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MECHANISMS OF SCHUMPETERIAN COMPETITION IN TURKISH MANUFACTURING INDUSTRIES

TÜRKIYE İMALAT SANAYİİNDE SCHUMPETER'İN REKABET MEKANİZMALARI

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ABSTRACT

Schumpeterian competition is a process of generating innovations which enable firms gaining decisive competitive advantage over their competitors. Two models of competition had been presented by Schumpeter. The earlier one (1934) is often referred to as the Mark I; while the later one (1950) is known as Mark II model of Schumpeterian competition. In the Mark I model, new firms bring innovations replacing the incumbents. On the contrary, in the Mark II model, innovations are brought by incumbent firms rather than entrants. The distinction between Mark I and Mark II models of Schumpeterian competition has been employed as a dichotomy for depicting the dynamics of industries. In an attempt to map the mechanisms of Schumpeterian competition in the Turkish manufacturing industries during the period of (2010-2015), Price's decomposition technique is utilized. In other words, this work tried to quantify the evolution of labor productivity (ΔZ) by decomposing it into selection, innovation and net entry effects. Whereas Schumpeterian Mark I industries are characterized by strong entry effect, Schumpeterian Mark II industries are characterized by strong innovation one. The data compiled by TSI that classified according to the Statistical Classification of Economic Activities in the European Community (NACE Rev.2) at four-digit level is employed in the empirical research. The results show that the labor productivity evolution is positive in twenty-one industries. The results also show that almost the majority of manufacturing industries follow Schumpeter's Mark II model of competition with relatively weak Mark I dynamics in general.

Keywords: Schumpeterian Competition, Innovation, Economic Selection, Price Equation.

ÖZ

Schumpeter'in rekabeti, firmaların rakiplerine göre rekabet avantajı elde etmelerini sağlayan yenilik sürecidir. Schumpeter tarafından iki rekabet modeli sunulmaktadır. Birincisi (1934) Mark I olarak; ikincisi ise (1950) Mark II modeli olarak bilinmektedir. Mark I modelinde, yenilik mevcut firmalar yerini yeni giren firmalar tarafından getirilmektedir. Aksine, Mark II modelinde yenilikler, yeni giren firmalar değil, mevcut olan firmalar tarafından getirilmektedir. Schumpeter'in Mark I ve Mark II modelleri arasındaki ayrım, endüstrilerin dinamiklerini belirlemek için bir ikilem olarak kullanılmıştır. Türkiye imalat sanayilerinde (2010-2015) döneminde Schumpeter'in rekabet mekanizmalarını tespit etme amacıyla Price'in ayrıştırma tekniği kullanılmaktadır. Başka bir deyişle, bu çalışma emek üretkenliğinin (ΔZ) artışını ekonomik seçim, yenilik ve net giriş etkileri ile ayrıştırarak incelemektedir. Schumpeter'in Mark I firmaları güçlü giriş etkisiyle karakterize edilirken, Mark II firmaları güçlü inovasyon ile karakterize edilmektedir. Türkiye İstatistik Enstitüsünün (TSI) 2010-2015 dönemi için Türkiye imalat sanayi NACE (Avrupa Topluluğundaki Ekonomik Faaliyetlerin İstatistiksel Sınıflaması, revize 2) dört haneli alt sektör verileri kullanılmıştır. Türkiye imalat sanayinde emek üretkenliği 2010-2015 dönemi için yirmi bir alt-sektörde pozitif büyüme göstermiştir. Son olarak, sonuçlar imalat endüstrilerinin neredeyse çoğunun, Schumpeter'in Mark II rekabet modelini takip ettiğini göstermektedir.

Anahtar sözcükler: Schumpeter'in Rekabeti, yenilik, ekonomik seçim, Price denklemi.

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INTRODUCTION

In times of fierce competition between firms, it is close to impossible surviving the market without innovations by which the firms maintain their business shares or even surpass their own-and competitors'-expectations. The innovative firms are ones those are able to achieve productivity improvements. In an *Inquiry into the Nature and Causes of the Wealth of Nations* (1776), Adam Smith considers the labor division as the mechanism that enables the invention of machinery which facilitates increasing the potentiality to bear productivity gains (Smith, 1776). The increasing productivity expands the firms' market shares the matter that stimulates further labor specialization leading in its turn to further machinery invention and productivity gains. Actually, the matter is not as easy as it seems. The scarcity supplies of labor but the abundant supplies of capital in the United States, for example, led to the adoption of the labor-saving technology. The scarcity of labor in the United States is responsible for innovations which are the key drivers of technological progress and therefore economic growth (Rosenberg, 1963). Technological progress induces the interchangeability inside the American system of manufactures leading to new patterns of the labor specialization; the matter that encouraged the new technology's transfer between the industrial sectors. The transfer of the new technology facilitates the American self-enforcement and open new opportunities for capital-saving innovations (Rosenberg, 1982). Conversely, the abundant supplies of labor but the scarcity supplies of capital in the underdeveloped countries led to the capital-saving techniques. In the Solow-Swan type neo-classical growth models, the exogenous technological progress and the capital accumulation are fundamental sources for expanding the market shares. As the capital accumulation is subject to diminishing returns to scale sooner or later, the technological advancements enables the long run economic growth.

Although the potential applicability of the innovation term in the early works; none of these precursors of innovation studies have been as effective as Schumpeter's approach of innovation as the firms' adoption of new technology, new products and new types of organizations in order to increase their productivity. Schumpeter forcefully adopted the idea that the long-run capitalist development is driven by the firms' technological innovation competitiveness. In other words, it is the technological, rather than price competition that drives the capitalist evolution. Schumpeter defined the innovation as the tradable economic process in which the "new combinations" draw the necessary new resources, equipment or knowledge 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 is satisfied with acquiring the knowledge until it 'sinks into the strata of subconsciousness'. For the first glance, it may be difficult to change the ordinary 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 in 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 constructivity are required to implement successful innovation. Schumpeter emphasizes the significance of the human capital in the process of innovation. In other words, the entrepreneurial function requires the entrepreneur who has the ability to take a huge risk,

find solutions and establish rules. That's not mean that the entrepreneurial function must be embodied in one physical person. Societies in every periods of time differ from one another in terms of finding the suitable strategies by which they organize the entrepreneurial functions (Schumpeter, 1989). The more productive firms increase their R&D expenditures on innovation in order to introduce new and more efficient machinery the matter that enables them achieve more profits, invest more, grow faster and increase their market shares. The low productive firms, as a result, will be forced to either improve their productivity or exit the market (Schumpeter, 1934).

The productivity always defines the degree of the innovation and technical change. The process of industrial dynamics had been a common tool for understanding the evolution of labor productivity over time. Decomposing the labor productivity evolution into the terms of selection, innovation and net entry enables interpreting the drivers of growth along with Schumpeterian competition models of economic evolution. The main purpose of this paper is estimating the key sources of the aggregate labor productivity evolution in the Turkish manufacturing industries at disaggregate level and intertwining these sources with the Schumpeterian mechanisms of competition during the period (2010-2015) which is a period of premature de-industrialization in the Turkish manufacturing industries. Despite the Kaldorian tradition which claims that the manufacturing sector is an engine of economic growth, the data shows something different. 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 rapid growth of the manufacturing sector's labor productivity more than the rest economy provides a strong evidence of the premature deindustrialization in the Turkish manufacturing industries during the period of (2010-2017). As long as the elasticity of substitution between manufacturing and other sectors is less than one, the manufacturing sector's value added grows faster than the rest sectors' one leading to slower employment growth in the manufacturing sector comparing with the rest economic sectors. Thus the manufacturing sector's nominal value added reaches an earlier peak than its real one for the reason of the reduction of the manufactured products' relative prices through standard supply-demand channels due to the technological progress. The technology-led deindustrialization is a part of Schumpeterian 'creative destruction' process in which more productive processes replace the old ones. To achieve our goal, Price's equation is applied to micro level registry data of about 59214 firms in order to map the mechanisms of Schumpeterian competition in the Turkish manufacturing industries during the period of (2010-2015). Price equation decomposes the aggregate labor productivity evolution into the effects of economic selection, learning, entry and exit[1]. The main advantage of applying Price's equation compared to the traditional methods is that it offers a comprehensible technique for measuring the industrial dynamics of the aggregate productivity evolution. Foster et al. (1998) employs Price's methodology to decompose the labor productivity change in the American manufacturing industries during the period of (1977-1987) at four-digit level[2].

1 Price equation is derived from the field of biology. According to Nelson and Winter, the goal of such application is to benefit from whatever can be found beneficial so as to scrutinize the complex and uncertain relationships between the microevolutions and the aggregate levels of the economic growth. In this paper we make use of the single level Price equation. Another technique of Price equation is the multilevel Price equation which enables measuring the industrial dynamics that affect the productivity evolution within industries.

2 Foster and colleagues utilized two methods to examine the industrial dynamics of the productivity evolution; the first one is the method that had been used by Baily, Hulten, and Campbell (1992) and the second one is the one that had

They conclude that the majority of the American manufacturing industries follow Schumpeter's Mark II model of competition with relatively weak Mark I dynamics in the output markets. Andersson (2006) employs the method of Baily, Hulten, and Campbell (1992) to decompose the productivity evolution in the Swedish industries during the period of (1997-2003) at four-digit level. Andersson reveals that Swedish manufacturing industries are characterized by strong innovation effect means that those industries follow Schumpeter's Mark II model of competition. Our results are similar, to some extent, to those had been yielded for American and Swedish manufacturing industries. The rest of the paper is structured as following: In section 2 a brief review of the literature is given. In section 3 Mark I and Mark II models of Schumpeterian competition will be discussed. In section 4, data materials and the methodology for mapping mechanisms of Schumpeterian competition is presented. In section 5, the conclusions have been discussed.

LITERATURE REVIEW

Schumpeter claimed that in order to yield profits, innovation must be done. He defined the innovation process as an industrial mutation by which the economic structure changes continuously. Schumpeter determined five methods of innovation: 1- the introduction of new products; 2- the introduction of new methods of production; 3- opening new markets; 4- supplying new raw materials or semi-finished goods; 5- change the industrial structure by the creation or destruction of the monopolistic position. In Schumpeter's claim, innovations driven by destroying the old structure and creating new one is the stone foundation of the economic development. The main cause for such 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, whereas the diffusion and imitation process have a much more impact on the state of an economy, the invention phase has less influence on it. 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.

The productivity always defines the degree of the innovation and technical change. The decomposition of productivity evolution into the effects of selection, innovation and net entry has been well documented for developed countries, while only few empirical studies have been implemented for the developing countries. Baily et al. (1996) investigate data of U.S. manufacturing sector's plants during the period of (1977-1987) in order to measure the relationship between the employment changes and the labor productivity growth. They distinguish between four sets of plants: the successful upsizers those that increase labor productivity concurrently with increasing employment, successful downsizers those that increase their productivity in consistent with decreasing employment, unsuccessful downsizers those that decrease their productivity concomitant with decreasing employment and unsuccessful upsizers those that decrease the labor productivity accompanying with increasing employment. Their results dissatisfy with the

been used by Griliches and Regev (1995). They also employed different choices of variables and found that Price equation is sensitive to the choice of variables. This paper utilizes the method used by Griliches and Regev (1995) with the choice of labor productivity weighted by employment units. The proxy of the competitive advantage means labor productivity (zi) is measured by dividing the firm's real value added on the number of its workers. The size of the firm (si) is measured by dividing the number of firm's workers on the total one.

traditional wisdom claims that the increasing productivity is driven by the falling employment. In contrast, they emphasize the positive relationship between the increasing employment and the increasing labor productivity due to idiosyncratic factors despite of the striking heterogeneities across economic sectors (Baily, Bartelsman and Haltiwanger, 1996). Krüger (2008) shed light on the external and internal sources of aggregate productivity growth of more 450 manufacturing industries at the four-digit level during the period of 1958–96. He found that the internal productivity growth of the single industries is accounted for the majority of the aggregate labor productivity evolution. He also found a considerable relationship between the aggregate productivity evolution (both labor productivity and total factor productivity) and the selection effect stemmed from the computer revolution for the high-tech and durable goods producing industries. Furthermore, he concluded that the selection effect in the form of employment reallocation is less intense than the selection effect in the form of value-added reallocation across industries. Disney et al. (2003) considered the technological progress as 'internal' determinant of productivity growth in UK manufacturing during the period of (1980-1992). They examine the importance of both internal and external restructuring to the aggregate productivity growth. They clarify that whereas the internal restructuring refers to the technological and organizational change, the external one refers to the market selection mechanisms associated with the entry of the high productivity firms gain market share and the exit of the low productivity ones. Their results show that around 50% of labor productivity growth and 90% of total factor productivity growth can be attributed to the external restructuring effect arises from entry of more productive multi-establishment firms and exit of less productive ones. Furthermore, they found that the importance of the external restructuring to the productivity growth takes a behavioral dimension by generating a competitive pressure on the existing establishment the matter that increases the productivity growth among them (Disney, Haske and Heden, 2003). The structural change and the net entry were also the key components that affect the aggregate productivity growth in the German manufacturing industries. Before the German reunification, the aggregate productivity growth has been connected to the within-firm effect accompanying with the entering of the firms with above-average productivity and the exiting of the ones with the below-average productivity. Since the German reunification, a non-negligible labor productivity growth can be attributed to the structural changes driven by the success-breeds-success dynamics combined with sufficient technological advancements for the majority of sectors (Cantner & Kruger, 2008).

Celasun (1983) employed a demand side decomposition technique in order to analyze the sources of output growth on both national and regional levels. He revealed that the positive contribution of the structural changes in the inward oriented era can be attributed to the considerable structural changes that decrease the share of primary production concurrently with increasing the capital accumulation and primary schooling. These structural transformations resulted from the import-substitution strategy started in late 1950s with replacing the imports of non-durable and then durable and capital consumer goods and continued till the mid of 1970s increasing the growth rates of GNP from 4.8 percent in (1953-1963) to 7.2 percent in (1973-1977). In the mid of 1970s, Turkey faced external shocks make the switch from import substitution to export-oriented strategy costly in term of aggregate growth losses. The annual growth decreased from 4.0 percent in 1977 to 0.4 percent in 1979. Turkey tried to preserve its growth momentum by promoting balance between the external debt along with 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. However, the unplanned capital liberalization, the high interest rates and large amounts of capital inflows moved into the Turkish economy made it suffers from vulnerability and financial crisis. As a result, sharp and rapid capital outflows from the country transform the crisis from the financial markets to real sectors of the economy causing adverse structural changes to take place and bring a drag on the Turkish economy as a whole. Akkemik (2006) employed the traditional shift-share method utilized by Timmer & Szirmai (2000) in order to investigate the importance of selection effect to the aggregate productivity growth in 19 Turkish manufacturing industries. He revealed that the structural change contributes positively to the aggregate productivity growth during the inward oriented era (till 1980). However, in the post-1980 known as the outward oriented era, it contributes negatively to the aggregate productivity evolution. Tuncer & Moalla (2020a) utilize 3-digit 185 Turkish non-farm business industries' data that classified according to (NACE Rev.2) for the period of 2003–2017 in order to split the evolution of the aggregate labor productivity growth into three effects which are: the within-shift effect, the between-shift effect and the covariance effect. They concluded that the positive evolution of labor productivity (27.9%) during the period of (2010-2017) is attributed to the within shift effect (30.6%) stemmed from R&D activities leading to innovation; but the between and covariance effects contributed negatively to the aggregate labor productivity evolution (-2.76%). They attribute the inverse structural changes to many reasons such as the rigidities in the labor markets, the micro and the non-selective macro policies that reallocate the sources towards the low productive industries. Tuncer & Moalla (2020b) make use of the traditional shift share analysis in order to determine the patterns of aggregate labor productivity evolution in the Turkish manufacturing industries at two-digit level during the period of (2010-2017). They concluded that whereas the within growth effect was responsible for the bonus of the aggregate productivity growth (5.87%) during the period of (2010-2017), the selection effect was negative due to the increasing informality and the side impacts of active employment policies caused some sorts of resource misallocations.

MARK I AND MARK II MODELS OF SCHUMPETERIAN COMPETITION

Schumpeterian competition is a process of generating innovations which enable firms gaining decisive competitive advantage over their competitors. It is the process in which firms either produce or imitate new combinations of the routines in order to 'survive' in the markets that operate as a selection mechanism on them in terms of ensuring the continuation of the firms with higher efficiency and contracting the ones those don't have the capacity to retain successful routines (Schumpeter, 1950). Nelson & Winter (1982) conceptualize the firm as a made up of routines for production, investment, marketing and so on. Competition is the engine by which firms eliminate the old routines by carrying out new ones such as the introduction of new products, new methods of production, marketing, new sources or new organization of any industry in order to increase their profits or decrease the unit cost of production (Schumpeter, 1934). Schumpeterian competition is considered as a permanent process in which any competitive advantage is transitory in terms of being imitated or surpassed by the innovations of other firms sooner or later. Two models of competition had been presented by Schumpeter. The earlier one (1934) is often referred to as the Mark I; while the later one (1950) is known as Mark II model of Schumpeterian competition. In the Mark I model, new "entrepreneurial" firms bring innovations replacing the incumbents.

Accordingly, Schumpeterian Mark I industries are characterized by technological competition presumes the form of "creative destruction" in chaotic environments with relatively low entry barriers. On the contrary, in the Mark II model innovations is brought by incumbent firms rather than entrants. Accordingly, Schumpeterian Mark II industries are characterized by technological competition presumes the form of "creative accumulation" in stable environments with relatively high entry barriers (Malerba, 2005). Describing the industrial dynamics of the economic sectors based on Mark I and Mark II models of Schumpeterian competition had been implemented by empirical literature. One of the fundamental empirical results is that these two patterns of innovation are, to large extent, technology specific; furthermore, the same industries are prone to adopt similar patterns of innovation even in different countries (Malerba & Orsenigo, 1996). Whereas Schumpeterian Mark I patterns of innovation occur when the environmental factors are governed by high technological opportunities, low alienability and low cumulativeness, Schumpeterian Mark II patterns of innovation occur when the environmental factors are governed by high alienability and high cumulativeness (Castellacci, 2007).

DATA AND METHODOLOGY

The data compiled by Turkish Statistical Institute (TSI) that classified according to Statistical Classification of Economic Activities in the European Community (NACE Rev.2) at four-digit level is employed in the empirical research. The number of total firms is 59214. Detailed information about the distribution of firms over 4-digit manufacturing industries is given in table (3) in the appendix. We distinguish between three sets of firms: 17942 firms as **C**ontinuing, 26326 firms as e**N**trants and 14946 firms as e**X**iters. For the reason that it is not allowed to report any results which may identify specific firms from the database, we make our calculations at the four-digit level, then we aggregated the data in 23 two-digit industries. The preliminary information about the manufacturing industries' two-digit codes and the description of the industries are shown in table (1) in the appendix. The available years are 2010 to 2015 (where the database was discontinued). Three variables from the database is utilized, namely total value added of the firms, total full-time equivalent employment for the firms over the years and industry classification. Additionally, the effect of inflation is eliminated by using the Producer Price Index (PPI) for the reason that the evolution of prices is an integral part of competitive advantage. The size of the firm (s_i) is measured by dividing the number of firm's workers on the total one. The proxy[3] of the competitive advantage means labor productivity (z_i) is measured by dividing the firm's real value added on their full-time equivalent workers. The industry's labor productivity (chosen proxy) and the growth do not necessarily exhibit covariation. One interpretation for that maybe that some firms' entry and exit impacts stem from reclassifying them rather than entrepreneurial entry and terminal exit[4]. The evolution of productivity had been decomposed from input weights perspective by applying a technique from biological population studies known as Price's equation[5]. The general decomposition equation of evolutionary change developed by Price includes the selection and the innovation effects (Frank, 1995). Andersen (2004) wrote it as following:

3 In some industries, there may be other issues that are more significant for competition from labor productivity.
4 In this paper, the entrepreneurial entry and terminal exit didn't have been taken into account; but it is a possible direction for research in the future.
5 In the field of economics, the theoretical background of Price's equation can be attributed to Metcalfe (2007) and Andersen (2004).

$$\Delta Z = \frac{Cov(wi, zi)}{W} + \frac{E(wi, zi)}{W} \quad (1)$$

Where ($\Delta Z=Z'-Z$) denotes the labor productivity evolution between two points of time (Z in t_{2010} and Z' in t_{2015}).The first term on the right hand of Price's equation denotes the selection effect. It can be interpreted as the covariance between the firm's growth rate plus one i.e. the firm fitness (w_i) and firm's labor productivity (z_i). It will contribute positively to the aggregate labor productivity growth if the correlation between the firms' initial productivity and its growth is high[6]. The second term on the right hand of Price's equation denotes the innovation effect. It can be interpreted as the firm's productivity evolution from pre evolution population to the post evolution population. It can be related to intra firm competition treatments such as R&D activities. If we multiply the two sides of equation (1) by $W= X'/X$ which denotes the fitness of population, we can get an alternative form of equation (1) which is:

$$W\Delta Z = Cov(wi, zi) + E(wi, zi) \quad (2)$$

The advantage of this equation is that it provides an equivalence relation between the firm-level on the right side of it and the population-level on the left side of it. Therefore, this equation can be substituted into itself as the researcher desires. The mentioned equation's two terms refer to firms which continue to exist all along the evolutionary process. Intertwining Price equation with Schumpeterian mechanisms of competition and applying it directly to firm data require taking the role of entry and exit into account. Accordingly, it is necessary to distinguish between three groups of firms: The e**X**iters i.e. the X firms those are exist in the pre evolution population (initial year), the e**N**trants i.e. the N firms those are exist in the post evolution population (final year which had been symbolized by the subscript (')) and the **C**ontinuing firms i.e. the C firms those are exist in both pre and post evolution population. To achieve this goal, let's start by expanding the covariance and expectation terms to:

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

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

By substituting the following equation into the above one as suggested by Holm (2014):

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

Where X denotes the population size in the pre-evolution population and X' denotes the size of population in the post-evolution population. With the same respect x_i denotes the firm's size in the pre-evolution population and x_i' denotes the firm's size in the post-evolution population. The subsequent equation could be attained:

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

As these two terms indicates only the C firms those exist in both the pre- and post-evolution population, the equation can be rewritten as:

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

6 Sometimes the selection effect may be strong even if the correlation between the firms' initial productivity and its growth is low under the condition of high productivity variance.

And by adding the role of the firms' entry and exit, Price equation could be rewritten as following:

$$\Delta Z = \underbrace{\sum_{i \epsilon C} \Delta s_i (z - Z)}_{\text{Selection effect}} + \underbrace{\sum_{i \epsilon C} s'_i \Delta z}_{\text{Innovation effect}} + \underbrace{\sum_{i \epsilon N} s'_i (z'_i - Z)}_{\text{Entry effect}} - \underbrace{\sum_{i \epsilon X} s_i (z_i - Z)}_{\text{Exit effect}} \quad (3)$$

The third and the fourth terms on the right hand of Price equation denote the entry and the exit effects respectively. The two terms are often merged as the net entry effect. The entry effect impacts the aggregate labor productivity growth positively (negatively) when the entrants' labor productivity is higher (lower) than the firms' average productivity in the pre-evolution population. The exit effect impacts the aggregate labor productivity growth positively (negatively) when the exiters' labor productivity is lower (higher) than the firms' average productivity in the pre-evolution population. Equation (3) provides the scale to classify the industries according to Schumpeterian mark I and mark II models of competition. Put it differently, whereas Schumpeterian Mark I industries are characterized by strong entry effect, Schumpeterian Mark II industries are characterized by strong innovation one. With this respect, strong selection accompanying with increase in market shares develop industries from Mark I configuration to Mark II one by replacing the old routines by entrepreneurial ones. The evolution back to Mark I occurs by investment in industries' fundamentals (Nelson & Winter, 2002). On the other hand, Equation (3) provides the ability to determine the intensity of competition between firms. Put it differently, the high selection and exit levels refer to strong competition process between firms because of the scarcity of sources and vice versa. That indicates that firms are generally compatible with the Schumpeterian mark I and mark II models of competition in several markets simultaneously and have a different set of competitors in each market as explored by Metcalfe & Ramlogan (2006) and Metcalfe (1997). Table (2) in the appendix reports the results of decomposing the labor productivity evolution of (23) Turkish manufacturing industries during the period of (2010-2015). All the effects in table (2) are reported as shares of the total change in labor productivity. The evolution of labor productivity is positive in all industries except for beverages and furniture industries. Accordingly, the negative effects in these industries are reported as positive shares. For example, the entry effect accounts for 265% of the labor productivity evolution in the furniture industry; but that doesn't mean that there is a strong positive entry effect. Actually, the entry effect contributes negatively to the labor productivity change in the furniture industry means that the firms that enter furniture industry have lower productivity than the average labor productivity of the population (The entry effect=-297.13 so $\frac{-297.13}{-112.19} = +2.65$)). Similarly, the rest effects contribute positively to the labor productivity evolution in the furniture industry. The selection effect is quite low in furniture industry. The negative change in labor productivity in beverages industry is caused by the negative contributions of the four effects. No specific effect can be isolated to dominate the labor productivity change in Printing and Reproduction of Recorded Media industry: about %34 of productivity evolution is caused by the innovation effect, %15 of it is caused by the entry effect, while %12 is caused by the selection effect. Although that 60% of labor productivity evolution is produced by the entry of highly

productive firms in Chemicals and Chemical Products industries, it cannot be said that this industry follows Schumpeter's Mark I model of competition for the reason that there is a high positive contribution of the innovation effect to the labor productivity evolution in this industry about %156; but what we can say is that there is a balance between Schumpeterian Mark I and Mark II models of competition in Chemicals and Chemical Products industries. It is noteworthy that the entry effect in the remaining industries is either negative or trivial. Put it differently, we can label the majority of Turkish manufacturing industries during the period of (2010-2015) as Mark II populations. There is a strong selection effect in the industries of food products, wood and of products of wood and cork, except furniture; articles of straw and plaiting materials and rubber and plastic products. But the selection effect is weak in the remaining industries the matter that can be interpreted in two ways. The first interpretation maybe that the firms in two-digit industries don't compete with each other. The second interpretation maybe that the labor productivity is not enough measure of competitive advantage in those industries (Holm, 2009). The exit effect is generally positive means that the firms exiting the market have labor productivity lower than the average labor productivity of the population the matter that affects the labor productivity evolution positively. The data of the Turkish manufacturing industries show that the entry and the exit effect of some entrants and exiters stem from reclassifying them rather than entrepreneurial entry and terminal exit. When classifying the sectors as high-, medium- and low-technology based on NACE Rev. 2 2-digit level; we found that the innovation effect accounts for the majority of the aggregate labor productivity growth in the Turkish manufacturing industries. Table (1) shows the evolution of labor productivity (Δz) during the period of (2010-2015) in terms of industries by technological intensity.

Table 1: Evolution of labor productivity (ΔZ) during the period of (2010-2015) in terms of industries by technological intensity

Technological intensity	selection effect	Innovation effect	Exit effect	Entry effect	ΔZ
High-technology	-124,57	949,81	-314,65	283,73	794,32
%	-16%	120%	-40%	36%	
Medium-high-technology	-212,03	1870,86	134,62	-9,43	1784,03
%	-12%	105%	8%	-1%	
Medium-low-technology	-78,55	1601,60	794,97	-804,65	1513,38
%	-5%	106%	53%	-53%	
Low-technology	672,66	1299,22	1992,34	-1954,75	2009,48
%	33%	65%	99%	-97%	
Total	257,52	5721,49	2607,30	-2485,10	6101,20

During the period (2010-2015), the innovation and the entry effect were the basic source of the aggregate labor productivity growth in the high-technology industries. In the medium-high- and medium-low-technology industries, the innovation effect accounts for the majority of the aggregate labor productivity evolution with positive exit effect. The low-technology industries expand the economic activities and increase the labor productivity as a whole. In these industries, except for the entry effect, the rest elements contribute positively to the aggregate labor productivity evolution. Such results provide an evidence for the claim that almost the majority of manufacturing industries follow Schumpeter's Mark II model of competition with relatively weak Mark I dynamics in general. It is important to figure out that the aggregated two-digit industries may contain

heterogeneous firms that do not have similar labor demands and as a result do not compete with each other directly; but further disaggregation should result in more homogeneous firms, which may compete with each other because they have more similar labor demands.

Conclusion

The rapid growth of the manufacturing sector's labor productivity more than the rest economy provides a strong evidence of the premature deindustrialization in the Turkish manufacturing industries during the period of (2010-2017). The deindustrialization is a part of Schumpeterian 'creative destruction' process in which the more productive firms survive but the less productive ones is forced either to improve their productivity or to exit the market. During the period from 2010 to 2015, the annual average labor productivity growth was positive. The main purpose of this paper is estimating the key sources of the aggregate labor productivity evolution during the period (2010-2015) in the Turkish manufacturing industries at disaggregate level and intertwining these sources with the Schumpeterian mechanisms of competition.

The empirical analysis indicates that the innovation effect accounts for the majority of the aggregate labor productivity evolution. In other words, the Schumpeterian Mark II model of competition characterizes the two-digit Turkish manufacturing industries during the period of (2010-2015) due to the innovative technological processes which had been achieved by implementing R&D activities which stimulate the labor productivity growth in those sectors. The interpretation for such result maybe that the Turkish economy get more integrated with the global economy during this period. However, Turkey's manufacturing industries don't expand efficiently and competitively enough. The fierce competition resulted from trade liberalization forced low productivity manufacturing firms to exit the market and only the firms with high productivity could survive. Labor released from these exiting firms usually reallocate to either low productivity service or informal sectors of the economy the matter that resulted in many case studies with growth reducing structural change (Rodrik, 2010). This can be translated by the negative selection effect during the studied period such in the industry of tobacco products (12); coke and refined petroleum products (19); chemicals and chemical products (20); basic pharmaceutical products and pharmaceutical preparations (21); basic metals (24); electrical equipment (27); motor vehicles, trailers and semi-trailers (29) and the industry of furniture (31).

As a result, a comprehensive upgrading of the business environment should be implemented in order to enable all firms achieve higher levels of productivity gains by improving the ineffective regulations and supporting the strategies of innovation incentives such as increasing the expenditure on R&D activities. Furthermore, a coherent strategy of flexicurity should be enhanced in order to make adjustment in the labor market associated with protecting those influenced by structural change. Faster productivity evolution necessities improving the quality of Turkey's human capital by the supportive education policies and the research and development activities. Additionally, developing the management skills and the productivity-boosting know-how practices in order to enable increasing productivity gains "within" and "between" firms in the shorter term.

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Appendix

Table 1: Two digit Turkish manufacturing industries

Two digit classification	Description
	Manufacture of…
10	Food Products
11	Beverages
12	Tobacco Products
13	Textiles
14	Wearing Apparel
15	Leather And Related Products
16	Wood And Of Products Of Wood And Cork, Except Furniture; Articles Of Straw And Plaiting Materials
17	Paper And Paper Products
18	Printing And Reproduction Of Recorded Media
19	Coke And Refined Petroleum Products
20	Chemicals And Chemical Products
21	Basic Pharmaceutical Products And Pharmaceutical Preparations
22	Rubber And Plastic Products
23	Other Non-Metallic Mineral Products
24	Basic Metals
25	Fabricated Metal Products, Except Machinery And Equipment
26	Computer, Electronic And Optical Products
27	Electrical Equipment
28	Machinery and Equipment N.E.C.
29	Motor Vehicles, Trailers And Semi-Trailers
30	Other Transport Equipment
31	Furniture
32	Other Manufacturing

Table 2: Evolution of productivity (ΔZ) during the period of (2010-2015) weighted by employment

Industry	Selection Effect	Innovation Effect	Exit Effect	Entry Effect	ΔZ
10	0,65	0,54	0,97	-1,17	314,58
11	0,46	0,40	0,02	0,12	-90,07
12	-7,15	-0,10	8,29	-0,05	9,93
13	0,25	0,64	0,49	-0,38	807,94
14	0,34	0,70	1,27	-1,32	639,21
15	0,42	0,87	1,38	-1,66	48,41
16	5,53	-1,43	8,73	-11,83	5,37
17	0,47	0,40	0,23	-0,10	178,85
18	0,12	0,34	0,40	0,15	137,51
19	-0,28	1,23	0,06	-0,01	141,52
20	-0,11	0,93	0,07	0,10	410,13
21	-0,42	1,56	-0,74	0,60	398,81
22	0,59	0,53	1,02	-1,13	142,81
23	0,08	0,97	0,59	-0,64	378,48
24	-0,42	1,34	0,26	-0,17	405,12
25	0,05	1,00	0,69	-0,74	445,44
26	0,11	0,83	-0,05	0,11	395,51
27	-1,16	1,81	0,85	-0,49	91,40
28	0,13	0,91	0,15	-0,19	512,47
29	-0,42	1,20	0,05	0,17	332,41
30	0,03	1,05	-0,15	0,07	437,62
31	-0,02	-0,14	-1,49	2,65	-112,19
32	0,13	0,44	0,28	0,15	69,94

Table (3): Detailed information about the distribution of firms over 4-digit manufacturing industries

Nace	2010	2015	Nace	2010	2015	Nace	2010	2015	Nace	2010	2015	Nace	2010	2015	Nace	2010	2015
1011	84	126	**1411**	192	160	**2051**	16	18	**2434**	38	67	**2731**	25	26	**3101**	286	503
1012	43	58	**1412**	94	134	**2052**	88	82	**2441**	1	3	**2732**	120	164	**3102**	271	389
1013	89	106	**1413**	1989	3032	**2053**	26	33	**2442**	170	279	**2733**	85	147	**3103**	99	145
1020	55	71	**1414**	1397	1655	**2059**	95	114	**2443**	33	35	**2740**	314	432	**3109**	1060	1370
1031	21	24	**1419**	241	362	**2060**	4	6	**2444**	57	107	**2751**	150	208	**3211**	2	2
1032	67	90	**1420**	61	110	**2120**	179	231	**2445**	8	7	**2752**	141	190	**3212**	240	360
1039	419	497	**1431**	202	214	**2211**	78	77	**2451**	185	252	**2790**	63	121	**3213**	39	58
1041	154	186	**1439**	306	279	**2219**	261	351	**2452**	91	106	**2811**	35	105	**3220**	45	69
1042	4	5	**1511**	253	280	**2221**	326	415	**2453**	101	135	**2812**	56	107	**3230**	35	65
1051	294	363	**1512**	134	205	**2222**	455	528	**2454**	24	57	**2813**	116	142	**3240**	63	110
1052	53	55	**1520**	461	717	**2223**	589	724	**2511**	594	725	**2814**	149	166	**3250**	237	372
1061	365	368	**1610**	177	190	**2229**	367	503	**2512**	687	820	**2815**	83	124	**3291**	74	87
1062	12	17	**1621**	114	166	**2311**	1	3	**2521**	138	163	**2821**	105	139	**3299**	140	168
1071	979	1334	**1622**	51	35	**2312**	158	225	**2529**	107	160	**2822**	236	360			
1072	134	144	**1623**	339	446	**2313**	84	90	**2530**	33	71	**2823**	10	20			
1073	33	50	**1624**	153	218	**2314**	7	10	**2540**	80	115	**2824**	2	2			
1081	69	8	**1629**	72	88	**2319**	56	46	**2550**	116	190	**2825**	225	277			
1082	180	250	**1712**	86	108	**2320**	27	38	**2561**	197	325	**2829**	190	326			
1083	89	103	**1721**	302	434	**2331**	40	87	**2562**	298	645	**2830**	177	265			
1084	74	118	**1722**	119	211	**2332**	293	317	**2571**	55	86	**2841**	124	208			
1085	3	39	**1723**	79	96	**2341**	70	93	**2572**	117	194	**2849**	62	100			
1086	18	27	**1724**	6	8	**2342**	44	61	**2573**	236	312	**2891**	43	91			
1089	56	80	**1729**	132	204	**2343**	8	17	**2591**	47	116	**2892**	169	212			
1091	154	200	**1811**	242	90	**2349**	31	29	**2592**	67	76	**2893**	195	248			
1092	7	23	**1812**	556	701	**2351**	36	52	**2593**	164	213	**2894**	133	161			
1101	7	11	**1813**	44	42	**2352**	66	82	**2594**	114	154	**2895**	19	25			
1102	59	105	**1814**	88	80	**2361**	349	507	**2599**	362	482	**2896**	62	143			
1105	4	5	**1820**	6	3	**2362**	50	60	**2611**	53	81	**2899**	113	159			
1107	196	248	**1910**	9	5	**2363**	370	596	**2612**	37	102	**2910**	30	39			
1200	22	31	**1920**	122	169	**2364**	9	123	**2620**	20	24	**2920**	329	355			
1310	498	550	**2011**	5	12	**2365**	2	5	**2630**	55	90	**2931**	84	120			
1320	560	692	**2012**	35	45	**2369**	19	18	**2640**	19	49	**2932**	650	791			
1330	503	658	**2013**	59	61	**2370**	606	769	**2651**	90	170	**3011**	212	149			
1391	223	323	**2014**	30	46	**2391**	43	76	**2652**	8	12	**3012**	114	146			
1392	618	780	**2015**	56	102	**2399**	63	118	**2660**	11	16	**3020**	9	22			
1393	173	261	**2016**	65	111	**2410**	144	173	**2670**	8	11	**3030**	13	40			
1394	33	71	**2020**	37	70	**2420**	88	148	**2680**	19	24	**3040**	6	5			
1395	6	16	**2030**	190	224	**2431**	11	17	**2711**	141	190	**3091**	9	30			
1396	180	274	**2041**	154	186	**2432**	2	2	**2712**	222	343	**3092**	65	129			
1399	228	289	**2042**	113	157	**2433**	10	14	**2720**	41	61	**3099**	21	42			