm selection effect based on the single Price equation; we concluded that in 2011, almost 86% of

the firms with negative firm selection effect had productivity above the labor productivity of the pre evolution population, but in 2015, almost 86% of the firms with negative firm selection effect had productivity above the average labor productivity of the pre evolution population and almost 81% of them had productivity above the labor productivity of the post evolution population. When calculating the firm selection effect based on multilevel Price equation; we concluded that in 2011 almost 66% of the firms with positive firm selection effect had productivity above the labor productivity of the pre evolution population, but in 2015, almost 79% of the firms with positive firm selection effect had productivity above the labor productivity of the pre evolution population and almost 70% of them had productivity above the labor productivity of the post evolution population. Moreover, when calculating the firm selection effect based on multilevel Price equation; we concluded that in 2011, almost 78% of the firms with negative firm selection effect had productivity above the labor productivity of the pre evolution population, but in 2015, almost 79% of the firms with negative firm selection effect had productivity above the average labor productivity of the pre evolution population and almost 74% of them had productivity above the average labor productivity of the post evolution population. One of the important results here is the conclusion that the one-level Price equation underestimates the firm selection effect on the Turkish manufacturing industries during the period of (2011-2015) comparing with the multi-level Price equation. If resources are reallocated decreasing the labor productivity compared to the productivity of industry, then the single-level technique predicts a negative inter- firm effect; while the multilevel technique predicts a positive inter-firm effect and a negative industry-selection effect.

According to the multi-level Price equation, the learning effect was (4400.89). It will contribute positively to the overall productivity evolution if the firms' those are exist in both pre- and post-evolution population increased their labor productivity in the end year. The negative value of the learning effect according to the multilevel Price equation indicates that the firms could not increase their productivity during the studied interval. With the single level of price equation, the learning effect was (3556.95). It has a positive impact on the overall productivity evolution if the firms those are exist in both pre- and post-evolution population increase their labor productivity. The negative value of the learning effect according to the single level Price equation indicates that the firms could not increase their labor productivity during the studied interval. We can distinguish between two groups of firms: those with positive learning effect and the firms with negative learning effect. The employment shares of the firms with positive learning effect increased from 73% in 2011 to 80% in 2015 according to multilevel Price equation. The employment shares of the firms with negative learning effect decreased from 27% in 2011 to 20% in 2015 according to the multilevel Price equation. The results according to the single level Price equation were the same. When calculating the learning

effect based on multilevel Price equation; we concluded that in 2011 almost 60% of the firms with positive learning effect had productivity above the labor productivity of the pre evolution population, but in 2015, almost 77% of the firms with positive learning effect had productivity above the average labor productivity of the pre evolution population and almost 70% of them had productivity above the average labor productivity of the post evolution population. When calculating the learning effect based on the single Price equation; we concluded that in 2011 almost 67% of the firms with positive learning effect had productivity above the average labor productivity of the pre evolution population, but in 2015, almost 77% of the firms with positive learning effect had productivity above the average labor productivity of the pre evolution population and almost 70% of them had productivity above the average labor productivity of the post evolution population.

When calculating the learning effect based on multilevel Price equation; we concluded that in 2011 almost 86% of the firms with negative learning effect had productivity above the average labor productivity of the pre evolution population, but in 2015, almost 83% of the firms with negative learning effect had productivity above the average labor productivity of the pre evolution population and almost 73% of them had productivity above the average labor productivity of the post evolution population. When calculating the learning effect based on the single Price equation; we concluded that in 2011 almost 79% of the firms with negative learning effect had productivity above the average labor productivity of the pre evolution population, but in 2015, almost 83% of the firms with negative learning effect had productivity above the average labor productivity of the pre-evolution population and almost 88% of them had productivity above the average labor productivity of the post evolution population. One of the important results here is the conclusion that the one-level Price equation and the multi-level one give approximate values of the learning effect during the period of (2011-2015).

In order to analyze the exit effect, let's first analyze the labor productivity and the employment shares of the exiters. About 90.82% of the exiters' labor productivity was around 25000 and this value is below the average labor productivity of the pre-evolution population which is ($Z_{2011}=31498.49$). The data provide us mixed results. In other words, some exiters had labor productivity above the average labor productivity in the pre-evolution population. The potential reason for that may stem from the firms moving among industries rather than terminal exit. There is a negative nexus between the labor productivity and employment shares of the exiters (Pearson coefficient=-0.07). With the single level of price equation, the exit effect was (2802.65) meaning that it affects the aggregate labor productivity growth positively. The positive exit effect according to the single level Price equation means that the labor productivity of the exiters is below the overall labor productivity in the base year. According to the multi-level Price equation, the exit effect was (1591.31) meaning that it affects the aggregate labor

productivity positively during the period of 2011-2015. It will contribute positively to the aggregate productivity evolution if the exiters' productivity was less than the mean labor productivity of the sub population in the pre-evolution population. The negative value of the exit effect according to the multilevel Price equation indicates that the exiters' productivity was more than that of the sub population but according to the single level Price equation the negative value of the exit effect indicated that the exiters' productivity was more than the overall labor productivity during the studied interval.

The average employment share of the exiters is about (0.005). The employment shares of the positive contribution exiters were 97% of total exiters and the employment share of the negative contribution exiters was 3% according to multi-level Price equation but according to the single level Price equation it was 94% for the positive contribution exiters and 6% for the negative contribution exiters. According to the multi-level Price equation, the positive contribution exiters are available in table (7-11) in the appendix. The negative contribution exiters are also available in table (7-12) in the appendix. According to the single level Price equation the results were different. Put it differently, the exit of the firms of (1629) manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials, (1820) reproduction of recorded media, (1910) manufacture of coke oven products, (2319) manufacture and processing of other glass, including technical glassware, (2343) manufacture of ceramic insulators and insulating fittings, (2454) casting of other non-ferrous metals, (2571) manufacture of cutlery, (2611) manufacture of electronic components, (2652) manufacture of watches and clocks, (2732) manufacture of other electronic and electric wires and cables and (2824) manufacture of power-driven hand tools contributes positively to the aggregate labor productivity growth during the period of 2011-2015; but according to the multi-level Price equation they contributed negatively. Similarly, the exit of the firms of (2015) manufacture of fertilizers and nitrogen compounds, (2016) manufacture of plastics in primary forms, (2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics, (2059) manufacture of other chemical products n.e.c., (2120) manufacture of pharmaceutical preparations, (2313) manufacture of hollow glass, (2351) manufacture of cement, (2433) cold forming or folding, (2640) manufacture of consumer electronics, (2680) manufacture of magnetic and optical media, (3011) building of ships and floating structures, (3012) building of pleasure and sporting boats, (3040) manufacture of military fighting vehicles and (3091) manufacture of motorcycles contributes negatively according to the single level Price equation but positively according to the multilevel Price equation. One of the important results here is the conclusion that the one-level Price equation overestimates the exit effect on the Turkish manufacturing industries during the period of (2011-2015) comparing with the multi-level Price equation.

In order to analyze the entry effect, let's first analyze the labor productivity and the employment shares of the entrants. About 89.1% of the entrants' labor productivity is below the average labor productivity of the pre-evolution population ($Z_{2011}=31498.49$) and below that of the post evolution population ($Z_{2015}=35978.6$). Almost 50.24% of the entrants' labor productivity was around 10000 and 38.86% of the entrants was around 30000. Only 10.9% of the entrants' labor productivity was above the average labor productivity of the pre- and post-evolution population. The reason for that maybe that such entry impact stems from firms moving between industries rather than entrepreneurial entry. The average employment share of the entrants is about 0.005. There is a negative nexus between the labor productivity and employment shares of the entrants (Pearson coefficient=-0.11).

According to the multi-level Price equation, the entry effect was (-1424.95) meaning that it affected the aggregate labor productivity negatively during the period of (2011-2015). It has a positive impact on the overall productivity evolution if the entrants' productivity in the end year was more than that of the sub population in the base year according to the multi-level Price equation, but according to the single level Price equation it will contribute positively if the entrants' productivity was more than the overall productivity. The negative value of the entry effect according to the multilevel Price equation indicates that the entrants' productivity was less than that of the sub population but according to the single level Price equation the negative value of the entry effect indicated that the exiters' productivity was less than the overall labor productivity during the studied interval. With the single level of price equation, the entry effect was (-2539.42) meaning that it affects the overall labor productivity evolution negatively. The employment shares of the positive contribution entrants were 18% of total entrants and the employment share of the negative contribution entrants was 82% according to multi-level Price equation, but according to the single level Price equation it was 11% for the positive contribution entrants and 89% for the negative contribution entrants. The positive contribution entrants during (2011-2015) according to the multi-level Price equation are available in table (7-13) in the appendix. The negative contribution entrants are also available in table (7-14) in the appendix.

According to the single level Price equation the results were different. Put it differently, the entry of the firms of (1011) processing and preserving of meat, (1085) manufacture of prepared meals and dishes, (1310) preparation and spinning of textile fibers, (1391) manufacture of knitted and crocheted fabrics, (1393) manufacture of carpets and rugs, (1412) manufacture of work wear, (1420) manufacture of articles of fur, (1439) manufacture of other knitted and crocheted apparel, (1511) tanning and dressing of leather; dressing and dyeing of fur, (1610) sawmilling and planning of wood, (1623) manufacture of other builders' carpentry and joinery, (1811) printing of newspapers, (1813) pre-press and pre-media services, (1820)

reproduction of recorded media, (2312) shaping and processing of flat glass, (2343) manufacture of ceramic insulators and insulating fittings, (2349) manufacture of other ceramic products, (2352) manufacture of lime and plaster, (2363) manufacture of ready-mixed concrete, (2445) other non-ferrous metal production, (2529) manufacture of other tanks, reservoirs and containers of metal, (2530) manufacture of steam generators, except central heating hot water boilers, (2561) treatment and coating of metals, (2571) manufacture of cutlery, (2611) manufacture of electronic components, (2652) manufacture of watches and clocks, (2752) manufacture of non-electric domestic appliances, (2823) manufacture of office machinery and equipment, (except computers and peripheral equipment), (2829) manufacture of other general-purpose machinery n.e.c., (3101) manufacture of office and shop furniture, (3213) manufacture of imitation jewelry and related articles, (3250) manufacture of medical and dental instruments and supplies contributes negatively to the aggregate productivity growth; but positively according to multi-level Price equation. Also, according to the single level Price equation, the entry of the firms of (1042) manufacture of margarine and similar edible fats, (1062) manufacture of starches and starch products, (1101) distilling, rectifying and blending of spirits, (1712) manufacture of paper and paperboard, (2016) manufacture of plastics in primary forms, (2020) manufacture of pesticides and other agrochemical products, (2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics, (2041) manufacture of soap and detergents, cleaning and polishing preparations, (2042) manufacture of perfumes and toilet preparations, (2059) manufacture of other chemical products n.e.c., (2060) manufacture of man-made fibers, (2313) manufacture of hollow glass, (2320) manufacture of refractory products, (2351) manufacture of cement, (2410) manufacture of basic iron and steel and of Ferro-alloys, (2433) cold forming or folding, (2441) precious metals production, (2521) manufacture of central heating radiators and boilers, (2620) manufacture of computers and peripheral equipment, (2640) manufacture of consumer electronics, (2651) manufacture of instruments and appliances for measuring, testing and navigation, (2751) manufacture of electric domestic appliances, (2811) manufacture of engines and turbines, except aircraft, vehicle and cycle engines, (2910) manufacture of motor vehicles, (2932) manufacture of other parts and accessories for motor vehicles, (3011) building of ships and floating structures, (3012) building of pleasure and sporting boats, (3020) manufacture of railway locomotives and rolling stock, (3030) manufacture of air and spacecraft and related machinery, (3040) manufacture of military fighting vehicles, (3091) manufacture of motorcycles and (3211) striking of coins contributes positively to the aggregate labor productivity growth during the period of 2011-2015; but according to the multi-level Price equation they contributed negatively. One of the important results here is the conclusion that the one-level Price equation underestimates the entry effect on the Turkish manufacturing industries during the period of

(2011-2015) comparing with the multi-level Price equation.

Table 4-5 summarizes the results of decomposing the aggregate labor productivity using the single and multilevel Price equation over the entire period of (2010-2015) and the sub-periods of (2010-2011), (2010-2012), (2011-2015), (2012-2013), (2013-2015) and (2014-2015) at the firm level.

Table 4.5. One- versus multi-level decomposition

Eq.	industry selection	Firm selection	learning	entry	exit
2010-2011, $\Delta Z/Z*100=0.05$					
multilevel	-0.02	0.01	0.08	-0.03	0.02
%	-39.37	15.39	147.73	-59.37	35.63
single level		0.01	0.06	-0.05	0.03
2010-2012, $\Delta Z/Z*100=-0.06$					
multilevel	-0.07	0.00	-0.03	-0.04	0.03
%	63.83	-0.81	28.52	34.45	-25.99
single level		0.01	-0.02	-0.09	0.04
2010-2015, $\Delta Z/Z*100=0.20$					
multilevel	-0.06	-0.01	0.27	-0.04	0.04
%	-26.97	-5.85	130.76	-17.24	19.30
single level		0.01	0.19	-0.08	0.09
2011-2015, $\Delta Z/Z*100=0.14$					
multilevel	0.0007	-0.003	0.14	-0.05	0.05
%	0.50	-2.30	98.11	-31.65	35.34
single level		0.02	0.11	-0.08	0.09
2012-2013, $\Delta Z/Z*100=0.12$					
multilevel	-0.01	0.02	0.14	-0.03	0.02
%	-4.54	11.71	99.47	-19.02	12.38
single level		0.01	0.12	-0.04	0.03
2013-2015, $\Delta Z/Z*100=0.15$					
multilevel	0.01	0.01	0.09	-0.03	0.04
%	7.94	9.81	73.57	-22.83	31.51
single level		0.04	0.08	-0.05	0.07
2014-2015, $\Delta Z/Z*100=0.15$					
multilevel	0.01	0.01	0.13	-0.02	0.02
%	5.81	5.25	87.55	-12.82	14.22
single level		0.02	0.13	-0.03	0.04

During the entire period of (2010-2015), labor productivity grew by 0.20 percent. According to the multilevel equation, the productivity growth was driven by the learning effect (130.76 per cent) and the positive exit effect. The contribution of the entrants was around -17

percent meaning that the entrants had lower labor productivity compare to the industry's mean productivity. The exit effect was 19.30 percent meaning that the low productive firms were forced to exit from the market the matter that influences the overall productivity evolution positively. The single-level technique and the multilevel one quantifies approximate values of the learning effect. At the industry level, selection favored industries with low labor productivity, and this contributed to -27 percent of the total productivity growth. The negative industry selection effect refers to the growing Turkish industries. Put it differently, the negative industry selection effect, according to the multi-level, means that the industries were not able to increase their labor productivity more than the average productivity of the overall population concurrently with expanding their relative sizes. The negative firm selection effect indicates that the firms could not increase their labor productivity more than the average industry's productivity concurrently with expanding their relative sizes. This is satisfied with a process of structural change in which the entry of the firm occurs into the low productivity industries. Figure 4-22 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period (2010-2015). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect; but the second component has large negative associations with the learning effect. When utilizing the multi-level Price equation, the results show that the first principal component has large positive associations with the industry selection, the learning and the exit effect; while the second component has negative associations with the learning effect.

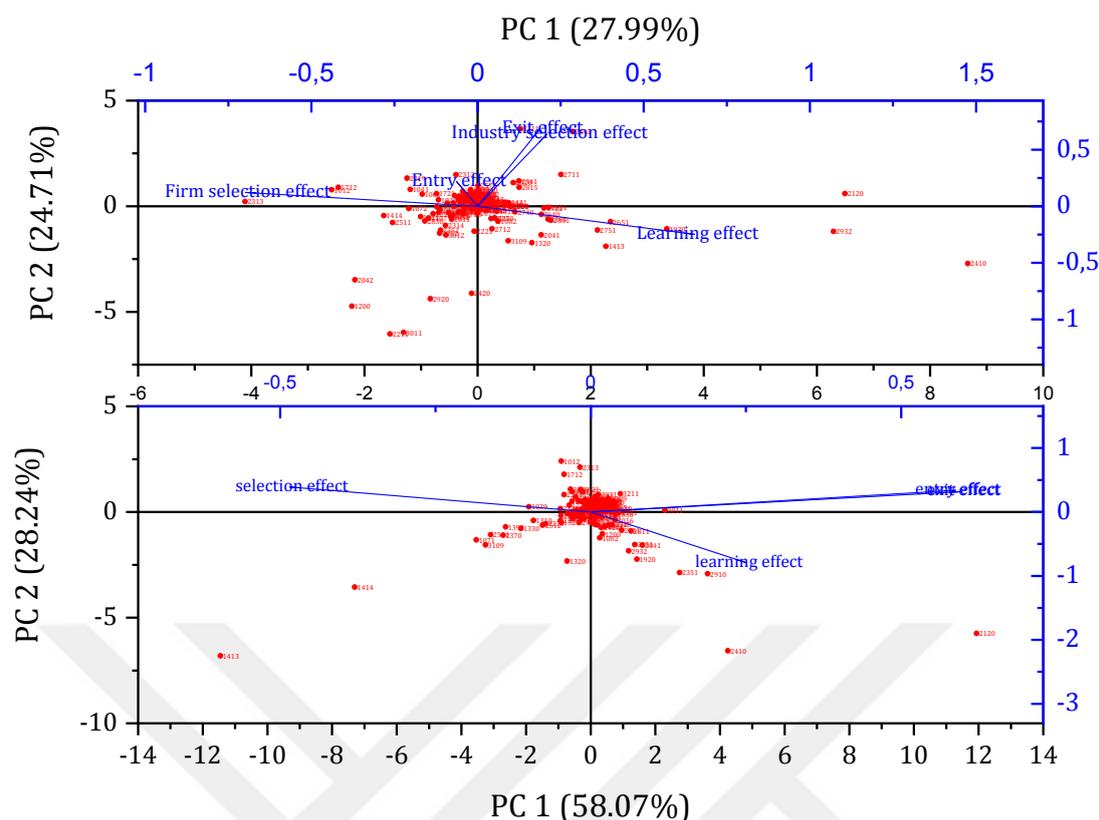


Figure 4.22. Biplot of Price equation during the period of (2010-2015)

The results of the period of (2011-2015) show that the labor productivity grew at the rate of 0.14. The results according to the single level Price equation show a negative entry effect means that the firms' productivity in the post-year is lower than the mean productivity of total population mean productivity in the base year. The positive exit effect indicates that the exiters contribute positively to the aggregate labor productivity growth during this period because that their labor productivity is below the average labor productivity of the total population. A positive selection effect according to the single level means that the firms were able to increase their labor productivity more than the average productivity of the whole population concomitant with expanding their relative sizes. However, the single level Price equation overestimates the firm selection effect because it predicts a positive firm selection effect. It also underestimates the entry effect because it gives low number comparing to those resulted from the multi-level Price equation. Figure 4-23 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2011-2015). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect; but the second component has large negative associations with the learning effect. These results are the same with those concluded during the period of (2010-2015). However, when utilizing the multi-level Price equation, the results show that the

first principal component has negative associations with the firm selection effect and the learning effect, while the second component has negative associations with the firm selection effect and the exit effect. And this is another evidence shows the results change when measuring the key sources of the aggregate labor productivity evolution at the disaggregate level.

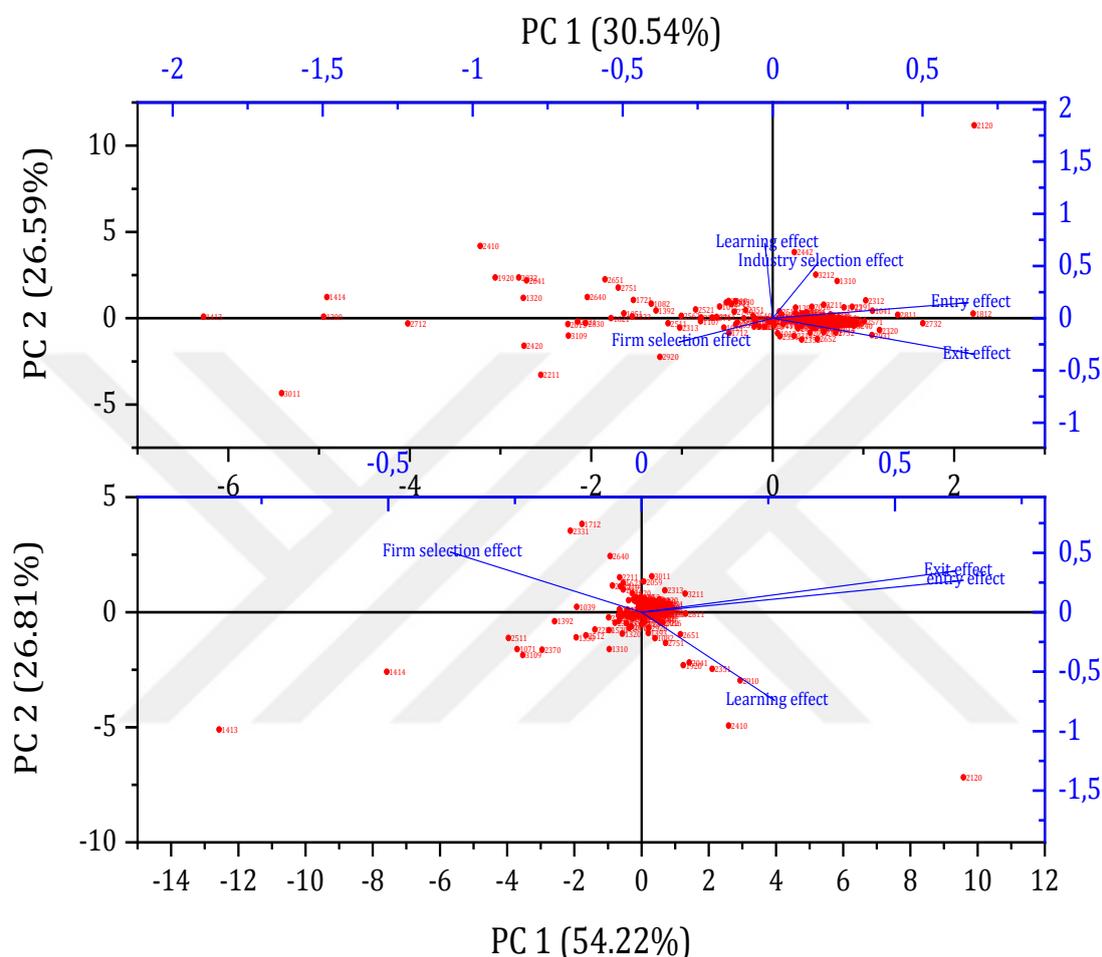


Figure 4.23. Biplot of Price equation during the period of (2011-2015)

The results of the period of (2010-2011) show that the labor productivity grew at the rate of 0.05. The results also show a negative industry selection effect but a positive firm selection effect when using the multilevel price equation. The firm selection effect according to the single level Price equation was the same. According to the single and multilevel Price equation the learning effect had a positive impact on the overall labor productivity evolution. Figure 4-24 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2010-2011). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect and the learning effect; but the second component has large negative associations with the firm selection and the exit effect. However, when utilizing the multi-level Price equation, the results

show that the first principal component has negative associations with the learning effect, while the second component has negative associations with the firm selection effect and the entry effect.

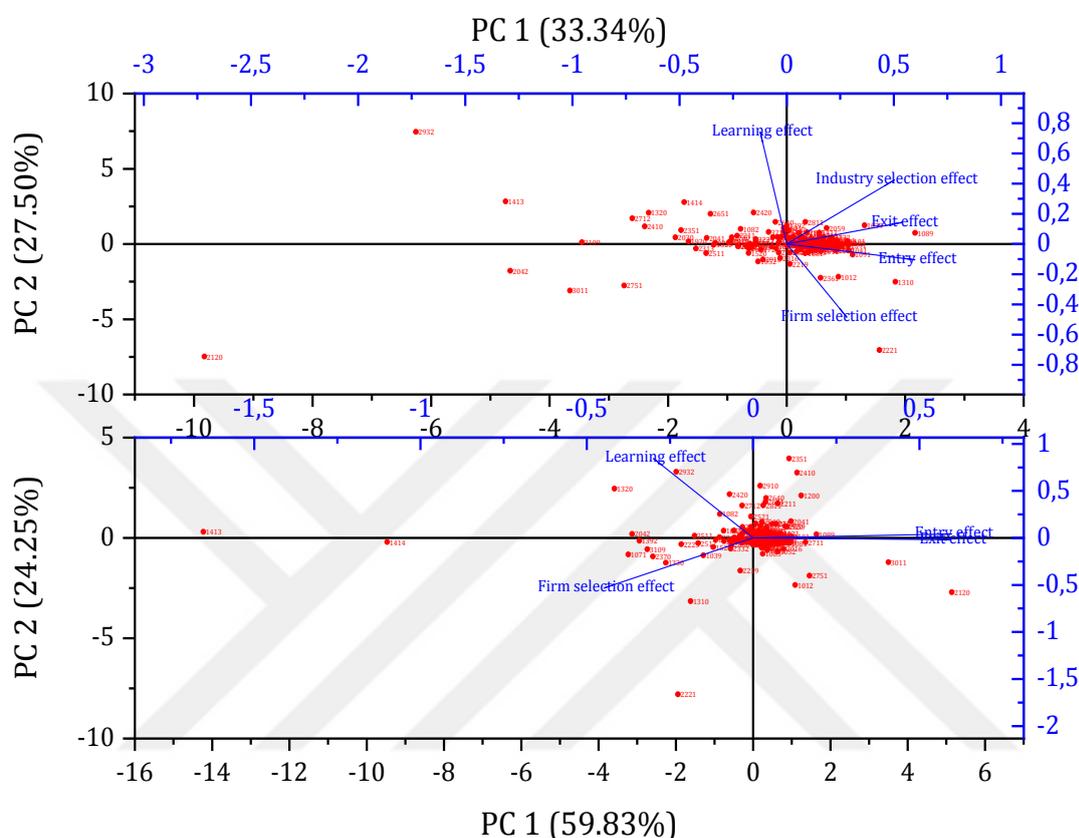


Figure 4.24. Biplot of Price equation during the period of (2010-2011)

The results of the period of (2010-2012) show that the labor productivity grew at the rate of 0.06. The results also show a negative industry selection effect but a positive and trivial firm selection effect when using the multilevel price equation. The single level Price equation underestimates the entry effect because it gives lower number comparing to that resulted from the multi-level Price equation. According to the single and multilevel Price equation the learning effect had a negative contribution to the overall labor productivity growth. Figure 4-25 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2010-2012). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect and the learning effect; but the second component has positive associations with all the effects during the studied interval, namely the firm selection, the learning, the entry, and the exit effect. However, when utilizing the multi-level Price equation, the results show that the first principal component has

negative associations with the firm selection and the learning effect, while the second component has negative associations with the entry effect.

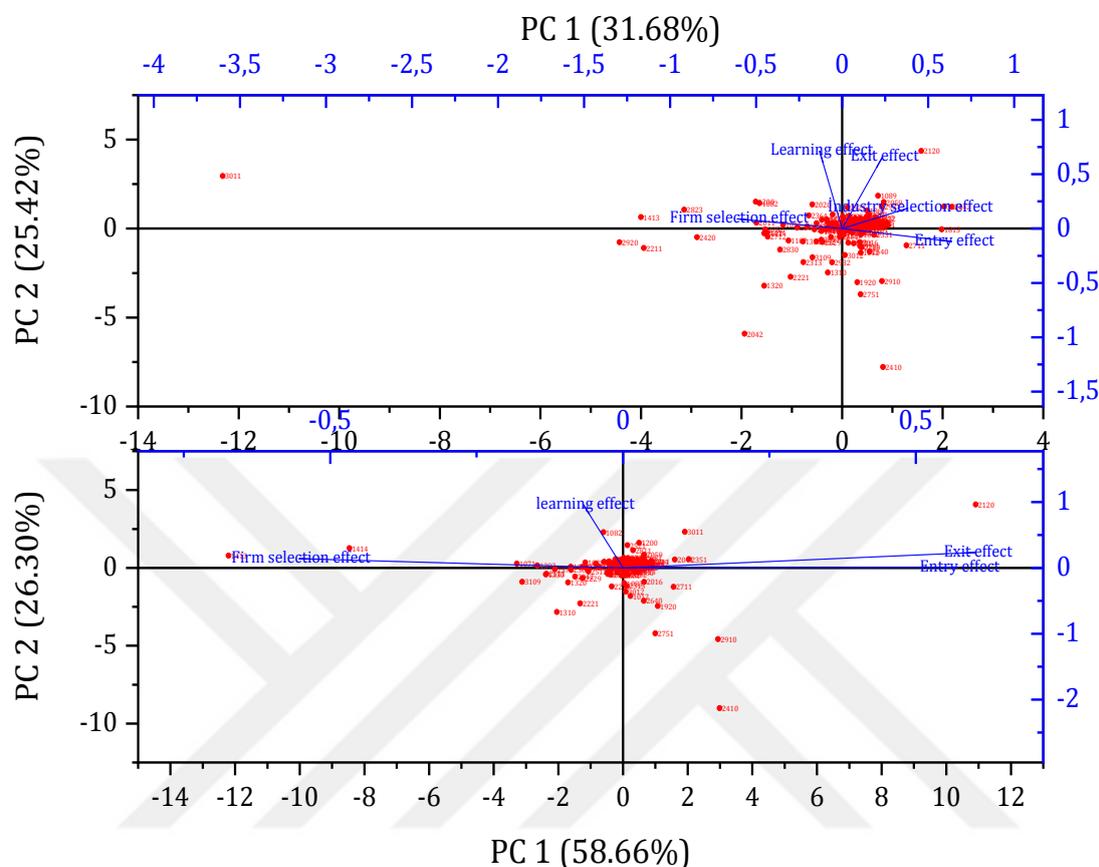


Figure 4.25. Biplot of Price equation during the period of (2010-2012)

The results of the period of (2012-2013) show that the labor productivity grew at the rate of 0.12. The results also show a negative industry selection effect but a positive firm selection effect when using the multilevel price equation. The positive firm selection effect according to the multilevel Price equation indicates that the firms were able to increase their labor productivity more than the average industry's productivity concurrently with expanding their employment shares. The single level Price equation underestimates the entry effect because it gives lower number comparing to that resulted from the multi-level Price equation. According to the single and multilevel Price equation the learning effect had a positive impact on the overall labor productivity evolution. Figure 4-26 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2012-2013). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect and the learning effect; but the second component has negative associations with the learning effect. However, when utilizing the multi-level Price equation, the results show that the first principal component has negative associations with the

learning effect, while the second component has negative associations with the exit and entry effect.

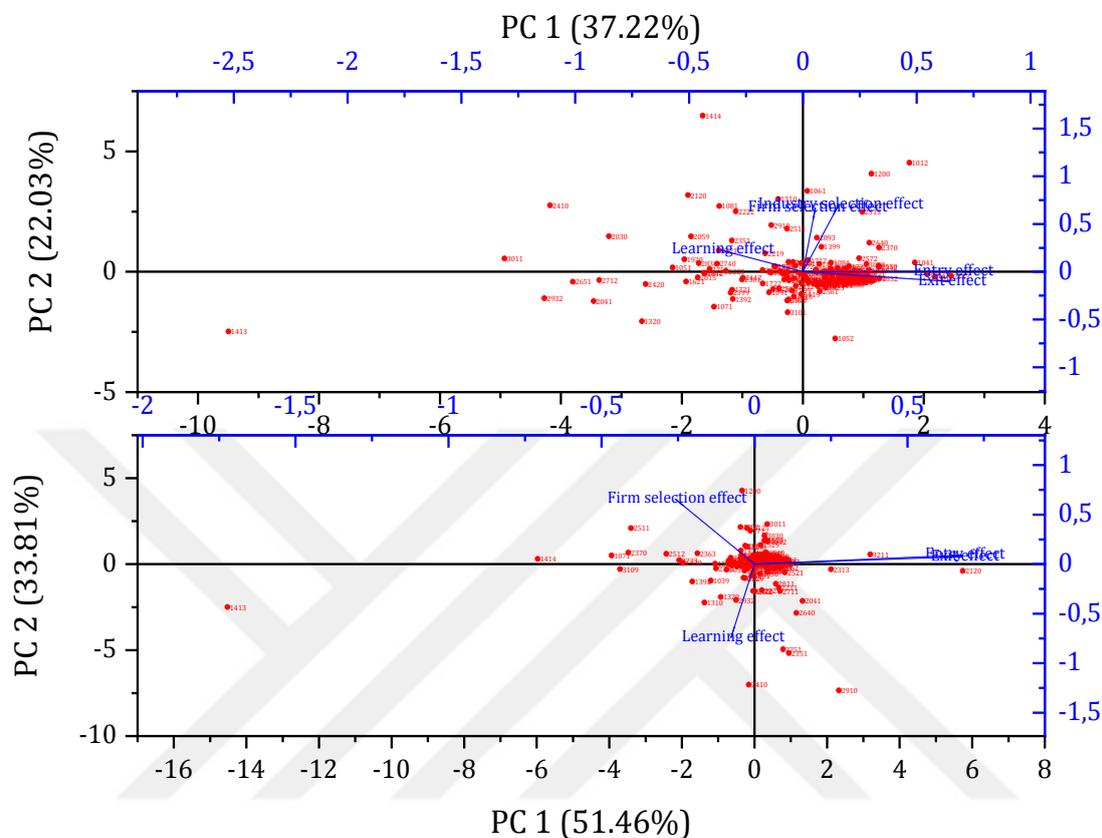


Figure 4.26. Biplot of Price equation during the period of (2012-2013)

The results of the period of (2013-2015) show that the labor productivity grew at the rate of 0.15. The results also show a positive industry selection effect and a positive firm selection effect when using the multilevel price equation. The positive industry selection effect indicates that the industries were able to increase their labor productivity concurrently with expanding their market shares. The single level Price equation underestimates the entry effect because it gives lower number comparing to that resulted from the multi-level Price equation. According to the single and multilevel Price equation the learning effect had a positive impact on the overall labor productivity evolution. Figure 4-27 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2013-2015). The results show that utilizing the single level Price equation, the first principal component has negative associations with the selection effect; but the second component has negative associations with the learning effect. However, when utilizing the multi-level Price equation, the results show that the first principal component has negative associations with the industry

selection and the learning effect; while the second component has negative associations with the industry selection, firm selection and the exit effect.

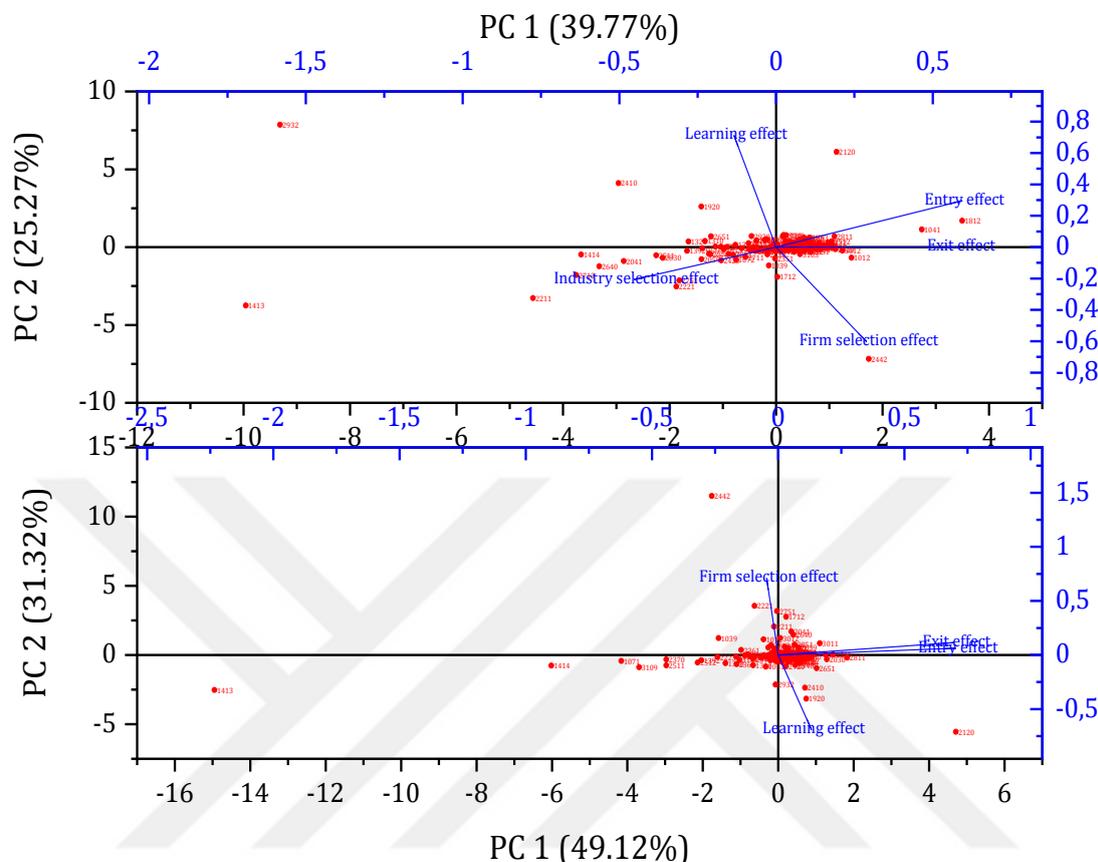


Figure 4.27. Biplot of Price equation during the period of (2013-2015)

The results of the period of (2014-2015) show that the labor productivity grew at the rate of 0.15. The results also show a positive industry selection effect and a positive firm selection effect when using the multilevel price equation. The single level Price equation underestimates the entry effect because it gives lower number comparing to that resulted from the multi-level Price equation. According to the single and multilevel Price equation the learning effect had the same positive impact on the overall labor productivity evolution. Figure 4-28 shows the impact of the mentioned effects based on the Principal Component Analysis (PCA) during the period of (2014-2015). The results show that utilizing the single level Price equation, the first principal component has negative associations with the learning effect; but the second component has negative associations with the exit effect. However, when utilizing the multi-level Price equation, the results show that the first principal component has negative associations with the firm selection and the entry effect, while the second component has negative associations with the learning and the entry effect.

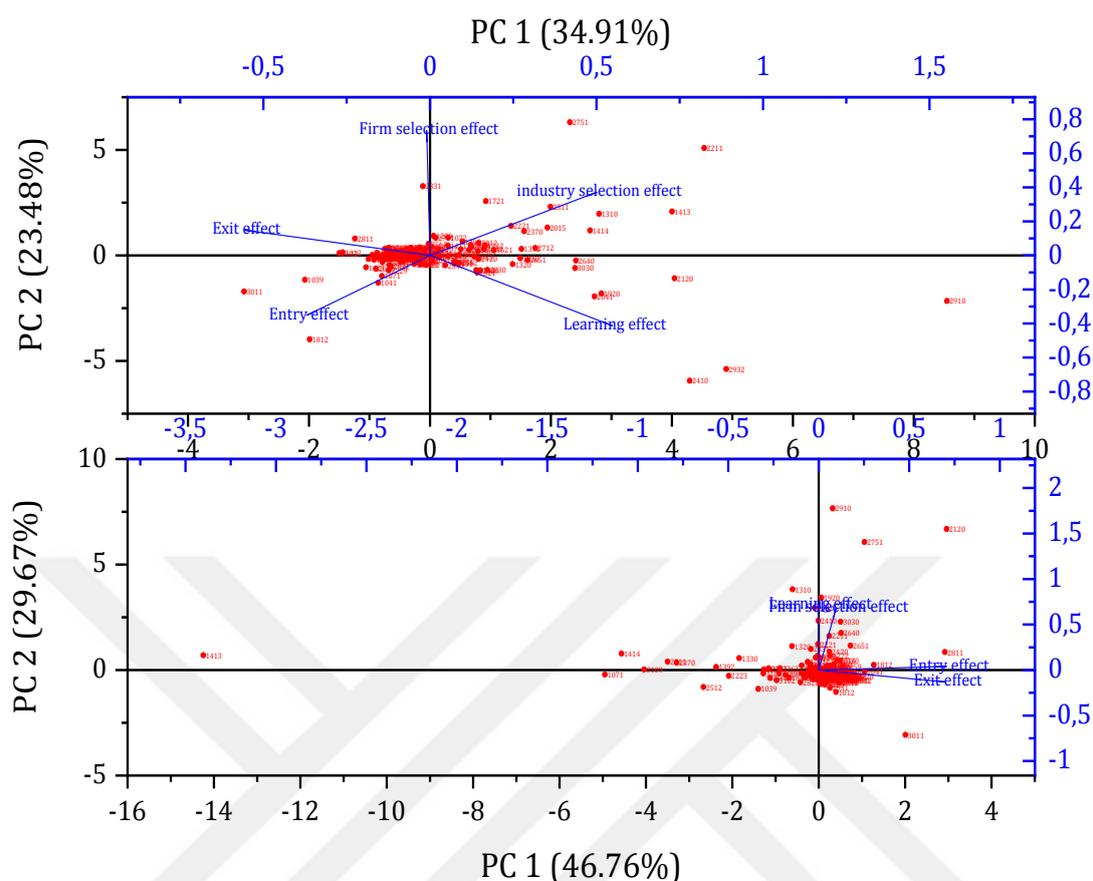


Figure 4.28. Biplot of Price equation during the period of (2014-2015)

It is important to figure out that Price equation predicts a negative entry effect and a positive exit effect for all the studied periods. Also, it predicts a positive learning contribution for all the studied interval except for 2010-2012. Table 4-6 compares the results of decomposing the evolution over a given period with the result of splitting up the period and reporting the sums of the effects over shorter periods which are decomposed separately. The data for (2010-2015) has been utilized. (2010-2015) data allow for a comparison of the effects of studying one period of six years versus three periods of two years (2010-2011), (2012-2013) and (2014-2015). At the same time, it allows for a comparison of the effects of studying one period of six years versus two periods of three years (2010-2012) and (2013-2015).

Table 4.6. splitting up the data and summing over periods

# period(s) of year(s)	# industry selection	Firm selection	learning	entry	exit
2010-2015, $\Delta Z/Z*100=0.20$					
1 of 6	-0.06	-0.01	0.27	-0.04	0.04
%	-26.97	-5.85	130.76	-17.24	19.30
2 of 3	-0.06	0.01	0.06	-0.06	0.07
3 of 2	-0.02	0.03	0.36	-0.08	0.06

We found that the entry effect is smaller when taken as sums over sub- periods. We also noticed that as the period becomes shorter, as the exit effect becomes stronger because of the low productivity of the exiting firms. Furthermore, the industry and firm selection effects of a single decomposition period will be smaller compared to these effects if they are summed up over shorter periods. The firm selection effect becomes positive as the interval becomes shorter meaning that firms' productivity is not distributed around the average productivity of the industry. Put it differently, the firm selection effect becomes larger when decomposing the aggregate productivity by splitting up the period and sums the results over shorter periods.

Shortly, there are differences in the labor productivity between the traditional and modern sectors of the Turkish economy as a whole and between the low and high value-added subsectors within the Turkish manufacturing sector. The labor flows from the low value added to the high value-added activities were the key driver of the labor productivity growth in the whole Turkish economy. Our results show that during the period of 2003-2017, selection effect has been evolution enhancing for the Turkish economy but growth reducing for the manufacturing sector at the industry level. The bulk of the difference between the evolution enhancing selection in the Turkish economy and the growth reducing structural change in the manufacturing sector is the labor moving from low to high-productivity sectors in the former, but in the opposite direction in the latter. That means that the within productivity evolution and productivity enhancing selection must go hand in hand during the development process of the Turkish economy, but investment in fundamentals will be significant in achieving sustained growth in the manufacturing sector at the industry level.

At the firm level, during the period of (2010-2015), the entry of new firms in the manufacturing sector contributes negatively to the overall labor productivity evolution rate. However, the exit effect contributes positively to overall labor productivity evolution rate. That means that the entered firms could not be able to improve their productivity concurrently with expanding their employment shares either because they lack the necessary knowledge or because they did not have the capability to process it. That has been confirmed by the negative contributions of the industry and firm selection effect according to the multilevel Price equation. An exception to this result is the low productivity industries that expand the economic activities and increase their

productivity. Taking into consideration the positive impact of the learning effect on the overall productivity evolution, we can conclude the firms in the manufacturing sector must increase their R&D expenditures to expand their product space and create new innovations by adopting new and more productive technology.

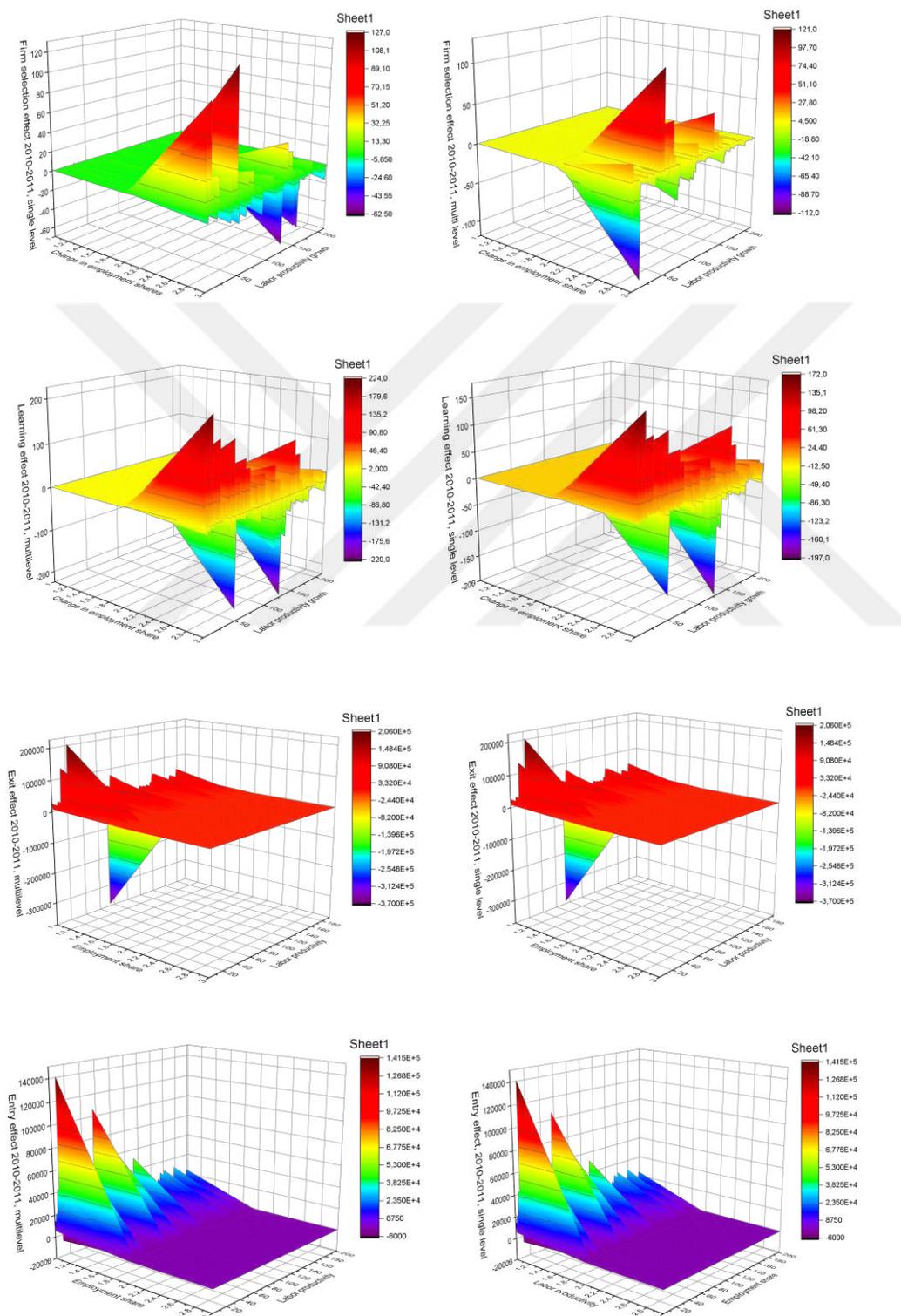


Figure 4.29. How does Price equation look like?

Figure 4-29 depicts the difference between the single- and multi-level Price equation during the period from 2010 to 2011. The single level of price equation overestimates the firm selection effect and the exit effect but it underestimates the entry effect compared to multi-level one. The two equations predicted approximately same learning effect.



5. CONCLUSIONS

Overall labor productivity evolution may have various sources. First, it may be stimulated by the internal productivity evolution within the firms that comprise an industry or by the internal productivity evolution within the single industries that comprise a broadly certain sector like manufacturing. The literature determined many factors affect the internal productivity evolution such as R&D activities and the level of labors' education. Second, overall productivity evolution may also be fostered by the impacts of selection process stemmed from the transformation of market shares from low value-added entities to high value-added entities, regardless of internal productivity evolution. The contribution of selection to the overall productivity evolution may be positive such as that in Asian countries or negative such as that in some Latin American and African countries. These contributions to overall productivity evolution are motivated by competition leading to above-mean evolution of technologically progressive firms or industries. Such evolution replaces entities with below-mean productivity with the entrants with above-mean productivity performance.

The process of selection and economic growth of developed countries is well documented but studies about developing countries are still very weak. To fill in some piece of this gap, we attempt to examine the importance of selection effect to productivity evolution in the Turkish manufacturing industries (at two- and four- digit level) and the entire economy (at two-digit level) using the traditional shift share analysis and an evolutionary method known as the "Price Equation" (at two levels: the single and the multi-level). We also compared the results of a one long period with the results of splitting and summing up the results from sub-periods.

We find using the traditional methods that the within-sector effect accounts for a major part of the aggregate productivity gains, while the structural change- seems to bring a drag on aggregate labor productivity growth, rather than a bonus in the Turkish manufacturing industry. These results are in line with those had been achieved by other studies about the Turkish Economy. Using the evolutionary methods, we found that at the single level, the productivity growth was driven by the positive learning effect, a positive firm selection effect and a positive exit effect. At the multilevel type of the Price equation, the productivity growth was driven by the learning effect and the positive exit effect. The results revealed that multilevel Price equation is more preferable decomposition technique when measuring the importance of selection to productivity growth at higher disaggregated level industries. On the contrast the traditional methods underestimate or overestimate the structural change's contribution because they do not consider the effect of the net entry at the disaggregate level.

The interpretation for such conclusions maybe the innovative technological processes which had been achieved by implementing R&D activities which reinforce the evolution of labor

productivity. However, Turkey's manufacturing industries do not expand efficiently and competitively enough during the period of (2011-2015) due to the Turkish incentive system lacked major selectivity across industries as proved by Kernel density estimator. On the other hand, the fierce competition resulted from trade liberalization forced low-productivity firms either to improve their productivity or exit the market and only the firms with high productivity could maintain or increase their market shares. Labor released from these exiting firms and from the agricultural sector usually move to either low productivity services or informal sectors of the economy the matter that indicates growth reducing structural change.

Another contribution of this study is determining the eligibility for incentives. In other words, the continuing firms that had the highest labor productivity were: manufacture of beer (1105), manufacture of tobacco products (1200), precious metals production (2441), firms of spacecraft and related machinery (3030), pharmaceutical preparations (2120) and refined petroleum products (1920). Pearson coefficient shows a positive nexus between the labor productivity evolution of these firms and the changes in their employment shares and the highest labor productivity evolution accounted for firms of manufacture of coke oven products (1910) with positive change in employment share (1.65) of total employment of the Turkish manufacturing industries. Also the firms of processing and preserving of meat (1011), manufacture of household and sanitary goods and of toilet requisites (1722) and manufacture of optical instruments and photographic equipment (2670) achieved high positive labor productivity evolution associated with positive change in employment share compared with the rest firms. On the contrast the firms of manufacture of other transport equipment n.e.c. (3099), pre-press and pre-media services (1813), manufacture of ceramic insulators and insulating fittings (2343), manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers (2920), manufacture of macaroni, noodles, couscous and similar farinaceous products (1073) and manufacture of office machinery and equipment (2823) had high labor productivity evolution associated with negative changes in employment shares. Also the eligibility for incentives for the positive contribution entrants and negative contribution exiters had been estimated and the results are available in the appendix.

Based on the Principal Component Analysis, the key evolution patterns had been estimated for every sector (at four-digit) separately. For example, the concludes revealed that the key evolution patterns were considerably the industry selection effect and the net entry effect for the firms of manufacture of pharmaceutical preparations (2120), other printing (1812), manufacture of other electronic and electric wires and cables (2732), manufacture of engines and turbines, except aircraft, vehicle and cycle engines (2811), manufacture of refractory products (2320), manufacture of oils and fats (1041), manufacture of electrical and electronic equipment for motor vehicles (2931), shaping and processing of flat glass (2312) and

manufacture of cutlery (2571). But these effects contribute negatively to the firms of manufacture of other inorganic basic chemicals (2013), manufacture of lifting and handling equipment (2822), cutting, shaping and finishing of stone (2370), building of pleasure and sporting boats (3012), manufacture of other food products n.e.c. (1089), processing and preserving of fish crustaceans and mollusks (1020), casting of iron (2451), manufacture of other technical and industrial textiles (1396), manufacture of perfumes and toilet preparations (2042) and manufacture of weapons and ammunition (2540).

Building on our results, the necessary policies could be summarized in three points:

- 1- Comprehensive selective policies such as improving the ineffective regulations and supporting the innovation incentives should be implemented to enable all firms achieve higher levels of productivity gains.
- 2- Additionally, a coherent strategy of flexicurity should take place to protect labors those influenced by structural change.
- 3- In the short run, improving the education policies and the productivity-boosting know-how practices may enable achieving faster labor productivity evolution.

Considering our and other empirical studies, total factor productivity seems to be a more reliable measure for the analysis of the nexus between selection and productivity evolution and this may be an avenue for further research.

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APPENDIX

Table 7.1. Descriptive statistics of all firms' labor productivity and employment shares during (2011-2015)

	Labor productivity				Employment shares			
	Mean	Variance	Coefficient of Variation	Median	Mean	Variance	Coefficient of Variation	Median
1011	19473,4734	8,91E+07	0,48485	19473,4734	0,00235	1,34E-07	0,15526	0,00235
1012	16520,2349	8440273,41	0,17586	16520,2349	0,01168	4,66E-08	0,01848	0,01168
1013	19986,2658	107751,293	0,01642	19986,2658	0,00241	2,36E-09	0,02017	0,00241
1020	27163,583	7246854,97	0,0991	27163,583	0,00232	6,35E-08	0,10877	0,00232
1031	34824,9123	5,48E+07	0,2126	34824,9123	0,00118	1,60E-08	0,10727	0,00118
1032	20284,9551	2,33E+07	0,23802	20284,9551	0,00149	9,79E-08	0,20936	0,00149
1039	11185,1202	1672598,5	0,11563	11185,1202	0,01698	3,15E-07	0,03307	0,01698
1041	40891,2408	9,19E+07	0,23448	40891,2408	0,00403	1,20E-08	0,02716	0,00403
1042	103966,187	2633463,49	0,01561	103966,187	3,96E-04	4,86E-09	0,17631	3,96E-04
1051	28412,2697	3774094,56	0,06838	28412,2697	0,01132	9,17E-07	0,08456	0,01132
1052	50168,751	7,98E+08	0,56315	50168,751	0,00137	7,69E-07	0,64158	0,00137
1061	31712,856	2,21E+07	0,14821	31712,856	0,00598	5,22E-07	0,12083	0,00598
1062	93464,2702	7,46E+07	0,09239	93464,2702	4,53E-04	1,18E-09	0,07579	4,53E-04
1071	11488,2478	1302631,77	0,09935	11488,2478	0,01907	5,52E-06	0,12316	0,01907
1072	25346,4707	7,65E+07	0,34511	25346,4707	0,00854	6,24E-08	0,02924	0,00854
1073	30149,8275	1,73E+08	0,43567	30149,8275	0,0014	7,94E-09	0,06347	0,0014
1081	46238,6268	9,54E+07	0,21124	46238,6268	0,00712	4,20E-06	0,2878	0,00712
1082	35068,8034	4061572,38	0,05747	35068,8034	0,00916	3,24E-07	0,0621	0,00916
1083	31035,8203	1,35E+08	0,37503	31035,8203	0,00533	6,27E-09	0,01485	0,00533
1084	30232,5473	144945,979	0,01259	30232,5473	0,00165	2,66E-09	0,03125	0,00165
1085	12639,3781	3561259,98	0,14931	12639,3781	6,91E-04	1,96E-07	0,64085	6,91E-04
1086	41947,1256	4,57E+08	0,50954	41947,1256	2,36E-04	2,26E-08	0,63649	2,36E-04
1089	45384,401	74401,3582	0,00601	45384,401	0,00202	7,91E-08	0,13901	0,00202
1091	32615,1147	7,67E+07	0,26848	32615,1147	0,00334	9,98E-09	0,02993	0,00334
1092	31506,8107	2,98E+07	0,17323	31506,8107	9,46E-05	1,41E-09	0,39646	9,46E-05
1101	67701,8158	4,51E+08	0,31382	67701,8158	2,92E-04	8,40E-11	0,03137	2,92E-04
1102	24507,0385	4010,2541	0,00258	24507,0385	5,03E-04	2,68E-09	0,10293	5,03E-04
1105	178028,586	9,10E+08	0,16942	178028,586	4,95E-04	6,92E-09	0,16792	4,95E-04
1107	42050,8165	6583343,13	0,06102	42050,8165	0,0044	4,25E-08	0,04685	0,0044
1200	165878,334	3,95E+09	0,37899	165878,334	0,00219	9,48E-07	0,44502	0,00219
1310	20693,3097	2,58E+07	0,24535	20693,3097	0,03001	3,33E-06	0,06082	0,03001
1320	29784,2845	1448593,4	0,04041	29784,2845	0,03028	8,08E-06	0,09386	0,03028
1330	17552,1082	1,42E+07	0,21477	17552,1082	0,01753	2,04E-09	0,00258	0,01753
1391	21312,2491	8296414,29	0,13515	21312,2491	0,00819	1,64E-06	0,15638	0,00819
1392	17615,3653	4036166,9	0,11405	17615,3653	0,02377	1,03E-06	0,04262	0,02377
1393	24977,4244	2,45E+07	0,19818	24977,4244	0,00982	1,31E-06	0,11654	0,00982
1394	14611,9522	334441,636	0,03958	14611,9522	4,06E-04	7,27E-10	0,06637	4,06E-04
1395	48568,0019	1,12E+08	0,21778	48568,0019	5,89E-04	4,15E-08	0,3456	5,89E-04
1396	26698,922	3992399,14	0,07484	26698,922	0,00538	9,95E-08	0,05861	0,00538
1399	15497,5923	6058237,02	0,15882	15497,5923	0,0053	6,81E-07	0,15575	0,0053
1411	21423,0505	2867208,63	0,07904	21423,0505	0,00317	1,48E-06	0,38384	0,00317
1412	15791,3314	2,02E+07	0,28446	15791,3314	0,00131	2,57E-08	0,12292	0,00131
1413	17009,7796	12847,6116	0,00666	17009,7796	0,06666	1,06E-06	0,01547	0,06666
1414	17990,0552	1358373,49	0,06479	17990,0552	0,04929	1,61E-05	0,08128	0,04929
1419	16334,6967	1768975,69	0,08142	16334,6967	0,00581	1,90E-07	0,07503	0,00581
1420	16362,3118	5539262,65	0,14384	16362,3118	6,75E-04	4,59E-08	0,31738	6,75E-04

1431	21457,1768	2,06E+07	0,21137	21457,1768	0,00803	8,19E-08	0,03565	0,00803
1439	18142,5467	1,42E+07	0,20735	18142,5467	0,00607	3,66E-08	0,03153	0,00607
1511	20160,2576	1,14E+07	0,1673	20160,2576	0,00315	3,40E-07	0,1855	0,00315
1512	15373,4903	1280665,39	0,07361	15373,4903	0,0026	1,01E-07	0,12222	0,0026
1520	15854,8241	6677489,28	0,16298	15854,8241	0,01059	2,05E-07	0,0427	0,01059
1610	13661,3784	1,57E+07	0,29032	13661,3784	0,00154	6,47E-08	0,16519	0,00154
1621	59735,8129	544123,218	0,01235	59735,8129	0,00581	1,27E-07	0,06126	0,00581
1622	25758,135	3206556,78	0,06952	25758,135	5,66E-04	1,92E-08	0,24467	5,66E-04
1623	10961,2868	2598587,18	0,14706	10961,2868	0,00263	8,64E-07	0,35339	0,00263
1624	12681,2113	1459674,12	0,09527	12681,2113	0,0022	3,91E-08	0,08986	0,0022
1629	11827,4501	1745059,14	0,11169	11827,4501	2,29E-04	6,69E-11	0,03569	2,29E-04
1712	60609,9888	8749751,75	0,0488	60609,9888	0,00221	2,39E-08	0,07013	0,00221
1721	34954,5006	4798659,22	0,06267	34954,5006	0,00908	3,33E-08	0,02009	0,00908
1722	39525,3634	4,14E+08	0,515	39525,3634	0,00374	1,62E-06	0,34094	0,00374
1723	27069,8277	1,99E+07	0,16474	27069,8277	0,00141	1,18E-08	0,07706	0,00141
1724	38336,3659	3,24E+08	0,46954	38336,3659	5,40E-05	8,21E-12	0,05308	5,40E-05
1729	27631,6434	2,90E+07	0,195	27631,6434	0,00242	1,13E-07	0,13925	0,00242
1811	18912,7254	3194961,85	0,09451	18912,7254	0,00137	8,71E-07	0,68271	0,00137
1812	31053,8952	6,98E+07	0,26905	31053,8952	0,00757	6,13E-08	0,0327	0,00757
1813	26905,8511	1,69E+08	0,48349	26905,8511	5,06E-04	1,82E-08	0,26679	5,06E-04
1814	15464,4198	16,07488	2,59E-04	15464,4198	1,50E-04	9,40E-10	0,20456	1,50E-04
1820	20167,933	2,09E+07	0,22665	20167,933	1,93E-05	5,44E-10	1,20783	1,93E-05
1910	11010,8388	7,37E+07	0,77985	11010,8388	1,57E-05	1,38E-10	0,74811	1,57E-05
1920	128913,803	2,51E+09	0,38842	128913,803	0,00286	7,70E-08	0,09716	0,00286
2011	38892,9958	806861,098	0,0231	38892,9958	2,59E-04	6,72E-10	0,10011	2,59E-04
2012	44947,5848	471358,004	0,01527	44947,5848	5,41E-04	7,38E-09	0,15887	5,41E-04
2013	71386,886	8388468,74	0,04057	71386,886	0,00124	1,66E-08	0,10404	0,00124
2014	45130,8058	619772,92	0,01744	45130,8058	3,76E-04	1,19E-09	0,09162	3,76E-04
2015	74011,0209	5,45E+08	0,31554	74011,0209	0,00137	6,18E-10	0,01818	0,00137
2016	54350,1944	3,36E+08	0,33749	54350,1944	0,00243	4,08E-08	0,08322	0,00243
2020	82588,7183	2,58E+08	0,19453	82588,7183	7,41E-04	7,06E-10	0,03584	7,41E-04
2030	71464,8818	1,17E+08	0,1513	71464,8818	0,00447	1,73E-07	0,09315	0,00447
2041	111879,756	9,06E+08	0,26899	111879,756	0,00459	3,06E-08	0,03808	0,00459
2042	46237,5425	3,63E+07	0,13038	46237,5425	0,00259	5,16E-10	0,00879	0,00259
2051	55775,7888	2,63E+07	0,09189	55775,7888	5,50E-04	1,87E-09	0,07855	5,50E-04
2052	39465,3074	1,02E+08	0,2558	39465,3074	8,73E-04	4,56E-08	0,24468	8,73E-04
2053	62920,0803	1068449,84	0,01643	62920,0803	2,31E-04	3,99E-10	0,08662	2,31E-04
2059	82859,9641	35769,772	0,00228	82859,9641	0,00204	6,49E-09	0,03955	0,00204
2060	105750,344	4,15E+08	0,19257	105750,344	0,00101	1,00E-08	0,09928	0,00101
2120	154301,345	3,20E+09	0,3664	154301,345	0,01232	3,42E-06	0,15012	0,01232
2211	80788,4958	3,58E+07	0,07402	80788,4958	0,00372	2,04E-07	0,1214	0,00372
2219	34768,3163	395817,28	0,0181	34768,3163	0,00969	2,84E-07	0,05495	0,00969
2221	38942,2158	4334638,38	0,05346	38942,2158	0,01112	2,10E-07	0,04121	0,01112
2222	30056,4811	1089374,9	0,03473	30056,4811	0,01033	2,05E-08	0,01388	0,01033
2223	15945,5391	1170261,03	0,06784	15945,5391	0,00931	4,87E-08	0,02369	0,00931
2229	22693,92	4489618,75	0,09337	22693,92	0,01119	1,40E-06	0,10572	0,01119
2311	111856,66	3,42E+08	0,16545	111856,66	9,59E-04	2,74E-09	0,0546	9,59E-04
2312	29112,9269	9944412,43	0,10832	29112,9269	0,00421	1,37E-07	0,08795	0,00421
2313	63936,3824	1,13E+08	0,16646	63936,3824	0,00428	1,93E-08	0,03253	0,00428
2314	77060,0683	5486611,27	0,0304	77060,0683	4,97E-04	2,29E-08	0,30437	4,97E-04
2319	20819,3909	1093623,51	0,05023	20819,3909	7,47E-04	3,58E-09	0,08007	7,47E-04
2320	37795,7521	1,25E+08	0,29561	37795,7521	9,02E-04	1,88E-10	0,01519	9,02E-04

2331	24029,8312	1,27E+07	0,14804	24029,8312	0,00629	3,57E-09	0,00949	0,00629
2332	7531,59395	4488678,83	0,2813	7531,59395	0,00742	6,39E-07	0,10769	0,00742
2341	26020,9243	2,02E+07	0,17282	26020,9243	0,00301	9,68E-08	0,10333	0,00301
2342	32667,5172	1,14E+07	0,10349	32667,5172	0,00317	2,27E-08	0,04761	0,00317
2343	20289,8334	7,81E+07	0,43557	20289,8334	1,46E-04	1,04E-11	0,02208	1,46E-04
2349	9914,00801	1,15E+07	0,34264	9914,00801	5,49E-05	9,93E-11	0,18133	5,49E-05
2351	117732,245	7,83E+07	0,07516	117732,245	0,00516	1,52E-07	0,07563	0,00516
2352	23303,3241	3,01E+07	0,23525	23303,3241	0,00127	2,58E-08	0,1263	0,00127
2361	22920,6329	1,02E+07	0,13928	22920,6329	0,00787	6,08E-08	0,03133	0,00787
2362	30135,2258	1,14E+08	0,35508	30135,2258	6,76E-04	1,46E-10	0,01786	6,76E-04
2363	22366,1674	5734921,86	0,10707	22366,1674	0,01334	7,10E-07	0,06317	0,01334
2364	42684,6031	1127465,15	0,02488	42684,6031	6,15E-04	4,72E-07	1,11785	6,15E-04
2365	38273,1126	2125434,98	0,03809	38273,1126	2,92E-04	3,50E-12	0,00641	2,92E-04
2369	17525,6521	4,89E+07	0,39895	17525,6521	1,47E-04	2,50E-09	0,34106	1,47E-04
2370	12245,9903	4501056,84	0,17325	12245,9903	0,0145	1,76E-06	0,09156	0,0145
2391	33997,2675	9118730,22	0,08882	33997,2675	7,65E-04	3,94E-09	0,08204	7,65E-04
2399	39271,3715	9760971,46	0,07956	39271,3715	0,00211	3,51E-09	0,02803	0,00211
2410	68138,0114	1,16E+08	0,15834	68138,0114	0,01903	3,82E-06	0,10274	0,01903
2420	58954,0046	3,30E+07	0,09747	58954,0046	0,00578	3,62E-07	0,10411	0,00578
2431	29709,7135	1629703,94	0,04297	29709,7135	1,44E-04	7,01E-10	0,18379	1,44E-04
2432	59714,0872	2,08E+08	0,24158	59714,0872	4,60E-05	5,86E-11	0,16633	4,60E-05
2433	41833,2705	7165722,24	0,06399	41833,2705	3,41E-04	1,31E-08	0,33593	3,41E-04
2434	38216,9511	2,64E+07	0,13449	38216,9511	8,85E-04	1,36E-08	0,13161	8,85E-04
2441	106297,941	9,90E+09	0,9359	106297,941	3,55E-04	3,13E-08	0,49859	3,55E-04
2442	21669,987	6055561,79	0,11356	21669,987	0,00771	3,25E-07	0,07389	0,00771
2443	22438,936	2066152,43	0,06406	22438,936	3,19E-04	2,89E-09	0,16879	3,19E-04
2444	34043,0415	1,15E+07	0,0996	34043,0415	0,00185	1,31E-08	0,06206	0,00185
2445	20773,4308	9305492,71	0,14685	20773,4308	2,30E-04	4,89E-10	0,09612	2,30E-04
2451	29532,4513	1,67E+07	0,1385	29532,4513	0,00544	6,65E-09	0,01498	0,00544
2452	20457,3342	1455304,22	0,05897	20457,3342	0,00176	2,12E-07	0,26135	0,00176
2453	22559,7814	16445,7154	0,00568	22559,7814	0,00202	6,12E-08	0,12245	0,00202
2454	13389,3771	157657,447	0,02965	13389,3771	1,23E-04	2,19E-10	0,12072	1,23E-04
2511	14950,82	1,25E+07	0,23672	14950,82	0,0182	3,27E-06	0,09935	0,0182
2512	9442,82839	3631,48126	0,00638	9442,82839	0,00767	1,24E-06	0,14499	0,00767
2521	50795,8893	1,33E+08	0,22743	50795,8893	0,00451	1,98E-07	0,09852	0,00451
2529	33274,8335	8,15E+07	0,27124	33274,8335	0,00272	1,38E-10	0,00433	0,00272
2530	21585,0598	6,78E+07	0,38136	21585,0598	7,35E-04	3,60E-09	0,08162	7,35E-04
2540	51564,6489	4,03E+07	0,12309	51564,6489	0,00484	3,13E-08	0,03656	0,00484
2550	37297,0971	5,75E+07	0,2033	37297,0971	0,00509	1,76E-07	0,08235	0,00509
2561	21885,9432	3,19E+07	0,25822	21885,9432	0,00357	3,86E-07	0,17387	0,00357
2562	22651,9986	273518,55	0,02309	22651,9986	0,00451	1,85E-06	0,30172	0,00451
2571	19708,2245	2,51E+07	0,25409	19708,2245	8,46E-04	2,85E-10	0,01995	8,46E-04
2572	22945,5469	8625977,49	0,128	22945,5469	0,00473	6,12E-08	0,05231	0,00473
2573	27268,8261	1,10E+07	0,12148	27268,8261	0,00435	1,67E-07	0,09406	0,00435
2591	29917,6916	3026873,85	0,05815	29917,6916	9,74E-04	1,98E-07	0,45711	9,74E-04
2592	39078,4178	1,61E+08	0,32471	39078,4178	0,00206	1,27E-07	0,17259	0,00206
2593	24165,4193	2674157,01	0,06767	24165,4193	0,00437	1,43E-07	0,08642	0,00437
2594	28752,9681	4983406,32	0,07764	28752,9681	0,00243	1,51E-07	0,16009	0,00243
2599	15794,3092	2565987,03	0,10142	15794,3092	0,00755	7,79E-07	0,11696	0,00755
2611	22982,9068	5279769	0,09998	22982,9068	8,58E-04	1,98E-11	0,00519	8,58E-04
2612	30398,359	3,68E+07	0,19943	30398,359	9,00E-04	3,90E-08	0,21955	9,00E-04
2620	81500,4072	1,06E+07	0,0399	81500,4072	4,94E-04	3,86E-08	0,39807	4,94E-04

2630	30366,5594	879283,667	0,03088	30366,5594	0,00153	3,60E-09	0,03933	0,00153
2640	132972,502	3,54E+08	0,14157	132972,502	0,00295	1,29E-07	0,12188	0,00295
2651	115432,638	2,64E+08	0,14089	115432,638	0,0043	4,87E-08	0,05128	0,0043
2652	18270,7579	1725167,13	0,07189	18270,7579	1,31E-04	4,54E-10	0,16294	1,31E-04
2660	50640,0958	6,47E+07	0,1588	50640,0958	1,13E-04	1,67E-09	0,36245	1,13E-04
2670	74139,8826	1,20E+09	0,46636	74139,8826	8,30E-05	3,26E-10	0,21727	8,30E-05
2680	119048,655	1,88E+09	0,3639	119048,655	2,30E-04	4,17E-09	0,28054	2,30E-04
2711	47546,6984	1283797,64	0,02383	47546,6984	0,00528	1,35E-08	0,02199	0,00528
2712	47415,0623	5,77E+07	0,16018	47415,0623	0,00692	7,02E-08	0,03827	0,00692
2720	42413,8005	4,58E+07	0,15963	42413,8005	0,00103	3,19E-09	0,05463	0,00103
2731	30709,3408	7,25E+07	0,27718	30709,3408	0,0011	3,02E-07	0,49883	0,0011
2732	24222,6741	6117354,2	0,10211	24222,6741	0,00391	4,46E-07	0,17087	0,00391
2733	18574,6662	1,78E+07	0,2272	18574,6662	0,00279	3,36E-09	0,02074	0,00279
2740	32639,3443	2,27E+07	0,14603	32639,3443	0,00547	5,21E-09	0,0132	0,00547
2751	49033,6279	1,89E+07	0,08865	49033,6279	0,01796	1,99E-07	0,02486	0,01796
2752	20720,3231	4525802,8	0,10267	20720,3231	0,00116	2,46E-11	0,00427	0,00116
2790	25582,3852	3898248,14	0,07718	25582,3852	0,00138	3,67E-09	0,04387	0,00138
2811	70592,0515	2,11E+08	0,2059	70592,0515	0,00454	4,13E-08	0,04478	0,00454
2812	32922,1273	7,34E+07	0,26025	32922,1273	0,00147	3,35E-10	0,01243	0,00147
2813	35433,0548	3,67E+07	0,17101	35433,0548	0,00233	6,09E-08	0,10584	0,00233
2814	29983,8644	3,16E+07	0,18744	29983,8644	0,00366	2,55E-08	0,04366	0,00366
2815	40649,1207	5,65E+07	0,18484	40649,1207	0,00267	9,65E-10	0,01162	0,00267
2821	21200,1041	4276504,35	0,09755	21200,1041	0,00152	3,68E-08	0,12635	0,00152
2822	20894,7795	1508426,6	0,05878	20894,7795	0,00556	1,01E-06	0,18103	0,00556
2823	21482,9012	8,22E+07	0,42206	21482,9012	1,32E-04	2,99E-09	0,41513	1,32E-04
2824	6126,51701	1,62E+07	0,65631	6126,51701	4,12E-06	1,21E-13	0,08431	4,12E-06
2825	25890,1384	1,34E+07	0,14134	25890,1384	0,0088	1,57E-07	0,04507	0,0088
2829	19542,4724	1,44E+07	0,19427	19542,4724	0,00476	5,97E-08	0,05134	0,00476
2830	47571,8428	1,65E+07	0,08536	47571,8428	0,00504	6,73E-07	0,16284	0,00504
2841	28396,1928	8476803,57	0,10253	28396,1928	0,00331	1,14E-07	0,10187	0,00331
2849	22279,6716	71900,7675	0,01204	22279,6716	9,63E-04	1,03E-08	0,10525	9,63E-04
2891	27040,1747	4582,95084	0,0025	27040,1747	7,38E-04	5,32E-09	0,0989	7,38E-04
2892	35289,4127	3,42E+07	0,16575	35289,4127	0,00436	5,19E-07	0,16512	0,00436
2893	30266,1538	2,12E+07	0,15218	30266,1538	0,00356	2,14E-08	0,04118	0,00356
2894	28888,131	24515,6836	0,00542	28888,131	0,00186	2,87E-09	0,02883	0,00186
2895	37290,9216	1,34E+08	0,31039	37290,9216	1,41E-04	4,60E-12	0,01523	1,41E-04
2896	29276,1627	3,31E+07	0,1965	29276,1627	9,45E-04	7,14E-09	0,08943	9,45E-04
2899	30531,1326	2,19E+07	0,15338	30531,1326	0,00156	9,37E-08	0,19588	0,00156
2910	100946,553	866458,366	0,00922	100946,553	0,01745	2,65E-06	0,09332	0,01745
2920	39113,8714	2,54E+08	0,40731	39113,8714	0,00439	3,31E-08	0,04151	0,00439
2931	30249,6091	4,40E+07	0,21938	30249,6091	0,00726	1,11E-07	0,04582	0,00726
2932	44365,4195	5733857,27	0,05397	44365,4195	0,03293	1,49E-05	0,11725	0,03293
3011	76552,5282	1,57E+08	0,16374	76552,5282	0,00265	6,39E-07	0,30156	0,00265
3012	53969,7689	2,16E+07	0,08616	53969,7689	0,00127	4,82E-08	0,17318	0,00127
3020	74667,3611	7230369,83	0,03601	74667,3611	0,00187	4,04E-08	0,10764	0,00187
3030	183110,237	7,45E+08	0,14906	183110,237	0,00291	2,31E-07	0,16496	0,00291
3040	153486,355	2,66E+09	0,33592	153486,355	4,83E-04	1,22E-08	0,22901	4,83E-04
3091	50129,5487	1,42E+08	0,23736	50129,5487	4,03E-04	1,37E-08	0,29016	4,03E-04
3092	36874,7872	1062906,76	0,02796	36874,7872	8,01E-04	6,65E-09	0,10185	8,01E-04
3099	38296,783	1,87E+08	0,35736	38296,783	1,49E-04	9,43E-10	0,20646	1,49E-04
3101	15476,5863	3559281,24	0,1219	15476,5863	0,00831	2,71E-06	0,19798	0,00831
3102	10165,0159	1244379,63	0,10974	10165,0159	0,00314	6,59E-08	0,08178	0,00314

3103	17398,765	272082,366	0,02998	17398,765	0,00256	5,96E-08	0,09531	0,00256
3109	13402,9634	24527,8964	0,01169	13402,9634	0,02627	8,89E-08	0,01135	0,02627
3211	258540,753	6,76E+08	0,10059	258540,753	1,44E-04	7,23E-11	0,05915	1,44E-04
3212	27861,7806	3854537,04	0,07047	27861,7806	0,00426	1,21E-07	0,08157	0,00426
3213	12124,2179	1,81E+07	0,35129	12124,2179	1,51E-04	1,53E-09	0,25872	1,51E-04
3220	18355,2249	3,26E+07	0,31111	18355,2249	5,43E-05	1,54E-11	0,07223	5,43E-05
3230	38789,7964	5,04E+07	0,18311	38789,7964	4,35E-04	4,89E-09	0,16095	4,35E-04
3240	28665,3682	1970604,45	0,04897	28665,3682	9,51E-04	3,06E-09	0,05816	9,51E-04
3250	29604,8058	2,64E+07	0,17351	29604,8058	0,00524	2,16E-07	0,08859	0,00524
3291	32086,8596	5556063,94	0,07346	32086,8596	6,02E-04	8,66E-11	0,01546	6,02E-04
3299	37838,8833	984283,587	0,02622	37838,8833	0,00268	5,06E-08	0,08399	0,00268

Table 7.2. Descriptive statistics of C firms' labor productivity and employment shares during (2011-2015)

	Labor productivity				Employment shares			
	Mean	Variance	Coefficient of Variation	Median	Mean	Variance	Coefficient of Variation	Median
1413	18765,808	3018687,06	0,09259	18765,808	0,05307	2,07E-06	0,02711	0,05307
2562	28436,7517	6962740,99	0,09279	28436,7517	0,00294	4,87E-07	0,23707	0,00294
2312	29819,1429	8731862,67	0,0991	29819,1429	0,00405	1,87E-09	0,01068	0,00405
2041	122999,01	1,02E+09	0,25914	122999,01	0,00507	1,23E-09	0,00691	0,00507
1011	22230,5937	1,49E+08	0,54943	22230,5937	0,00215	3,25E-08	0,08368	0,00215
2841	30306,1482	8902084,9	0,09845	30306,1482	0,00352	3,43E-08	0,05268	0,00352
2732	21978,7576	1725884,17	0,05977	21978,7576	0,00398	3,96E-07	0,15815	0,00398
1396	29067,6089	1,07E+07	0,11232	29067,6089	0,00581	5,26E-07	0,12493	0,00581
1414	19852,551	868003,029	0,04693	19852,551	0,0447	4,56E-07	0,0151	0,0447
1623	12707,8544	1096769,44	0,08241	12707,8544	0,00186	3,35E-07	0,31181	0,00186
2223	18700,5634	3731799,42	0,1033	18700,5634	0,00797	1,26E-07	0,0446	0,00797
2219	36459,4046	230234,021	0,01316	36459,4046	0,0106	4,02E-08	0,01891	0,0106
2511	17357,8839	1,30E+07	0,20795	17357,8839	0,01529	3,04E-09	0,00361	0,01529
2332	7847,749	5277393,16	0,29273	7847,749	0,00799	3,35E-07	0,07243	0,00799
3109	14705,8424	33715,8218	0,01249	14705,8424	0,02497	6,42E-07	0,03209	0,02497
1073	31869,0788	2,16E+08	0,46096	31869,0788	0,00163	1,26E-08	0,06887	0,00163
1039	11731,6053	2047988,19	0,12198	11731,6053	0,01791	1,21E-06	0,06145	0,01791
2811	71293,6539	5,32E+08	0,32354	71293,6539	0,00468	3,82E-08	0,04178	0,00468
2012	50128,1009	1396336,38	0,02357	50128,1009	5,71E-04	5,80E-09	0,13341	5,71E-04
1399	17097,8376	1,12E+07	0,19613	17097,8376	0,00523	1,34E-06	0,22135	0,00523
1610	14720,3487	1,60E+07	0,27172	14720,3487	0,00115	2,23E-09	0,04109	0,00115
3299	41546,2119	62265,2971	0,00601	41546,2119	0,00269	7,14E-09	0,03145	0,00269
3030	187662,516	1,14E+09	0,17975	187662,516	0,00352	2,24E-07	0,13426	0,00352
2363	22988,8276	1,02E+07	0,13898	22988,8276	0,0118	5,09E-09	0,00604	0,0118
1102	27105,5318	103585,166	0,01187	27105,5318	4,98E-04	2,88E-09	0,10774	4,98E-04
2620	79501,4793	3,35E+08	0,23028	79501,4793	4,74E-04	1,93E-08	0,29282	4,74E-04
1511	20971,5646	1,00E+07	0,15114	20971,5646	0,00279	9,42E-08	0,10985	0,00279
2042	51383,3806	5,32E+07	0,14193	51383,3806	0,00243	1,08E-10	0,00427	0,00243
2053	69304,4368	7060216,69	0,03834	69304,4368	2,50E-04	2,74E-11	0,0209	2,50E-04
2592	41187,3602	1,01E+08	0,24417	41187,3602	0,00233	4,34E-07	0,28288	0,00233
3250	31160,7251	1,71E+07	0,13273	31160,7251	0,00478	2,83E-08	0,03524	0,00478
2599	16978,317	4736224,63	0,12818	16978,317	0,00737	5,28E-07	0,09851	0,00737
2311	111856,66	3,42E+08	0,16545	111856,66	0,0012	7,24E-09	0,07072	0,0012
1330	19156,958	1,59E+07	0,20836	19156,958	0,017	2,72E-08	0,00969	0,017

2593	25558,8611	2304719,95	0,0594	25558,8611	0,00464	1,24E-07	0,07593	0,00464
2361	26404,5254	2,25E+07	0,17955	26404,5254	0,00664	5,09E-10	0,0034	0,00664
2932	45751,0192	2801331,64	0,03658	45751,0192	0,03672	1,38E-05	0,10132	0,03672
1320	31033,0773	1007614,91	0,03235	31033,0773	0,03375	1,47E-05	0,11373	0,03375
1061	33114,1444	1,60E+07	0,12092	33114,1444	0,00593	2,19E-07	0,07898	0,00593
1439	19280,0019	1,02E+07	0,16527	19280,0019	0,00574	1,88E-07	0,07557	0,00574
2221	42268,4825	9144801,5	0,07154	42268,4825	0,01158	1,02E-07	0,02757	0,01158
1051	30888,4466	2886019,73	0,055	30888,4466	0,01203	1,03E-06	0,08433	0,01203
1722	42183,8216	4,99E+08	0,52949	42183,8216	0,00395	1,65E-06	0,32488	0,00395
1082	37842,94	3660488,4	0,05056	37842,94	0,01009	3,32E-07	0,0571	0,01009
1431	22234,5571	2,08E+07	0,20512	22234,5571	0,00893	6,66E-09	0,00913	0,00893
1920	154155,479	3,53E+09	0,38556	154155,479	0,0029	6,57E-08	0,08828	0,0029
2341	26115,2251	3933965,83	0,07595	26115,2251	0,00338	6,28E-08	0,07413	0,00338
1393	26156,5364	2,86E+07	0,20438	26156,5364	0,01032	1,23E-06	0,10733	0,01032
1721	38258,6283	5331525,42	0,06035	38258,6283	0,00974	2,71E-08	0,01689	0,00974
2561	24512,3917	4,55E+07	0,27512	24512,3917	0,00321	1,65E-07	0,12643	0,00321
3099	46003,7182	5,42E+08	0,50627	46003,7182	1,48E-04	1,95E-11	0,02991	1,48E-04
1812	31185,1064	6,63E+07	0,2611	31185,1064	0,00598	3,82E-08	0,03268	0,00598
3101	16170,795	2047727,82	0,08849	16170,795	0,00764	3,55E-07	0,07797	0,00764
1814	20158,3157	4969077,83	0,11058	20158,3157	9,59E-05	2,16E-09	0,4853	9,59E-05
2892	38271,8214	4,58E+07	0,17684	38271,8214	0,00432	5,07E-07	0,16496	0,00432
2910	101251,497	284300,767	0,00527	101251,497	0,02176	3,30E-06	0,08351	0,02176
2512	11066,3893	89388,3332	0,02702	11066,3893	0,00567	5,42E-07	0,12995	0,00567
1107	46745,8185	1,67E+07	0,08735	46745,8185	0,00431	5,16E-08	0,05269	0,00431
2830	52833,994	1,18E+07	0,06506	52833,994	0,00524	3,36E-07	0,11064	0,00524
2733	20089,9983	1,95E+07	0,21993	20089,9983	0,00293	3,51E-09	0,0202	0,00293
2222	32569,9695	2850501,45	0,05184	32569,9695	0,0109	1,71E-09	0,00379	0,0109
2712	54226,347	5,64E+07	0,13846	54226,347	0,0069	2,51E-08	0,02293	0,0069
1391	21737,0706	1,15E+07	0,15618	21737,0706	0,00847	1,47E-06	0,14299	0,00847
2821	23100,9563	4063585,14	0,08726	23100,9563	0,00146	2,68E-08	0,11221	0,00146
2720	44447,4497	4,19E+07	0,14559	44447,4497	0,00122	2,48E-10	0,01293	0,00122
2451	31606,6408	1,48E+07	0,12158	31606,6408	0,00605	1,66E-08	0,0213	0,00605
2370	13696,2983	9106042,65	0,22032	13696,2983	0,01155	1,99E-07	0,03857	0,01155
1071	12871,4566	2826631,99	0,13062	12871,4566	0,01624	9,29E-08	0,01877	0,01624
2364	47053,7201	7,61E+07	0,1854	47053,7201	5,85E-04	3,86E-07	1,06124	5,85E-04
2823	23032,8331	1,12E+08	0,45957	23032,8331	1,05E-04	4,31E-10	0,1979	1,05E-04
2891	29852,2367	75701,5664	0,00922	29852,2367	6,51E-04	5,51E-11	0,0114	6,51E-04
2920	46954,2319	4,75E+08	0,46409	46954,2319	0,00391	8,98E-10	0,00767	0,00391
3091	52064,4283	2,80E+08	0,3214	52064,4283	3,83E-04	5,16E-09	0,18768	3,83E-04
2822	22987,7726	5085530,11	0,0981	22987,7726	0,00486	2,35E-07	0,09974	0,00486
2391	35761,6963	1,37E+07	0,10358	35761,6963	8,81E-04	1,02E-08	0,11479	8,81E-04
3102	11901,6257	3265930,11	0,15184	11901,6257	0,0023	2,48E-08	0,0685	0,0023
2896	30281,0175	2,66E+07	0,17036	30281,0175	9,18E-04	4,88E-09	0,07609	9,18E-04
2751	50651,6424	1,64E+07	0,07987	50651,6424	0,02109	6,76E-07	0,03899	0,02109
2571	17402,6021	2,39E+07	0,28109	17402,6021	4,43E-04	8,86E-09	0,21263	4,43E-04
2550	38861,7681	7,74E+07	0,22641	38861,7681	0,00568	2,56E-07	0,08904	0,00568
2442	24349,9655	6959965,08	0,10834	24349,9655	0,00774	3,11E-07	0,07202	0,00774
2752	21082,3366	83184,141	0,01368	21082,3366	9,97E-04	1,82E-08	0,13523	9,97E-04
2529	34878,1198	8,76E+07	0,26829	34878,1198	0,00293	2,88E-08	0,05798	0,00293
1520	17013,6024	9944088,06	0,18535	17013,6024	0,00991	1,61E-09	0,00404	0,00991
2540	53829,929	4,45E+07	0,12396	53829,929	0,0057	3,30E-08	0,03187	0,0057
1085	13878,4326	5226684,36	0,16473	13878,4326	5,73E-04	8,84E-08	0,51906	5,73E-04

2612	29189,1081	5,60E+07	0,25633	29189,1081	6,02E-04	3,34E-12	0,00304	6,02E-04
3230	45352,2198	7,57E+07	0,19178	45352,2198	3,78E-04	3,22E-09	0,15012	3,78E-04
1392	18941,9549	5194224,55	0,12032	18941,9549	0,02449	4,97E-07	0,02877	0,02449
3212	31408,8042	43700,6024	0,00666	31408,8042	0,00331	4,47E-08	0,06386	0,00331
2711	50516,4094	1496660,87	0,02422	50516,4094	0,0058	3,77E-08	0,0335	0,0058
2931	29619,7546	2,81E+07	0,17912	29619,7546	0,00836	8,84E-08	0,03558	0,00836
1419	17895,8601	3366738,84	0,10253	17895,8601	0,00489	4,28E-08	0,04229	0,00489
2521	55204,1805	1,21E+08	0,19922	55204,1805	0,00483	1,17E-07	0,07092	0,00483
2030	76319,3878	1,73E+08	0,17237	76319,3878	0,00471	1,77E-08	0,02822	0,00471
2229	23951,3092	5419382,22	0,0972	23951,3092	0,01179	9,40E-07	0,08227	0,01179
2313	67031,8421	2,05E+08	0,21358	67031,8421	0,00439	3,47E-08	0,04247	0,00439
2740	36102,2885	3,19E+07	0,15644	36102,2885	0,00542	9,86E-11	0,00183	0,00542
2572	23677,0742	8926793,09	0,12619	23677,0742	0,00536	7,32E-08	0,05048	0,00536
3011	95046,6698	3,98E+08	0,20987	95046,6698	0,00193	1,20E-07	0,17923	0,00193
2059	89916,9052	4,86E+07	0,07755	89916,9052	0,00202	3,07E-08	0,0869	0,00202
2814	31799,427	5,74E+07	0,23817	31799,427	0,00395	6,81E-08	0,06606	0,00395
2452	21841,8556	4319776,24	0,09516	21841,8556	0,0019	2,89E-07	0,28305	0,0019
2825	27528,8356	1,54E+07	0,14233	27528,8356	0,00944	1,13E-09	0,00357	0,00944
2573	29962,6159	1,54E+07	0,13113	29962,6159	0,00413	5,00E-08	0,0541	0,00413
1624	13921,3637	3392481,57	0,13231	13921,3637	0,00182	4,22E-10	0,01129	0,00182
1712	67101,7384	3,10E+07	0,08291	67101,7384	0,0023	6,59E-09	0,03528	0,0023
1811	18915,2089	3,70E+07	0,32151	18915,2089	6,99E-04	3,72E-08	0,2758	6,99E-04
1091	36054,3683	9,61E+07	0,2719	36054,3683	0,00328	3,58E-08	0,05765	0,00328
1086	42225,5769	6,49E+08	0,60323	42225,5769	2,06E-04	7,67E-08	1,34664	2,06E-04
2410	70967,7582	1,06E+08	0,14525	70967,7582	0,02243	3,59E-06	0,0845	0,02243
1083	32267,5357	1,36E+08	0,3608	32267,5357	0,00639	1,47E-11	5,99E-04	0,00639
1200	208303,21	2,27E+08	0,07226	208303,21	0,00214	2,13E-07	0,21529	0,00214
1012	16957,6883	1,46E+07	0,22564	16957,6883	0,01347	5,98E-07	0,05743	0,01347
1020	32587,5852	1,32E+07	0,1116	32587,5852	0,00211	1,39E-07	0,17713	0,00211
2611	23050,5324	1,73E+07	0,18043	23050,5324	7,72E-04	8,21E-09	0,11731	7,72E-04
2530	22894,9003	9,22E+07	0,41943	22894,9003	7,39E-04	2,35E-09	0,06551	7,39E-04
2120	160255,556	3,63E+09	0,37581	160255,556	0,01289	2,71E-06	0,12764	0,01289
2813	38213,5118	2,89E+07	0,14056	38213,5118	0,00235	1,88E-07	0,18458	0,00235
2014	43391,7085	9,96E+07	0,23001	43391,7085	3,88E-04	3,39E-09	0,15013	3,88E-04
1622	26787,8978	2580730,09	0,05997	26787,8978	5,67E-04	2,66E-08	0,28768	5,67E-04
2899	34379,5836	2,84E+07	0,15488	34379,5836	0,00131	2,19E-10	0,01126	0,00131
3240	26253,157	4,97E+07	0,26844	26253,157	8,18E-04	3,42E-10	0,02261	8,18E-04
1420	17290,6034	5332510,54	0,13355	17290,6034	6,67E-04	8,40E-08	0,43445	6,67E-04
1041	41214,4869	4,57E+07	0,16411	41214,4869	0,00416	1,30E-08	0,0274	0,00416
2362	37399,4698	1,82E+08	0,36049	37399,4698	6,14E-04	2,54E-10	0,02594	6,14E-04
1032	21406,4129	2,68E+07	0,24167	21406,4129	0,00159	1,57E-07	0,24865	0,00159
2211	86677,0338	8902741,99	0,03442	86677,0338	0,00431	1,89E-07	0,10101	0,00431
1512	16085,1831	2000493,16	0,08793	16085,1831	0,0025	8,18E-08	0,11423	0,0025
1310	20992,5806	2,21E+07	0,22369	20992,5806	0,03308	1,41E-06	0,03592	0,03308
1412	17525,7177	3,33E+07	0,32925	17525,7177	0,00109	9,03E-08	0,27595	0,00109
2893	32782,6241	3,48E+07	0,18002	32782,6241	0,00361	1,52E-09	0,0108	0,00361
2020	87677,5628	5,81E+08	0,27502	87677,5628	7,31E-04	2,84E-09	0,07293	7,31E-04
1729	30536,3461	3,14E+07	0,18341	30536,3461	0,00235	8,38E-08	0,12293	0,00235
2790	27310,594	1,67E+07	0,14955	27310,594	0,00132	3,53E-08	0,14203	0,00132
2013	79262,3044	5467654,67	0,0295	79262,3044	0,00136	8,21E-09	0,06683	0,00136
2444	37574,0927	2,11E+07	0,12233	37574,0927	0,00199	5,26E-09	0,03641	0,00199
3213	13768,9976	1,28E+07	0,26005	13768,9976	1,03E-04	1,31E-11	0,03493	1,03E-04

2351	119796,875	9,47E+07	0,08122	119796,875	0,00628	1,50E-07	0,06166	0,00628
2352	24971,98	1,08E+07	0,13135	24971,98	0,00129	6,30E-10	0,01948	0,00129
1723	28718,835	1,59E+07	0,13899	28718,835	0,00153	5,87E-09	0,04996	0,00153
2894	29250,3179	9208575,79	0,10374	29250,3179	0,00158	6,68E-09	0,05178	0,00158
2433	43490,4433	1,19E+07	0,07938	43490,4433	3,17E-04	1,99E-08	0,44507	3,17E-04
1411	23581,7692	318680,915	0,02394	23581,7692	0,00277	7,17E-07	0,30621	0,00277
2399	43049,6429	2,26E+07	0,11047	43049,6429	0,00215	5,94E-08	0,11362	0,00215
2812	35790,1331	7,83E+07	0,24724	35790,1331	0,00152	1,53E-11	0,00258	0,00152
2849	24091,3903	36,51479	2,51E-04	24091,3903	9,16E-04	1,98E-11	0,00485	9,16E-04
1072	27711,5764	8,45E+07	0,33167	27711,5764	0,00889	1,43E-06	0,13451	0,00889
2420	64202,9214	2,03E+07	0,07021	64202,9214	0,00645	2,81E-07	0,08227	0,00645
3012	63331,8359	6,60E+07	0,12832	63331,8359	0,001	2,58E-08	0,16044	0,001
2651	123851,101	2,52E+08	0,12816	123851,101	0,00478	6,47E-08	0,05327	0,00478
3103	20112,3283	588873,484	0,03815	20112,3283	0,0025	5,09E-08	0,09021	0,0025
2015	97733,0212	7,00E+08	0,2707	97733,0212	0,00113	1,17E-09	0,03035	0,00113
2052	42521,5529	1,24E+08	0,26171	42521,5529	9,21E-04	5,78E-08	0,26105	9,21E-04
2342	34212,6358	1,12E+07	0,09766	34212,6358	0,00357	8,41E-10	0,00813	0,00357
3291	37176,1645	1947441,15	0,03754	37176,1645	5,92E-04	1,77E-09	0,07099	5,92E-04
1089	50177,6714	260499,816	0,01017	50177,6714	0,00217	2,11E-07	0,21233	0,00217
2016	59906,3756	6,45E+08	0,42408	59906,3756	0,00256	1,04E-08	0,03978	0,00256
1101	71990,7597	3,94E+08	0,27559	71990,7597	3,17E-04	1,99E-09	0,14068	3,17E-04
2051	60963,5048	2,75E+08	0,2719	60963,5048	5,31E-04	1,66E-12	0,00243	5,31E-04
1084	32292,1227	3998801,86	0,06193	32292,1227	0,00166	4,40E-09	0,03985	0,00166
2829	21010,781	2,29E+07	0,2278	21010,781	0,00437	4,40E-10	0,0048	0,00437
1621	64344,1825	3031,93078	8,56E-04	64344,1825	0,00655	2,25E-07	0,07242	0,00655
2454	13890,262	4783821,56	0,15746	13890,262	6,20E-05	7,94E-11	0,14366	6,20E-05
3092	39521,9475	1694095,61	0,03293	39521,9475	8,38E-04	4,08E-10	0,02408	8,38E-04
2319	21275,111	177085,877	0,01978	21275,111	7,27E-04	6,90E-10	0,03615	7,27E-04
2670	78869,9979	1,70E+09	0,5232	78869,9979	9,52E-05	3,09E-10	0,18457	9,52E-05
2815	42755,3389	9,17E+07	0,22397	42755,3389	0,00287	1,54E-08	0,04323	0,00287
2630	32932,6857	29443,6663	0,00521	32932,6857	0,00162	2,56E-09	0,03124	0,00162
3211	-1096,85057	3916350,44	-1,80424	-1096,85057	1,31E-06	1,47E-12	0,93038	1,31E-06
2594	31831,6315	1291018,78	0,03569	31831,6315	0,00231	9,71E-08	0,13464	0,00231
2343	21258,7229	1,06E+08	0,48477	21258,7229	1,64E-04	1,57E-10	0,07626	1,64E-04
2349	9194,00834	61831,203	0,02705	9194,00834	2,07E-05	7,87E-12	0,13523	2,07E-05
2453	24024,6008	605235,943	0,03238	24024,6008	0,00212	5,38E-08	0,10942	0,00212
2434	41867,183	6,72E+07	0,19581	41867,183	0,001	3,20E-08	0,17878	0,001
2640	143727,034	7,75E+07	0,06125	143727,034	0,00322	9,74E-07	0,30674	0,00322
2591	36804,1967	1,44E+07	0,1032	36804,1967	9,42E-04	4,05E-07	0,67594	9,42E-04
2314	79646,3684	2,47E+07	0,06242	79646,3684	5,99E-04	2,49E-08	0,2634	5,99E-04
3040	155523,202	2,68E+09	0,33289	155523,202	5,95E-04	2,22E-08	0,25033	5,95E-04
1052	54651,4337	9,58E+08	0,56636	54651,4337	0,00153	1,02E-06	0,66043	0,00153
1042	123006,841	4,51E+08	0,17274	123006,841	4,04E-04	4,94E-10	0,05506	4,04E-04
2331	25534,5402	3,01E+07	0,21476	25534,5402	0,0074	1,02E-07	0,04318	0,0074
2731	31483,5447	8,16E+07	0,28687	31483,5447	0,00128	3,47E-07	0,45888	0,00128
2443	25613,1247	226643,439	0,01859	25613,1247	2,75E-04	1,69E-10	0,0473	2,75E-04
2320	28163,1421	2,08E+07	0,16204	28163,1421	8,27E-04	2,74E-09	0,06328	8,27E-04
2660	48653,84	1,17E+08	0,22222	48653,84	9,29E-05	3,85E-10	0,21126	9,29E-05
1394	16494,059	1290596,32	0,06888	16494,059	3,23E-04	2,45E-09	0,15346	3,23E-04
3220	33285,7636	1,27E+08	0,33896	33285,7636	3,11E-05	1,21E-12	0,03525	3,11E-05
1081	46981,3193	7,60E+07	0,18555	46981,3193	0,00862	4,07E-06	0,23409	0,00862
1013	22734,0169	782968,131	0,03892	22734,0169	0,00229	1,84E-07	0,18762	0,00229

1062	100210,818	50284,1836	0,00224	100210,818	5,05E-04	1,09E-09	0,06531	5,05E-04
2652	17278,3015	547,96724	0,00135	17278,3015	1,33E-04	1,04E-12	0,00768	1,33E-04
2895	44450,0648	3,19E+08	0,40204	44450,0648	1,40E-04	5,33E-10	0,16488	1,40E-04
2431	32466,6959	2842600,15	0,05193	32466,6959	1,31E-04	1,96E-09	0,33814	1,31E-04
1395	48618,4028	1,13E+08	0,21902	48618,4028	7,11E-04	5,07E-08	0,31675	7,11E-04
3020	75332,3242	790852,516	0,01181	75332,3242	0,00222	1,20E-07	0,15594	0,00222
2369	21876,4546	3,17E+07	0,25756	21876,4546	1,21E-04	3,54E-11	0,04929	1,21E-04
2365	39450,0417	9748859,42	0,07915	39450,0417	3,53E-04	1,01E-10	0,02846	3,53E-04
1910	3113,76078	9459380,6	0,98775	3113,76078	5,05E-06	2,35E-11	0,96005	5,05E-06
2060	113070,481	2,26E+08	0,13284	113070,481	0,00116	4,11E-10	0,01755	0,00116
1724	27270,8967	3086402,1	0,06442	27270,8967	5,22E-05	2,47E-10	0,30095	5,22E-05
1813	29715,0028	2,23E+08	0,50245	29715,0028	4,57E-04	1,46E-08	0,26384	4,57E-04
2441	104178,888	1,05E+10	0,9837	104178,888	3,11E-04	1,43E-09	0,12148	3,11E-04
1031	38302,9555	2,96E+07	0,14215	38302,9555	0,00129	6,60E-08	0,19861	0,00129
1629	13356,1962	1138818,18	0,0799	13356,1962	8,66E-05	3,09E-10	0,20317	8,66E-05
2011	46883,4447	1,50E+07	0,08274	46883,4447	2,50E-04	7,60E-10	0,11031	2,50E-04
2680	128698,364	1,17E+09	0,26606	128698,364	1,96E-04	1,49E-09	0,19697	1,96E-04
1092	35611,5315	3595387,88	0,05325	35611,5315	9,05E-05	5,00E-10	0,24717	9,05E-05
1105	180933,872	7,98E+08	0,1561	180933,872	6,10E-04	1,02E-08	0,1653	6,10E-04
2445	21909,1155	1664608,11	0,05889	21909,1155	2,55E-04	6,49E-11	0,03158	2,55E-04
2432	62881,7564	9,89E+07	0,15817	62881,7564	5,33E-05	1,77E-11	0,07901	5,33E-05

Table 7.3. Firms those were able to increase their labor productivity concomitant with increasing their employment shares during the period of (2011-2015):

(1011) processing and preserving of meat
(1020) processing and preserving of fish crustaceans and mollusks
(1041) manufacture of oils and fats
(1051) operation of dairies and cheese making
(1071) manufacture of bread; manufacture of fresh pastry goods and cakes
(1072) manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes (1084) manufacture of condiments and seasonings
(1085) manufacture of prepared meals and dishes
(1089) manufacture of other food products n.e.c.
(1320) weaving of textiles
(1391) manufacture of knitted and crocheted fabrics
(1393) manufacture of carpets and rugs
(1395) manufacture of non-woven and articles made from non-woven except apparel
(1419) manufacture of other wearing apparel and accessories
(1520) manufacture of footwear
(1621) manufacture of veneer sheets and wood-based panels
(1623) manufacture of other builders' carpentry and joinery
(1624) manufacture of wooden containers
(1721) manufacture of corrugated paper and paperboard and of containers of paper and paperboard
(1722) manufacture of household and sanitary goods and of toilet requisites
(1724) manufacture of wallpaper
(1729) manufacture of other articles of paper and paperboard
(1812) other printing
(2014) manufacture of other organic basic chemicals
(2016) manufacture of plastics in primary forms
(2020) manufacture of pesticides and other agrochemical products
(2219) manufacture of other rubber products
(2222) manufacture of plastic packing goods
(2229) manufacture of other plastic products
(2312) shaping and processing of flat glass
(2331) manufacture of ceramic tiles and flags
(2343) manufacture of ceramic insulators and insulating fittings
(2361) manufacture of concrete products for construction purposes
(2363) manufacture of ready-mixed concrete
(2364) manufacture of mortars
(2365) manufacture of fiber cement
(2431) cold drawing of bars

(2442) aluminum production
(2443) lead zinc and tin production
(2530) manufacture of steam generators except central heating hot water boilers
(2561) treatment and coating of metals
(2562) machining (2573) manufacture of tools
(2592) manufacture of light metal packaging
(2594) manufacture of fasteners and screw machine products
(2599) manufacture of other fabricated metal products n.e.c.
(2611) manufacture of electronic components
(2640) manufacture of consumer electronics
(2651) manufacture of instruments and appliances for measuring testing and navigation
(2652) manufacture of watches and clocks
(2660) manufacture of irradiation electro medical and electrotherapeutic equipment
(2670) manufacture of optical instruments and photographic equipment
(2732) manufacture of other electronic and electric wires and cables
(2733) manufacture of wiring devices
(2740) manufacture of electric lighting equipment
(2751) manufacture of electric domestic appliances
(2752) manufacture of non-electric domestic appliances
(2811) manufacture of engines and turbines except aircraft vehicle and cycle engines
(2812) manufacture of fluid power equipment
(2813) manufacture of other pumps and compressors
(2815) manufacture of bearings gears gearing and driving elements
(2822) manufacture of lifting and handling equipment
(2829) manufacture of other general-purpose machinery n.e.c.
(2893) manufacture of machinery for food beverage and tobacco processing
(2894) manufacture of machinery for textile apparel and leather production
(2895) manufacture of machinery for paper and paperboard production
(2896) manufacture of plastics and rubber machinery
(2920) manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
(2932) manufacture of other parts and accessories for motor vehicles
(3030) manufacture of air and spacecraft and related machinery
(3040) manufacture of military fighting vehicles
(3099) manufacture of other transport equipment n.e.c.
(3101) manufacture of office and shop furniture
(3102) manufacture of kitchen furniture
(3103) manufacture of mattresses
(3220) manufacture of musical instruments
(3230) manufacture of sports goods
(3250) manufacture of medical and dental instruments and supplies.

Table 7.4. The firms those decreased their labor productivity concomitant with decreasing their employment shares during the period of (2011-2015)

(1031) processing and preserving of potatoes,
(1039) other processing and preserving of fruit and vegetables,
(1052) manufacture of ice cream,
(1086) manufacture of homogenized food preparations and dietetic food,
(1101) distilling, rectifying and blending of spirits,
(1105) manufacture of beer,
(1512) manufacture of luggage, handbags and the like, saddlery and harness,
(1622) manufacture of assembled parquet floors,
(1629) manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials,
(1910) manufacture of coke oven products,
(2012) manufacture of dyes and pigments,
(2051) manufacture of explosives,
(2313) manufacture of hollow glass,
(2314) manufacture of glass fibers,
(2320) manufacture of refractory products,
(2341) manufacture of ceramic household and ornamental articles,
(2444) copper production,
(2591) manufacture of steel drums and similar containers,
(2612) manufacture of loaded electronic boards,
(2711) manufacture of electric motors, generators and transformers,
(2824) manufacture of power-driven hand tools,
(2891) manufacture of machinery for metallurgy,

(2910) manufacture of motor vehicles,
(2931) manufacture of electrical and electronic equipment for motor vehicles,
(3012) building of pleasure and sporting boats,
(3020) manufacture of railway locomotives and rolling stock,
(3091) manufacture of motorcycles,
(3211) striking of coins,
(3212) manufacture of jewelry and related articles

Table 7.5. The firms those increased their labor productivity concomitant with decreasing their employment share during the period of (2011-2015)

(1013) production of meat and poultry meat products,
(1042) manufacture of margarine and similar edible fats,
(1061) manufacture of grain mill products,
(1073) manufacture of macaroni, noodles, couscous and similar farinaceous products,
(1081) manufacture of sugar,
(1082) manufacture of cocoa, chocolate and sugar confectionery,
(1083) processing of tea and coffee,
(1091) manufacture of prepared feeds for farm animals,
(1107) manufacture of soft drinks; production of mineral waters and other bottled waters,
(1200) manufacture of tobacco products,
(1310) preparation and spinning of textile fibers,
(1330) finishing of textiles,
(1392) manufacture of made-up textile articles, except apparel,
(1394) manufacture of cordage, rope, twine and netting,
(1396) manufacture of other technical and industrial textiles,
(1399) manufacture of other textiles n.e.c.,
(1411) manufacture of leather clothes,
(1412) manufacture of work wear,
(1413) manufacture of other outerwear,
(1414) manufacture of underwear,
(1420) manufacture of articles of fur,
(1431) manufacture of knitted and crocheted hosiery,
(1439) manufacture of other knitted and crocheted apparel,
(1511) tanning and dressing of leather; dressing and dyeing of fur,
(1610) sawmilling and planning of wood,
(1723) manufacture of paper stationery,
(1811) printing of newspapers,
(1813) pre-press and pre-media services,
(1814) binding and related services,
(1820) reproduction of recorded media,
(1920) manufacture of refined petroleum products,
(2011) manufacture of industrial gases,
(2013) manufacture of other inorganic basic chemicals,
(2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics,
(2041) manufacture of soap and detergents, cleaning and polishing preparations,
(2042) manufacture of perfumes and toilet preparations,
(2052) manufacture of glues,
(2060) manufacture of man-made fibers,
(2120) manufacture of pharmaceutical preparations,
(2221) manufacture of plastic plates, sheets, tubes and profiles,
(2223) manufacture of builders' ware of plastic,
(2332) manufacture of bricks, tiles and construction products, in baked clay,
(2342) manufacture of ceramic sanitary fixtures,
(2349) manufacture of other ceramic products,
(2351) manufacture of cement,
(2352) manufacture of lime and plaster,
(2362) manufacture of plaster products for construction purposes,
(2369) manufacture of other articles of concrete, plaster and cement,
(2370) cutting, shaping and finishing of stone,
(2399) manufacture of other non-metallic mineral products n.e.c.,
(2410) manufacture of basic iron and steel and of Ferro-alloys,

(2434) cold drawing of wire,
(2445) other non-ferrous metal production,
(2451) casting of iron,
(2452) casting of steel,
(2511) manufacture of metal structures and parts of structures,
(2521) manufacture of central heating radiators and boilers,
(2529) manufacture of other tanks, reservoirs and containers of metal,
(2540) manufacture of weapons and ammunition,
(2550) forging, pressing, stamping and roll-forming of metal; powder metallurgy,
(2571) manufacture of cutlery,
(2572) manufacture of locks and hinges,
(2593) manufacture of wire products, chain and springs,
(2620) manufacture of computers and peripheral equipment,
(2680) manufacture of magnetic and optical media,
(2720) manufacture of batteries and accumulators,
(2731) manufacture of fiber optic cables,
(2790) manufacture of other electrical equipment,
(2814) manufacture of other taps and valves,
(2821) manufacture of ovens, furnaces and furnace burners,
(2823) manufacture of office machinery and equipment, (except computers and peripheral equipment),
(2825) manufacture of non-domestic cooling and ventilation equipment,
(2892) manufacture of machinery for mining, quarrying and construction,
(3011) building of ships and floating structures,
(3213) manufacture of imitation jewelry and related articles
(3299) other manufacturing n.e.c.

Table 7.6. The firms those decreased their labor productivity concomitant with increasing their employment shares during the period of (2011-2015)

(1012) processing and preserving of poultry meat,
(1032) manufacture of fruit and vegetable juice,
(1062) manufacture of starches and starch products,
(1092) manufacture of prepared pet foods,
(1102) manufacture of wine from grape,
(1712) manufacture of paper and paperboard,
(2015) manufacture of fertilizers and nitrogen compounds,
(2053) manufacture of essential oils,
(2059) manufacture of other chemical products n.e.c.,
(2211) manufacture of rubber types and tubes; retreading and rebuilding of rubber types,
(2311) manufacture of flat glass,
(2319) manufacture and processing of other glass, including technical glassware,
(2391) production of abrasive products,
(2420) manufacture of tubes, pipes, hollow profiles and related fittings, of steel,
(2432) cold rolling of narrow strip,
(2433) cold forming or folding,
(2441) precious metals production,
(2453) casting of light metals,
(2454) casting of other non-ferrous metals,
(2512) manufacture of doors and windows of metal,
(2630) manufacture of communication equipment,
(2712) manufacture of electricity distribution and control apparatus,
(2830) manufacture of agricultural and forestry machinery,
(2841) manufacture of metal forming machinery,
(2849) manufacture of other machine tools,
(2899) manufacture of other special-purpose machinery n.e.c.,
(3092) manufacture of bicycles and invalid carriages,
(3109) manufacture of other furniture,
(3240) manufacture of games and toys
(3291) manufacture of brooms and brushes.

Table 7.7. The dynamic C firms those were able to increase their labor productivity and employment shares during (2011-2015):

(2312) shaping and processing of flat glass,
(1011) processing and preserving of meat,
(2732) manufacture of other electronic and electric wires and cables,
(1623) manufacture of other builders' carpentry and joinery,
(2219) manufacture of other rubber products,
(2511) manufacture of metal structures and parts of structures,
(2811) manufacture of engines and turbines, except aircraft, vehicle and cycle engines,
(3030) manufacture of air and spacecraft and related machinery,
(2363) manufacture of ready-mixed concrete,
(1102) manufacture of wine from grape,
(2053) manufacture of essential oils,
(2592) manufacture of light metal packaging,
(3250) manufacture of medical and dental instruments and supplies,
(2599) manufacture of other fabricated metal products n.e.c.,
(1330) finishing of textiles,
(2361) manufacture of concrete products for construction purposes,
(2932) manufacture of other parts and accessories for motor vehicles,
(1320) weaving of textiles,
(1439) manufacture of other knitted and crocheted apparel,
(1051) operation of dairies and cheese making,
(1722) manufacture of household and sanitary goods and of toilet requisites,
(1431) manufacture of knitted and crocheted hosiery,
(1393) manufacture of carpets and rugs,
(1721) manufacture of corrugated paper and paperboard and of containers of paper and paperboard,
(2561) treatment and coating of metals,
(1812) other printing,
(3101) manufacture of office and shop furniture,
(2512) manufacture of doors and windows of metal,
(2733) manufacture of wiring devices,
(1391) manufacture of knitted and crocheted fabrics,
(2451) casting of iron,
(1071) manufacture of bread; manufacture of fresh pastry goods and cakes,
(2364) manufacture of mortars,
(2822) manufacture of lifting and handling equipment,
(2751) manufacture of electric domestic appliances,
(2442) aluminum production,
(1520) manufacture of footwear,
(1085) manufacture of prepared meals and dishes,
(3230) manufacture of sports goods,
(2229) manufacture of other plastic products,
(2059) manufacture of other chemical products n.e.c.,
(2573) manufacture of tools,
(1091) manufacture of prepared feeds for farm animals,
(1020) processing and preserving of fish, crustaceans and mollusks,
(2813) manufacture of other pumps and compressors,
(2014) manufacture of other organic basic chemicals,
(3240) manufacture of games and toys,
(2362) manufacture of plaster products for construction purposes,
(2020) manufacture of pesticides and other agrochemical products,
(1729) manufacture of other articles of paper and paperboard,
(2894) manufacture of machinery for textile, apparel and leather production,
(1072) manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes, (2651) manufacture of instruments and appliances for measuring, testing and navigation,
(3103) manufacture of mattresses,
(2342) manufacture of ceramic sanitary fixtures,
(2454) casting of other non-ferrous metals,
(3092) manufacture of bicycles and invalid carriages,
(2319) manufacture and processing of other glass, including technical glassware,
(2670) manufacture of optical instruments and photographic equipment,
(2594) manufacture of fasteners and screw machine products,

(2640) manufacture of consumer electronics,
(3040) manufacture of military fighting vehicles,
(1395) manufacture of non-woven and articles made from non-woven, except apparel,
(1910) manufacture of coke oven products
(2445) other non-ferrous metal production.

Table 7.8. The C firms those decreased their labor productivity concomitant with decreasing their employment share during (2011-2015)

(1039) other processing and preserving of fruit and vegetables,
(2012) manufacture of dyes and pigments,
(2341) manufacture of ceramic household and ornamental articles,
(1814) binding and related services,
(2910) manufacture of motor vehicles,
(2712) manufacture of electricity distribution and control apparatus,
(2891) manufacture of machinery for metallurgy,
(3091) manufacture of motorcycles,
(2612) manufacture of loaded electronic boards,
(2711) manufacture of electric motors, generators and transformers,
(1811) printing of newspapers,
(1086) manufacture of homogenized food preparations and dietetic food,
(1622) manufacture of assembled parquet floors,
(2899) manufacture of other special-purpose machinery n.e.c.,
(1512) manufacture of luggage, handbags and the like, saddlery and harness,
(2444) copper production,
(2849) manufacture of other machine tools,
(3012) building of pleasure and sporting boats,
(2015) manufacture of fertilizers and nitrogen compounds,
(3291) manufacture of brooms and brushes,
(1101) distilling, rectifying and blending of spirits,
(2051) manufacture of explosives,
(3211) striking of coins,
(2314) manufacture of glass fibers,
(1052) manufacture of ice cream,
(2320) manufacture of refractory products,
(3020) manufacture of railway locomotives and rolling stock,
(1031) processing and preserving of potatoes
(1105) manufacture of beer.

Table 7.9. The C firms those increased their labor productivity concomitant with decreasing their employment shares during (2011-2015)

(1413) manufacture of other outerwear,
(2041) manufacture of soap and detergents, cleaning and polishing preparations,
(1396) manufacture of other technical and industrial textiles,
(1414) manufacture of underwear,
(2223) manufacture of builders' ware of plastic,
(2332) manufacture of bricks, tiles and construction products, in baked clay,
(3109) manufacture of other furniture,
(1073) manufacture of macaroni, noodles, couscous and similar farinaceous products,
(1399) manufacture of other textiles n.e.c.,
(1610) sawmilling and planning of wood,
(3299) other manufacturing n.e.c.,
(2620) manufacture of computers and peripheral equipment,
(1511) tanning and dressing of leather; dressing and dyeing of fur,
(2042) manufacture of perfumes and toilet preparations,
(2593) manufacture of wire products, chain and springs,
(1061) manufacture of grain mill products,
(2221) manufacture of plastic plates, sheets, tubes and profiles,
(1082) manufacture of cocoa, chocolate and sugar confectionery,
(1920) manufacture of refined petroleum products,
(3099) manufacture of other transport equipment n.e.c.,

(2892) manufacture of machinery for mining, quarrying and construction,
(1107) manufacture of soft drinks; production of mineral waters and other bottled waters,
(2222) manufacture of plastic packing goods,
(2821) manufacture of ovens, furnaces and furnace burners,
(2720) manufacture of batteries and accumulators,
(2370) cutting, shaping and finishing of stone,
(2823) manufacture of office machinery and equipment, (except computers and peripheral equipment),
(2920) manufacture of bodies, (coachwork) for motor vehicles; manufacture of trailers and semi-trailers,
(3102) manufacture of kitchen furniture,
(2896) manufacture of plastics and rubber machinery,
(2571) manufacture of cutlery,
(2550) forging, pressing, stamping and roll-forming of metal; powder metallurgy,
(2752) manufacture of non-electric domestic appliances,
(2529) manufacture of other tanks, reservoirs and containers of metal,
(2540) manufacture of weapons and ammunition,
(1392) manufacture of made-up textile articles, except apparel,
(3212) manufacture of jewelry and related articles,
(1419) manufacture of other wearing apparel and accessories,
(2521) manufacture of central heating radiators and boilers,
(2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics,
(2740) manufacture of electric lighting equipment,
(2572) manufacture of locks and hinges,
(3011) building of ships and floating structures,
(2814) manufacture of other taps and valves,
(2452) casting of steel,
(2825) manufacture of non-domestic cooling and ventilation equipment,
(1624) manufacture of wooden containers,
(2410) manufacture of basic iron and steel and of ferro-alloys,
(1083) processing of tea and coffee,
(1200) manufacture of tobacco products,
(2611) manufacture of electronic components,
(2530) manufacture of steam generators, except central heating hot water boilers,
(2120) manufacture of pharmaceutical preparations,
(1420) manufacture of articles of fur,
(1041) manufacture of oils and fats,
(1310) preparation and spinning of textile fibers,
(1412) manufacture of work wear,
(2893) manufacture of machinery for food, beverage and tobacco processing,
(2790) manufacture of other electrical equipment,
(2013) manufacture of other inorganic basic chemicals,
(3213) manufacture of imitation jewelry and related articles,
(2351) manufacture of cement,
(2352) manufacture of lime and plaster,
(1723) manufacture of paper stationery,
(1411) manufacture of leather clothes,
(2399) manufacture of other non-metallic mineral products n.e.c.,
(2812) manufacture of fluid power equipment,
(2052) manufacture of glues,
(2016) manufacture of plastics in primary forms,
(1084) manufacture of condiments and seasonings,
(2829) manufacture of other general-purpose machinery n.e.c.,
(2815) manufacture of bearings, gears, gearing and driving elements,
(2630) manufacture of communication equipment,
(2343) manufacture of ceramic insulators and insulating fittings,
(2349) manufacture of other ceramic products,
(2434) cold drawing of wire,
(2591) manufacture of steel drums and similar containers,
(2331) manufacture of ceramic tiles and flags,
(2731) manufacture of fiber optic cables,
(1394) manufacture of cordage, rope, twine and netting,
(3220) manufacture of musical instruments,
(1081) manufacture of sugar,
(1013) production of meat and poultry meat products,

(1062) manufacture of starches and starch products,
(2652) manufacture of watches and clocks,
(2895) manufacture of machinery for paper and paperboard production,
(2369) manufacture of other articles of concrete, plaster and cement,
(2365) manufacture of fiber cement,
(2060) manufacture of man-made fibers,
(1724) manufacture of wallpaper,
(1813) pre-press and pre-media services,
(1629) manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
(2011) manufacture of industrial gases and (2680) manufacture of magnetic and optical media.

Table 7.10. The C firms those decreased their labor productivity concomitant with increasing their employment share during (2011-2015)

(2562) machining,
(2841) manufacture of metal forming machinery,
(2311) manufacture of flat glass,
(2830) manufacture of agricultural and forestry machinery,
(2391) production of abrasive products,
(2931) manufacture of electrical and electronic equipment for motor vehicles,
(2313) manufacture of hollow glass,
(1712) manufacture of paper and paperboard,
(1012) processing and preserving of poultry meat,
(1032) manufacture of fruit and vegetable juice,
(2211) manufacture of rubber types and tubes; retreading and rebuilding of rubber types,
(2433) cold forming or folding,
(2420) manufacture of tubes, pipes, hollow profiles and related fittings, of steel,
(1089) manufacture of other food products n.e.c.,
(1621) manufacture of veneer sheets and wood-based panels,
(2453) casting of light metals,
(1042) manufacture of margarine and similar edible fats,
(2443) lead, zinc and tin production,
(2660) manufacture of irradiation, electro medical and electrotherapeutic equipment,
(2431) cold drawing of bars,
(2441) precious metals production,
(1092) manufacture of prepared pet foods
(2432) cold rolling of narrow strip.

Table 7.11. The positive contribution exitters during (2011-2015) according to the multi-level Price equation

(1011) processing and preserving of meat,
(1012) processing and preserving of poultry meat,
(1013) production of meat and poultry meat products,
(1020) processing and preserving of fish, crustaceans and mollusks,
(1031) processing and preserving of potatoes,
(1032) manufacture of fruit and vegetable juice,
(1039) other processing and preserving of fruit and vegetables,
(1041) manufacture of oils and fats,
(1042) manufacture of margarine and similar edible fats,
(1051) operation of dairies and cheese making,
(1052) manufacture of ice cream,
(1061) manufacture of grain mill products,
(1062) manufacture of starches and starch products,
(1071) manufacture of bread; manufacture of fresh pastry goods and cakes,
(1072) manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes, (1073) manufacture of macaroni, noodles, couscous and similar farinaceous products,
(1081) manufacture of sugar,
(1082) manufacture of cocoa, chocolate and sugar confectionery,
(1083) processing of tea and coffee,
(1084) manufacture of condiments and seasonings,
(1085) manufacture of prepared meals and dishes,
(1086) manufacture of homogenized food preparations and dietetic food,
(1089) manufacture of other food products n.e.c.,

(1091) manufacture of prepared feeds for farm animals,
(1092) manufacture of prepared pet foods,
(1101) distilling, rectifying and blending of spirits,
(1102) manufacture of wine from grape,
(1105) manufacture of beer,
(1107) manufacture of soft drinks; production of mineral waters and other bottled waters,
(1200) manufacture of tobacco products,
(1310) preparation and spinning of textile fibers,
(1320) weaving of textiles,
(1330) finishing of textiles,
(1391) manufacture of knitted and crocheted fabrics,
(1392) manufacture of made-up textile articles, except apparel,
(1393) manufacture of carpets and rugs, (1394) manufacture of cordage, rope, twine and netting, (1396) manufacture of other technical and industrial textiles,
(1399) manufacture of other textiles n.e.c.,
(1411) manufacture of leather clothes,
(1412) manufacture of work wear,
(1413) manufacture of other outerwear,
(1414) manufacture of underwear,
(1419) manufacture of other wearing apparel and accessories,
(1420) manufacture of articles of fur,
(1431) manufacture of knitted and crocheted hosiery,
(1439) manufacture of other knitted and crocheted apparel,
(1511) tanning and dressing of leather; dressing and dyeing of fur,
(1512) manufacture of luggage, handbags and the like, saddlery and harness,
(1520) manufacture of footwear,
(1610) sawmilling and planing of wood,
(1621) manufacture of veneer sheets and wood-based panels,
(1622) manufacture of assembled parquet floors,
(1623) manufacture of other builders' carpentry and joinery,
(1624) manufacture of wooden containers,
(1712) manufacture of paper and paperboard,
(1721) manufacture of corrugated paper and paperboard and of containers of paper and paperboard,
(1722) manufacture of household and sanitary goods and of toilet requisites,
(1723) manufacture of paper stationery,
(1724) manufacture of wallpaper,
(1729) manufacture of other articles of paper and paperboard,
(1811) printing of newspapers,
(1812) other printing,
(1813) pre-press and pre-media services,
(1814) binding and related services,
(1920) manufacture of refined petroleum products,
(2011) manufacture of industrial gases,
(2012) manufacture of dyes and pigments,
(2013) manufacture of other inorganic basic chemicals,
(2015) manufacture of fertilizers and nitrogen compounds,
(2016) manufacture of plastics in primary forms,
(2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics,
(2041) manufacture of soap and detergents, cleaning and polishing preparations,
(2042) manufacture of perfumes and toilet preparations,
(2051) manufacture of explosives,
(2052) manufacture of glues,
(2053) manufacture of essential oils,
(2059) manufacture of other chemical products n.e.c.,
(2060) manufacture of man-made fibers,
(2120) manufacture of pharmaceutical preparations,
(2211) manufacture of rubber types and tubes; retreading and rebuilding of rubber types,
(2219) manufacture of other rubber products,
(2221) manufacture of plastic plates, sheets, tubes and profiles,
(2222) manufacture of plastic packing goods,
(2223) manufacture of builders' ware of plastic,
(2229) manufacture of other plastic products,
(2312) shaping and processing of flat glass,

(2313) manufacture of hollow glass,
(2314) manufacture of glass fibers,
(2331) manufacture of ceramic tiles and flags,
(2332) manufacture of bricks, tiles and construction products, in baked clay,
(2342) manufacture of ceramic sanitary fixtures,
(2349) manufacture of other ceramic products,
(2351) manufacture of cement,
(2352) manufacture of lime and plaster,
(2361) manufacture of concrete products for construction purposes,
(2362) manufacture of plaster products for construction purposes,
(2363) manufacture of ready-mixed concrete,
(2369) manufacture of other articles of concrete, plaster and cement,
(2370) cutting, shaping and finishing of stone,
(2391) production of abrasive products,
(2399) manufacture of other non-metallic mineral products n.e.c.,
(2410) manufacture of basic iron and steel and of Ferro-alloys,
(2420) manufacture of tubes, pipes, hollow profiles and related fittings, of steel,
(2431) cold drawing of bars, (2433) cold forming or folding,
(2434) cold drawing of wire,
(2442) aluminum production,
(2443) lead, zinc and tin production,
(2444) copper production,
(2445) other non-ferrous metal production,
(2451) casting of iron,
(2452) casting of steel,
(2453) casting of light metals,
(2511) manufacture of metal structures and parts of structures,
(2512) manufacture of doors and windows of metal,
(2521) manufacture of central heating radiators and boilers,
(2529) manufacture of other tanks, reservoirs and containers of metal,
(2530) manufacture of steam generators, except central heating hot water boilers,
(2540) manufacture of weapons and ammunition,
(2550) forging, pressing, stamping and roll-forming of metal; powder metallurgy,
(2561) treatment and coating of metals,
(2562) machining,
(2572) manufacture of locks and hinges,
(2573) manufacture of tools,
(2591) manufacture of steel drums and similar containers,
(2592) manufacture of light metal packaging,
(2593) manufacture of wire products, chain and springs,
(2594) manufacture of fasteners and screw machine products,
(2599) manufacture of other fabricated metal products n.e.c.,
(2630) manufacture of communication equipment,
(2640) manufacture of consumer electronics,
(2651) manufacture of instruments and appliances for measuring, testing and navigation,
(2660) manufacture of irradiation, electro medical and electrotherapeutic equipment,
(2680) manufacture of magnetic and optical media,
(2711) manufacture of electric motors, generators and transformers,
(2712) manufacture of electricity distribution and control apparatus,
(2720) manufacture of batteries and accumulators,
(2731) manufacture of fiber optic cables,
(2733) manufacture of wiring devices,
(2740) manufacture of electric lighting equipment,
(2751) manufacture of electric domestic appliances,
(2752) manufacture of non-electric domestic appliances,
(2790) manufacture of other electrical equipment,
(2812) manufacture of fluid power equipment,
(2813) manufacture of other pumps and compressors,
(2814) manufacture of other taps and valves,
(2815) manufacture of bearings, gears, gearing and driving elements,
(2821) manufacture of ovens, furnaces and furnace burners,
(2822) manufacture of lifting and handling equipment,
(2823) manufacture of office machinery and equipment, (except computers and peripheral equipment),

(2825) manufacture of non-domestic cooling and ventilation equipment,
(2829) manufacture of other general-purpose machinery n.e.c.,
(2830) manufacture of agricultural and forestry machinery,
(2841) manufacture of metal forming machinery,
(2849) manufacture of other machine tools,
(2891) manufacture of machinery for metallurgy,
(2892) manufacture of machinery for mining, quarrying and construction,
(2893) manufacture of machinery for food, beverage and tobacco processing,
(2895) manufacture of machinery for paper and paperboard production,
(2896) manufacture of plastics and rubber machinery,
(2899) manufacture of other special-purpose machinery n.e.c.,
(2910) manufacture of motor vehicles,
(2920) manufacture of bodies, (coachwork) for motor vehicles; manufacture of trailers and semi-trailers,
(2932) manufacture of other parts and accessories for motor vehicles,
(3011) building of ships and floating structures,
(3012) building of pleasure and sporting boats,
(3040) manufacture of military fighting vehicles,
(3091) manufacture of motorcycles,
(3092) manufacture of bicycles and invalid carriages,
(3099) manufacture of other transport equipment n.e.c.,
(3101) manufacture of office and shop furniture,
(3102) manufacture of kitchen furniture,
(3103) manufacture of mattresses,
(3109) manufacture of other furniture,
(3212) manufacture of jewelry and related articles,
(3213) manufacture of imitation jewelry and related articles,
(3220) manufacture of musical instruments,
(3230) manufacture of sports goods,
(3250) manufacture of medical and dental instruments and supplies,
(3291) manufacture of brooms and brushes
(3299) other manufacturing n.e.c.

Table 7.12. The negative contribution exiters during (2011-2015) according to the multi-level Price equation

(1629) Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials,
(1820) Reproduction of recorded media,
(1910) Manufacture of coke oven products,
(2014) Manufacture of other organic basic chemicals,
(2020) Manufacture of pesticides and other agrochemical products,
(2319) Manufacture and processing of other glass, including technical glassware,
(2320) Manufacture of refractory products,
(2341) Manufacture of ceramic household and ornamental articles,
(2343) Manufacture of ceramic insulators and insulating fittings,
(2364) Manufacture of mortars,
(2454) Casting of other non-ferrous metals,
(2571) Manufacture of cutlery,
(2611) Manufacture of electronic components,
(2612) Manufacture of loaded electronic boards,
(2620) Manufacture of computers and peripheral equipment,
(2652) Manufacture of watches and clocks,
(2670) Manufacture of optical instruments and photographic equipment,
(2732) Manufacture of other electronic and electric wires and cables,
(2811) Manufacture of engines and turbines, except aircraft, vehicle and cycle engines,
(2894) Manufacture of machinery for textile, apparel and leather production,
(2931) Manufacture of electrical and electronic equipment for motor vehicles,
(3020) Manufacture of railway locomotives and rolling stock,
(3211) Striking of coins
(3240) Manufacture of games and toys.

Table 7.13. The positive contribution entrants during (2011-2015) according to the multi-level Price equation

(1011) processing and preserving of meat,
(1041) manufacture of oils and fats,
(1061) manufacture of grain mill products,
(1085) manufacture of prepared meals and dishes,
(1310) preparation and spinning of textile fibers,
(1391) manufacture of knitted and crocheted fabrics,
(1393) manufacture of carpets and rugs,
(1395) manufacture of non-woven and articles made from non-woven, except apparel,
(1412) manufacture of work wear,
(1420) manufacture of articles of fur,
(1439) manufacture of other knitted and crocheted apparel,
(1511) tanning and dressing of leather; dressing and dyeing of fur,
(1610) sawmilling and planning of wood,
(1623) manufacture of other builders' carpentry and joinery,
(1722) manufacture of household and sanitary goods and of toilet requisites,
(1724) manufacture of wallpaper,
(1811) printing of newspapers,
(1812) other printing,
(1813) pre-press and pre-media services,
(1820) reproduction of recorded media,
(2051) manufacture of explosives,
(2120) manufacture of pharmaceutical preparations,
(2312) shaping and processing of flat glass,
(2343) manufacture of ceramic insulators and insulating fittings,
(2349) manufacture of other ceramic products,
(2352) manufacture of lime and plaster,
(2363) manufacture of ready-mixed concrete,
(2445) other non-ferrous metal production,
(2529) manufacture of other tanks, reservoirs and containers of metal,
(2530) manufacture of steam generators, except central heating hot water boilers,
(2561) treatment and coating of metals,
(2571) manufacture of cutlery,
(2592) manufacture of light metal packaging,
(2611) manufacture of electronic components,
(2652) manufacture of watches and clocks,
(2660) manufacture of irradiation, electro medical and electrotherapeutic equipment,
(2680) manufacture of magnetic and optical media,
(2732) manufacture of other electronic and electric wires and cables,
(2752) manufacture of non-electric domestic appliances,
(2823) manufacture of office machinery and equipment, (except computers and peripheral equipment),
(2829) manufacture of other general-purpose machinery n.e.c.,
(2896) manufacture of plastics and rubber machinery,
(3101) manufacture of office and shop furniture,
(3213) manufacture of imitation jewelry and related articles
(3250) manufacture of medical and dental instruments and supplies.

Table 7.14. The negative contribution entrants during (2011-2015) according to the multi-level Price equation

(1012) processing and preserving of poultry meat,
(1013) production of meat and poultry meat products,
(1020) processing and preserving of fish, crustaceans and mollusks,
(1031) processing and preserving of potatoes,
(1032) manufacture of fruit and vegetable juice,
(1039) other processing and preserving of fruit and vegetables,
(1042) manufacture of margarine and similar edible fats,
(1051) operation of dairies and cheese making,
(1052) manufacture of ice cream,
(1062) manufacture of starches and starch products,
(1071) manufacture of bread; manufacture of fresh pastry goods and cakes,
(1072) manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes, (1073) manufacture of macaroni, noodles, couscous and similar farinaceous products,
(1082) manufacture of cocoa, chocolate and sugar confectionery,
(1083) processing of tea and coffee,
(1084) manufacture of condiments and seasonings,
(1086) manufacture of homogenized food preparations and dietetic food,
(1089) manufacture of other food products n.e.c.,
(1091) manufacture of prepared feeds for farm animals,
(1092) manufacture of prepared pet foods,
(1101) distilling, rectifying and blending of spirits,
(1102) manufacture of wine from grape,
(1105) manufacture of beer,
(1107) manufacture of soft drinks; production of mineral waters and other bottled waters,
(1200) manufacture of tobacco products,
(1320) weaving of textiles,
(1330) finishing of textiles,
(1392) manufacture of made-up textile articles, except apparel,
(1394) manufacture of cordage, rope, twine and netting,
(1396) manufacture of other technical and industrial textiles,
(1399) manufacture of other textiles n.e.c.,
(1411) manufacture of leather clothes,
(1413) manufacture of other outerwear,
(1414) manufacture of underwear,
(1419) manufacture of other wearing apparel and accessories,
(1431) manufacture of knitted and crocheted hosiery,
(1512) manufacture of luggage, handbags and the like, saddlery and harness,
(1520) manufacture of footwear,
(1621) manufacture of veneer sheets and wood-based panels,
(1622) manufacture of assembled parquet floors,
(1624) manufacture of wooden containers,
(1629) manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials,
(1712) manufacture of paper and paperboard,
(1721) manufacture of corrugated paper and paperboard and of containers of paper and paperboard,
(1723) manufacture of paper stationery,
(1729) manufacture of other articles of paper and paperboard,
(1814) binding and related services,
(1910) manufacture of coke oven products,
(1920) manufacture of refined petroleum products,
(2011) manufacture of industrial gases,
(2012) manufacture of dyes and pigments,
(2013) manufacture of other inorganic basic chemicals,
(2014) manufacture of other organic basic chemicals,
(2015) manufacture of fertilizers and nitrogen compounds,
(2016) manufacture of plastics in primary forms,
(2020) manufacture of pesticides and other agrochemical products,
(2030) manufacture of paints, varnishes and similar coatings, printing ink and mastics,
(2041) manufacture of soap and detergents, cleaning and polishing preparations,
(2042) manufacture of perfumes and toilet preparations,
(2052) manufacture of glues,

(2053) manufacture of essential oils,
(2059) manufacture of other chemical products n.e.c.,
(2060) manufacture of man-made fibers,
(2211) manufacture of rubber types and tubes; retreading and rebuilding of rubber types,
(2219) manufacture of other rubber products,
(2221) manufacture of plastic plates, sheets, tubes and profiles,
(2222) manufacture of plastic packing goods,
(2223) manufacture of builders' ware of plastic,
(2229) manufacture of other plastic products,
(2313) manufacture of hollow glass,
(2314) manufacture of glass fibers,
(2319) manufacture and processing of other glass, including technical glassware,
(2320) manufacture of refractory products,
(2331) manufacture of ceramic tiles and flags,
(2332) manufacture of bricks, tiles and construction products, in baked clay,
(2341) manufacture of ceramic household and ornamental articles,
(2342) manufacture of ceramic sanitary fixtures,
(2351) manufacture of cement,
(2361) manufacture of concrete products for construction purposes,
(2362) manufacture of plaster products for construction purposes,
(2364) manufacture of mortars,
(2365) manufacture of fiber cement,
(2369) manufacture of other articles of concrete, plaster and cement,
(2370) cutting, shaping and finishing of stone,
(2391) production of abrasive products,
(2399) manufacture of other non-metallic mineral products n.e.c.,
(2410) manufacture of basic iron and steel and of Ferro-alloys,
(2420) manufacture of tubes, pipes, hollow profiles and related fittings, of steel,
(2431) cold drawing of bars,
(2432) cold rolling of narrow strip,
(2433) cold forming or folding,
(2434) cold drawing of wire,
(2441) precious metals production,
(2442) aluminum production,
(2443) lead, zinc and tin production,
(2444) copper production,
(2451) casting of iron,
(2452) casting of steel,
(2453) casting of light metals,
(2454) casting of other non-ferrous metals,
(2511) manufacture of metal structures and parts of structures,
(2512) manufacture of doors and windows of metal,
(2521) manufacture of central heating radiators and boilers,
(2540) manufacture of weapons and ammunition,
(2550) forging, pressing, stamping and roll-forming of metal; powder metallurgy,
(2562) machining,
(2572) manufacture of locks and hinges,
(2573) manufacture of tools,
(2591) manufacture of steel drums and similar containers,
(2593) manufacture of wire products, chain and springs,
(2594) manufacture of fasteners and screw machine products,
(2599) manufacture of other fabricated metal products n.e.c.,
(2612) manufacture of loaded electronic boards,
(2620) manufacture of computers and peripheral equipment,
(2630) manufacture of communication equipment,
(2640) manufacture of consumer electronics,
(2651) manufacture of instruments and appliances for measuring, testing and navigation,
(2670) manufacture of optical instruments and photographic equipment,
(2711) manufacture of electric motors, generators and transformers,
(2712) manufacture of electricity distribution and control apparatus,
(2720) manufacture of batteries and accumulators,
(2731) manufacture of fiber optic cables,
(2733) manufacture of wiring devices,

(2740) manufacture of electric lighting equipment,
(2751) manufacture of electric domestic appliances,
(2790) manufacture of other electrical equipment,
(2811) manufacture of engines and turbines, except aircraft, vehicle and cycle engines,
(2812) manufacture of fluid power equipment,
(2813) manufacture of other pumps and compressors,
(2814) manufacture of other taps and valves,
(2815) manufacture of bearings, gears, gearing and driving elements,
(2821) manufacture of ovens, furnaces and furnace burners,
(2822) manufacture of lifting and handling equipment,
(2824) manufacture of power-driven hand tools,
(2825) manufacture of non-domestic cooling and ventilation equipment,
(2830) manufacture of agricultural and forestry machinery,
(2841) manufacture of metal forming machinery,
(2849) manufacture of other machine tools,
(2891) manufacture of machinery for metallurgy,
(2892) manufacture of machinery for mining, quarrying and construction,
(2893) manufacture of machinery for food, beverage and tobacco processing,
(2894) manufacture of machinery for textile, apparel and leather production,
(2895) manufacture of machinery for paper and paperboard production,
(2899) manufacture of other special-purpose machinery n.e.c.,
(2910) manufacture of motor vehicles,
(2920) manufacture of bodies, (coachwork) for motor vehicles; manufacture of trailers and semi-trailers,
(2931) manufacture of electrical and electronic equipment for motor vehicles,
(2932) manufacture of other parts and accessories for motor vehicles,
(3011) building of ships and floating structures, (3012) building of pleasure and sporting boats, (3020) manufacture of railway locomotives and rolling stock,
(3030) manufacture of air and spacecraft and related machinery,
(3040) manufacture of military fighting vehicles,
(3091) manufacture of motorcycles,
(3092) manufacture of bicycles and invalid carriages,
(3099) manufacture of other transport equipment n.e.c.,
(3102) manufacture of kitchen furniture,
(3103) manufacture of mattresses,
(3109) manufacture of other furniture,
(3211) striking of coins,
(3212) manufacture of jewelry and related articles,
(3220) manufacture of musical instruments,
(3230) manufacture of sports goods,
(3240) manufacture of games and toys,
(3291) manufacture of brooms and brushes
(3299) other manufacturing n.e.c.

RESUME

Adı ve Soyadı : Maya MOALLA

Doğum Tarihi :

E-mail:

Öğrenim Durumu :

Derece	Bölüm/Program	Üniversite	Yıl
Lisans	(Orman ve Çevre-Orman mühendisi)	(Tishreen University-KTÜ)	(2008-2020)
Yüksek Lisans	İktisat	Tishreen University	2013
Doktora	İktisat	Mersin University	2021

Görevler :

Görev Ünvanı	Görev Yeri	Yıl

ESERLER (Makaleler ve Bildiriler)

1. International Conference on Economics Turkish Economic Association 18 “Structural Change and Growth Prospects in the Turkish Manufacturing Industry”
2. International Conference on Economics Turkish Economic Association 19: “Patterns of Structural Change and Economic Growth in the Turkish Manufacturing Industry”
3. International Conference on Empirical Economics and Social Science ICEESS 19 “Sources of Economic Growth and Structural Change in the Turkish Economy: Demand Side Perspective 2002-2012”.
4. Book chapter IJOPEC: Structural Change and Aggregate Labour Productivity in The Turkish Non-Farm Business Industries. In Hatirli, S., Koç, Ş. Demirel, O., Theoretical And Applied Studies On Turkish Economy, IJOPEC, 1, pp.155-173.
5. Mechanisms Of Schumpeterian Competition in Turkish Manufacturing Industries. Mersin Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 4(1), pp.121-135.
6. Structural Change and Growth Prospects in the Turkish Manufacturing Industry. Bulletin of Economic Theory and Analysis, 5(1), pp.1-20.