ELIT
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Montenegrin Journal of Economics

Moalla, M. (2022), "Is there a Nexus between Micro and Macro Labor Productivity Evolution in the Turkish Manufacturing Industries?", *Montenegrin Journal of Economics*, Vol. 18, No. 1, pp. 139-149.

Is there a Nexus between Micro and Macro Labor Productivity Evolution in the Turkish Manufacturing Industries?

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ARTICLE INFO

Received February 10, 2021
Revised from March 12, 2021
Accepted April 12, 2021
Available online March 15, 2022

JEL classification:

J21, R11, 040, 012, 033, L16, L60

DOI: 10.14254/1800-5845/2022.18-1.11

Keywords:

Economic selection,
aggregate productivity growth,
manufacturing sector,
within growth,
structural change,
firm level

ABSTRACT

In this work, the overall labor productivity evolution in the Turkish manufacturing industries for the period from 2010 to 2015 has been explored. The scaled sum of the within, between and covariance effects reflects the growth rate of labor productivity at the two-digit level. The study employed Baily et al. (1996) decomposition technique which operates on two stages. The first one employed the data of two-digit industries to quantify the impacts of between- and covariance- evolution. The second one has been applied to the four-digit industries covering the weights of within-industry, between-industry and cross-industry covariance evolution to quantify the two-digit within-evolution. The sum of the between and covariance effects reflect the contribution of the selection effect. To achieve our goal, we utilized data compiled by TSI that classified according to NACE Rev.2; namely the firms' value-added, the total full-time equivalent employment and the industry classification. Additionally, we eliminated the effect of inflation by using the Producer Price Index (PPI) for the mentioned period. The labor productivity is estimated by calculating real value added and then divided by the number of labors. Our outcomes revealed that the overall productivity evolution (0.20%) during the studied period is responsive to the within growth effect (0,88) and the covariance effect (0,42), whereas the between effect is low (-0,30). The relationship between the productivity evolution and the selection effect seems to be more prominent at the two-digit level compared to the four-digit level. That means that the structural change plays, to some extent, a significant role in the evolution of aggregate productivity at the two-digit level when compared to its contribution at the four-digit level. The between (-0,05) and the covariance (-0,03) effects at the firm level are negligible.

INTRODUCTION

In an "*Inquiry into the Nature and Causes of the Wealth of Nations*" (1976), Adam Smith considers that the labor division contributes to changes in the economic sectors' structure and these changes are the key necessity enable reaching higher stages of evolution (Silva and Teixeira, 2008). Smith considers two distinct types of labor division. First: intra-firm division of labor and it is related to the subdivision of different processes by which a specific good is produced in a particular firm or plant; the limit of

which is restrained by the demand for output of a firm or a plant. An increase in demand for the industry expands the market shares of the existing firms and stimulating entering new firms leading to changes in the firms' structure and thus leads to decrease the products' cost and price.

The second type is known as the inter-firm division of labor and it is related to the specialization of firms in the same industry; the limit of which is restrained by the demand for the industry as a whole. In the case of inter-firm division of labor, lateral disintegration may diminish the unit costs. Whereas the first type copes with the equilibrium theory of a competitive industry, the second type copes with the disequilibrium behavior of firms (Negishi, 2000). The change in the structure of the sectors offers a reserve aggregate productivity's improvement through the labor transformation from the traditional sectors with low-labor productivity and low percentage of technological progress to the modern ones with higher-labor productivity and technological progress (Lewis, 1954).

The relationship between the structure's change and the productivity evolution had been confirmed by Kuznets (1971). The decomposition of the productivity evolution into the components of internal and external productivity growth has been somewhat a common tool for investigating the micro-dynamics of the macro-evolution over time. The internal sources of productivity growth indicate the intra-firm component that involves the adaptation as well as the creation of novelty. On the contrary, the external sources of productivity growth indicate the inter-firm or the intra-industry effect that includes the reallocation of resources from the low productive firms to the more productive ones and vice versa. Both of the external and the internal effects may contribute positively or negatively to the aggregate productivity growth according to their direction and velocity. Whereas the internal stimulators of the aggregate productivity growth are driven by R&D activities and the workers' education; the external ones are influenced by the competition process stemmed from the technological progress by which the new innovations replace the old routines.

1. LITERATURE REVIEW

Several studies have examined the nexus between micro- and macro- productivity evolution in developed countries but only few empirical studies have been conducted for developing countries. Baily et al. (1996) investigated the nexus between the employment shares' changes and the evolution of labor productivity utilizing the data of U.S. manufacturing sector's plants for the period 1977 to 1987. They found a positive correlation between the increasing employment and the increasing labor productivity. They ascribed the positive relationship to idiosyncratic factors despite of the striking heterogeneities across economic sectors (Baily, Bartelsman and Haltiwanger, 1996). Similar approach to that used by Baily et al. (1996) had been employed by Peneder (2003) and Fagerberg (2000). Fagerberg (2000) used the data of 24 manufacturing industries in 39 countries for the period 1973 to 1990. He found that the selecton component has no important impact on the overall productivity evolution.

Peneder (2003) employed the data of three-digit manufacturing industries in the European Union countries. He concluded that selection component has not impacted the overall labor productivity evolution much smaller. Krüger (2008) investigated the impact of the external and internal sources on the aggregate labor productivity evolution. The data of more 450 four-digit manufacturing industries at the for period 1958 to 1996 mirrored the important contribution of the internal productivity evolution in the single industries to the overall labor productivity evolution. Disney et al. (2003) documented that about 50% of labor productivity- and 90% of total factor productivity evolution stems from the external restructuring impact due to the entry of more productive multi-establishment firms and the exit of less productive ones. Moreover, a competitive pressure on the existing establishment may be generated due to the external restructuring leading to increase their productivity (Disney, Haske and Heden, 2003).

Cantner and Kruger (2008) ascribed the evolution of the aggregate labor productivity, before the German reunification, to firms' within-growth accompanying above-mean productivity entrants and below-mean productivity exiters. Since the German reunification, the structural change played significant role to enhance labor productivity evolution due to the success-breeds-success dynamics combined with sufficient technological advancements (Cantner and Kruger, 2008). Bottazzi et.al. (2010) investi-

gated how the productivity and profitability affect economic growth using Italian and French industrial firms' panel data. The outcomes indicated a weak relationship between the selection effect and the economic growth. Holm (2014) employed Price equation for Denmark from 1992 to 2010 to examine the industrial dynamics of the aggregate labor productivity growth. The study showed that the economic selection affects considerably the productivity growth. This result exhibits a correlation between the firms' pre-evolution and its growth during the studied interval. Anderson and Holm (2014) emphasize the necessity to examine the types of economic selection which are: the directional, the stabilizing and the diversifying selection; to determine the clues of change in the economic evolution. Andersen (2004) introduced Price equation as an evometric tool to analyze the economic change overtime. Akkemik (2006) employed the shift-share method utilized by Timmer and Szirmai (2000) assess the nexus between the selection component and the overall productivity evolution in 19 Turkish manufacturing industries. He found that selection component affects the overall productivity evolution positively during the inward oriented era (till 1980).

However, in the post-1980 known as the outward oriented era, the structural change affects the aggregate productivity evolution negatively. Celasun (1983) revealed that the positive contribution of the structural changes in the inward oriented era stemmed from the considerable structural changes that decrease the share of primary production, increase the capital accumulation and primary schooling. Tuncer and Moalla (2020a) and Moalla (2020) confirmed that there was an adverse structural change during the period from 2003 to 2017. Tuncer and Moalla (2020b) ascribed the adverse structural change to the rigidities in the labor markets, the micro and the non-selective macro policies that lead to some sorts of resource misallocations. They ascribed the positive evolution of labor productivity (27.9%) during the period of (2010-2017) to the within-growth stemmed from R&D activities.

1.1 Decomposition of Labor Productivity Evolution

The early techniques decompose the aggregate labor productivity evolution into the within- and between-sector productivity evolution. The within-sector productivity growth (means the internal resources) has been derived from the neo-classical model in which the growth is based on accumulating the physical and human capital, and endogenizing technological change. Between-sector productivity growth (means the external resources) has been derived from the dual economy approach characterized by the labor reallocation across sectors that diverge in their labor productivity. Let's symbolize it. The overall labor productivity at time t is written as eaquation (1).

$$P^t = \sum_{i=1}^{n} \theta_i^t \, p_i^t \qquad (1)$$

Where, subscript *i* denotes the economic sectors *(i=1… n)*, P^t represents the total labor productivity in year *t*. represents the employment share of sector *i* in total employment at time *t*. denotes *i* sector's labor productivity at time *t*. Taking the evolution of overall labor productivity levels between *t* and *t– k (Δ P^t)* can be resulted in equation (2).

$$\Delta P^t = \sum_{i=1}^{n} \theta_i^{t-k} \Delta P_i^t + \sum_{i=1}^{n} \Delta \theta_i^t P_i^t \qquad (2)$$

Where, Δ operator shows the evolution of labor productivity level or employment shares between *t – k* and *t*. The first element in the right hand of equation (2) is the "within-sector" component. The second one is the "structural change" component. The within-growth labor has a positive impact on the overall labor productivity if the sectors are able to increase their labor productivity at time *t* comparing with those at time *t – k*. The contribution of the "between-growth" component to overall productivity growth will be positive if the sources (in this paper labor force) are reallocated from the low-productive sectors to the high-productive ones. Baily et al. (1996) proposed decomposing the aggregate labor productivity evolution as equation (3).

$$\frac{\Delta \bar{a}_{t+1}}{\bar{a}_t} = + \frac{\sum_{i=1}^{N} s_{it} \Delta a_{it+1}}{\bar{a}_t} (within - growth)$$
$$+ \frac{\sum_{i=1}^{N} \Delta s_{it+1} (a_{it} - \bar{a}_t)}{\bar{a}_t} (between - growth) \qquad (3)$$
$$+ \frac{\sum_{i=1}^{N} \Delta s_{it+1} \Delta a_{it+1}}{\bar{a}_t} (\mathrm{cov}\, ariance - effect)$$

Where, sit denotes i industry's employment share at time *t* and a_{it} symbolizes its labor productivity level. The first element on the right-hand side of the decomposition equation represents the within-productivity growth effect. It denotes the share-weighted average internal productivity evolution of the individual industries. The second element represents between-productivity evolution. It contributes positively to the aggregate labor productivity growth if the industries with above (below)-mean productivity levels are able to increase (decrease) their employment shares during the interval from *t* to *t + 1*. The third element represents covariance-type term. It contributes positively to overall labor productivity growth if the evolution of the industries' employment shares and the evolution of industries' productivity level have same trends.

With the availability of firm-level data, it becomes possible to take the role of firms' entry and exit into consideration. The most common methodology was that employed by Foster et al. (1998). Foster et.al. (1998) presented alternative decomposition methodologies such as those utilized by Baily, Hulten and Campbell (1992) on one hand and Griliches and Regev (1995) on the other hand. The first methodology utilized by Baily, Hulten, and Campbell (1992) is as equation (4).

$$\Delta P_{it} = + \sum_{e \in C} s_{et-1} \Delta P_{et} (within - growth)$$
$$+ \sum_{e \in C} (p_{et-1} - P_{it-1}) \Delta s_{et} (between - growth)$$
$$+ \sum_{e \in C} \Delta p_{et} \Delta s_{et} (\mathrm{cov}\, ariance - growth) \qquad (4)$$
$$+ \sum_{e \in N} s_{et} (p_{et} - P_{it-1}) (entry - effect)$$
$$- \sum_{e \in X} s_{et-1} (p_{et-1} - P_{it-1}) (exit - effect)$$

Where: P_{it} represents the industry productivity, set represents the e firm's share in industry *i*, and p_{et} represents the firm-level productivity. The first element in the right-hand of equation (4) symbolizes within productivity growth of continuing firms (C). It represents the within firms' productivity evolution weighted by initial employment shares in the industry. It has a positive evolution trend if the C firms are able to increase their labor productivity during the period from *t-1* to *t*. The second element symbolizes between productivity evolution of the continuing firms. It represents the deviation of initial productivity of firm from the initial industry's productivity weighted by employment shares' evolution. It reacts positively to the overall labor productivity if the firms that have initial productivity above (below) the mean productivity of the industry in the pre-evolution population are able to increase (decrease) their employment shares during the period from *t-1* to *t*.

The third element on the right hand of equation (4) represents covariance evolution of the continuing firms. It demonstrates a positive impact on the overall productivity growth if the firms are able to increase (decrease) their labor productivity concurrently with increasing (decreasing) their employment shares during the period from *t-1* to *t*. The fourth element represents entry impact of the entrants (N). It denotes the deviation of firm's productivity at time *t* from initial industry's productivity leaden by the firms' employment shares at time *t-1*. It positively affects overall labor productivity evolution if the entrants' labor productivity at time *t* is above the industry's labor productivity at time *t-1*. The fifth element represents exit impact of the exiters (X). It denotes the deviation of firm's productivity at time *t-1* from initial industry's productivity leaden by the firms' employment shares at time *t-1*.

A positive impact on the overall productivity evolution can be predicted only if the firm's productivity at time *t-1* is lower than the industry's productivity at time *t-1*. Another method represented by Foster et al. (1998) is the one that had been employed by Griliches and Regev (1995) as equation (5).

$$\begin{aligned}\Delta P_{it} &= +\sum_{e\in C} \bar{s}_e \Delta P_{et}(within-growth)\\ &+\sum_{e\in C}(\bar{p}_e-\bar{P}_i)\Delta s_{et}(between-growth)\\ &+\sum_{e\in N} s_{et}(p_{et}-\bar{P}_i)(entry-effect)\\ &-\sum_{e\in X} s_{et-1}(p_{et-1}-\bar{P}_i)(exit-effect)\end{aligned} \quad (5)$$

where the (-) over the icon means its mean over the initial and post years. The first element on the right hand of equation (5) represents the within-evolution of continuing firms (C). It denotes the leaden sum of productivity with the weights equal to the mean shares. The second element represents between-evolution of the continuing firms (C). It denotes the deviations of the mean firm level productivity from the mean overall industry level productivity weighted by the changing employment shares at time t. The third element represents entry impact of the entrants. It denotes the deviations of the entering firm's productivity from the mean overall industry level productivity weighted by the employment shares at time t. It will contribute positively to the overall labor productivity evolution only if the entrants' productivity is higher than the industry's average one. The fourth element represents exit impact of the exiters. It denotes the deviations of the exiting firm's productivity from the mean overall industry level productivity weighted by the employment shares at time t-1. It demonstrates a positive influence on the overall productivity evolution only if the exiters' productivity is lower than the industry's average one. It seems that the methodology that had been employed by Baily, Hulten and Campbell (1992) is more sensitive to outputs or inputs' measurement error comparing to the methodology that had been employed by Griliches and Regev (1995).

2. DATA AND METHODOLOGY

The data compiled by Turkish Statistical Institute (TSI) that classified according to NACE Rev.2 at four-digit level is employed in the empirical research. The number of total firms during the period of (2010-2015) is 59214. Because that it is not allowed to report any information that defines specific firm, we aggregate the data in 23 two-digit industries and 213 four-digit ones. The preliminary information about the manufacturing industries' two-digit codes and the description of the industries are shown in table (1) in the appendix. Table (2) in the appendix shows the number of the firms during the studied interval in details. Three variables from the database is utilized, namely industry classification, total value added and total full-time equivalent employment.

Additionally, the effect of inflation is eliminated by using the Producer Price Index (PPI). The size of the firm means its employment share (si) is measured by dividing the number of firm's workers on the total one. The labor productivity (ai) is measured by dividing the firm's real value added on their full-time equivalent workers. In this work, the evolution of productivity had been decomposed from input weights perspective by utilizing Baily et al. (1996) decomposition technique. This methodology operates on two stages. The first one employed the data of two-digit industries to quantify the impacts of between- and covariance- evolution.

The second one has been applied to the four-digit industries covering the weights of within-industry, between-industry and cross-industry covariance evolution to quantify the two-digit within-evolution. The sum of the between and covariance effects reflect the contribution of the selection effect. In the light of the foregoing considerations, the overall labor productivity evolution can be splitted as equation (6).

$$\frac{\Delta\bar{a}_{t+1}}{\bar{a}_t}(\mathrm{Pr}oductivity-growth)=$$

$$\left[\begin{array}{l}\dfrac{\sum_{j=1}^{n}\Delta s_{jt+1}(\bar{a}_{jt}-\bar{a}_t)}{\bar{a}_t}(Between-growth)+\\ \dfrac{\sum_{j=1}^{n}\Delta s_{jt+1}\Delta\bar{a}_{jt+1}}{\bar{a}_t}(Co\,\mathrm{var}\,iance-growth)+\end{array}\right]2digit$$

$$\left[\begin{array}{l}\dfrac{\sum_{j=1}^{n}s_{jt}\sum_{j=1}^{nj}s_{it}^{j}\Delta a_{ijt+1}}{\bar{a}_t}(Within-industry(4-digit))+\\ \dfrac{\sum_{j=1}^{n}s_{jt}\sum_{j=1}^{nj}\Delta s_{it+1}^{j}(a_{ijt}-\bar{a}_{jt})}{\bar{a}_t}(Between-industry(4-digit))+\\ \dfrac{\sum_{j=1}^{n}s_{jt}\sum_{j=1}^{nj}\Delta s_{it+1}^{j}\Delta a_{ijt+1}}{\bar{a}_t}(Cross-industry(4-digit))\end{array}\right]\left[2digit(within-growth)\right] \quad (6)$$

where, s_{ijt} symbolizes the share that four-digit industry $i \in \{1, ..., nj\}$ has in inclusive employment; pertaining to the two-digit major group $j \in \{1, ..., n\}$ at time t. This can be reshaped as the product 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} so that $s_{ijt} = s_{jt} \cdot s_{it}^{j}$. Harmoniously, a_{ijt} symbolizes the productivity level of the four-digit industry i pertaining to the two-digit major group j in period t. Then $\bar{a}_{jt} = \sum_{i=1}^{nj} s_{it}^{j} a_{ijt}$ is the (share-weighted) mean productivity level of the two-digit major group j and $\bar{a}_t = \sum_{i=1}^{nj} s_{it}^{j} a_{ijt} = \sum_{j=1}^{n}\sum_{i=1}^{nj} s_{ijt} a_{ijt}$ denotes manufacturing sector's total productivity at time t. The first ingredient on the right-hand of equation (6) represents between ingredient for the two-digit level. The second element represents covariance ingredient for two-digit level. The sum of the remaining three terms represents the within ingredient for the two-digit level. The within ingredient at the two-digit level consists of the within-, between- and cross-industry covariance ingredient at the four-digit industries.

3. RESULTS AND DISCUSSION

The picture can be drawn about the structure of the manufacturing industries sector during the studied interval is that the majority of the firms in it has low labor productivity and this productivity decreases more concurrently with the increase in employment shares. Figure (1) depicts the density of the firms in 2010 and 2015 based on Kernel density estimator. Equation (7) is employed to calculate the density values:

$$f(x,y,vX,vY,w_x,w_y)=\frac{1}{n}\sum_{i=1}^{n}\frac{1}{2\prod w_x w_y}\exp\left(-\frac{(x-vX_i)^2}{2w_x^{\,2}}-\frac{(y-vY_i)^2}{2w_y^{\,2}}\right. \quad (7)$$

Where n is the number of subindustries in vector vX (employment shares) or vY (labor productivity), Wx and Wy denotes the values of optimal bandwidths which had been calculated based on linear diffusion process; and vXi and vYi denotes the employment share and the labor productivity respectively.

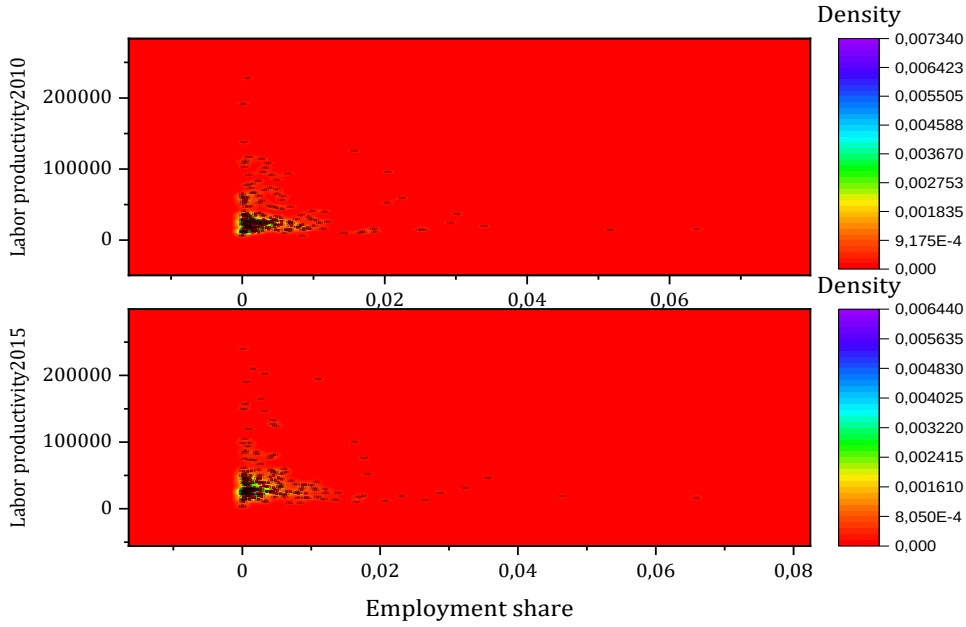

Figure1. Firms' density during (2010-2015) achieved by bivariate Kernel density estimator

However, the data show that 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 ingredient 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 (2010-2015) are accounted for the firms of manufacture of tobacco products (1200) and precious metals production (2441). However, the lowest variances are accounted for the firms of manufacture of manufacture of fruit and vegetable juice (1032) and the firms of manufacture of electric domestic appliances (2751). Figure (2) depicts the correlation between (end year) labor productivity and changes in employment shares in the four-digit Turkish manufacturing industries during the period from 2010 to 2015.

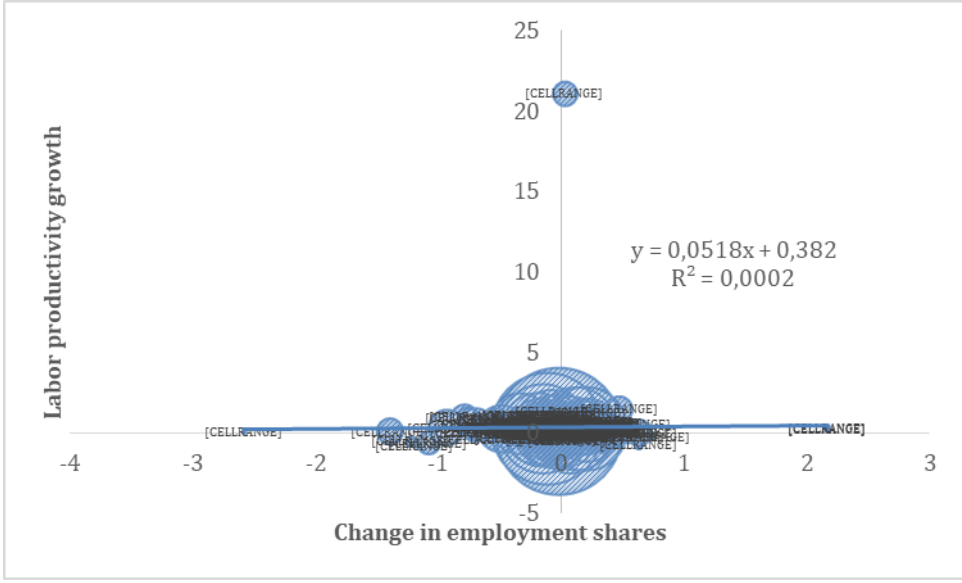

Figure 2. Correlation between labor productivity growth and changes in employment shares in the four-digit Turkish Manufacturing Industries (2010-2015). Note: Size of circles represents employment shares in 2010.

The correlation between the labor productivity growth and employment shares' evolution at four-digit level is positive and the regression line has a positive slope (Pearson corr.=0.015 and p-value= 0.83). That means that the selection effect impacts the aggregate labor growth positively during the period of (2010-2015). Some other studies such as ones by Rodrik (2010) and Atiyas and Bakış (2013) at the more aggregated level of industry classification reported a positive selection effect especially for the 1990s and initial years of 2000s. However, Tuncer and Moalla (2020b) found a negative selection effect bring some drag on the aggregate labor productivity evolution of at least the non-farm total value added and employment growth between 2003 and 2017.

We divided the firms into four groups: successful upsizers, successful downsizers, unsuccessful downsizers and unsuccessful upsizers. The successful upsizers increased their employment shares from about 33% in 2010 to about 39% in 2015. The successful downsizers decreased their employment shares from about 55% in 2010 to about 48% in 2015. The unsuccessful downsizers kept (in total) their employment shares around 5%. The unsuccessful upsizers kept (in total) their employment shares around 7% during the period from 2010 to 2015. The highest labor productivity growth during the studied interval had been achieved by the firms in the industry of perfumes and toilet preparations (2042) and the firms in the industry of household and sanitary goods and of toilet requisites (1722).

Those two industries increased their employment shares during the studied period. The number of firms in the industry of perfumes and toilet preparations increased from 113 in (2010) to 157 in (2015). Those firms increased their labor productivity in 2015 up to more than 22 times comparing with their productivities in 2010. The number of firms in the industry of household and sanitary goods and of toilet requisites increased from 119 in (2010) to 211 in (2015). Those firms increased their labor productivity in 2015 up to about 2.5 times comparing with their productivities in 2010. The firms in the wallpaper achieved high labor productivity growth despite decreasing their employment shares during the studied period. In general, the average labor productivity in 2011 was about (29879,03) and the average one in 2015 was (35978,60).

In 2011, the employment shares of the firms those had labor productivity above the average one in 2011 were about 28% of total employment. In 2015, the employment shares of the firms those had labor productivity above the average one in 2015 were close to 32% of total employment in the Turkish manufacturing industries. The results show that the overall productivity evolution (0.20%) for the period from 2010 to 2015. At four-digit level, the main source of the overall labor productivity evolution is within growth effect (0.96).

The positive within growth effect at four-digit level means that the firms were able to increase their labor productivity during the studied interval. However, the effect of the structural change (-0.08) brings a drag on the aggregate labor productivity evolution. The negative structural change contribution at four-digit level is stemmed from the negative between-growth effect (-0.05) and the negative cross-growth effect (-0.03).

The negative between-growth effect at four-digit level means that the firms were not able to increase their labor productivity more than the average labor productivity of the industry that includes it concurrently with increasing their relative sizes and vice versa. The negative cross growth effect means that firms were not able to increase their labor productivities concurrently with increasing their employment shares and vice versa. At two digit-level, the key source of the aggregate labor growth is the within growth effect (0.88). Furthermore, a positive contribution (0,42) is accounted for the covariance at two-digit-level. This positive covariance growth effect means that the industries increased their labor productivities incomitant with increasing their employment shares and vice versa. However, a negative contribution is accounted for the between effect (-0,30).

The negative between growth effect at the two-digit level means that the industries couldn't increase their labor productivity above the average overall labor productivity concurrently with increasing their relative sizes and vice versa. At two-digit level, a positive contribution (0.12) is accounted for the structural change effect. The relationship between the productivity evolution and the selection component seems to be more prominent at the two-digit level when *compared* to its contribution at the four-digit level. Moreover, the within effect at the two-digit level is more controlling than it is at the four-digit level and between-industry ingredient is again trivial.

CONCLUSION

The main intention of this paper is to define the connection between the micro and macro aggregate labor productivity evolution in the Turkish manufacturing industries during the period from 2010 to 2015. The results revealed that either at the two-digit or the four-digit level, the internal sources that may be triggered by the productivity improvements within the firms that constitute the industry or within single industries those constitute the sector have the largest share in the aggregate labor productivity growth. The interpretation for such finding maybe the integration with the global economy during the studied interval. This result comes in line with several studies such as Tuncer and Moalla (2020a), Tuncer and Moalla (2020b) and Moalla (2020). At the same time, this paper documented mixed results about the nexus between the structural change and the aggregate labor productivity evolution. At two-digit level, a positive but insignificant influence of the structural change on the overall labor productivity evolution, while at four-digit level we found a negative impact of the selection component on the overall labor productivity evolution. In both cases, we concluded that the Turkish manufacturing industries don't expand efficiently and competitively enough (Moalla, 2020). Therefore, it is necessary to implement selective policies such as supporting R&D activities and improving the ineffective regulations to enable all firms increasing their productivity gains.

BIBLIOGRAPHY

Akkemik, K. (2006), "Patterns of industrialisation, structural changes and productivity in Turkish manufacturing (1970- 2000)", *Journal of Economic Cooperation*, Vol. 27, No. 1, pp. 71-88.

Andersen, E.S. (2004), "Population thinking, Price's equation and the analysis of economic evolution", *Evolutionary and Institutional Economics Review*, Vol. 1, No. 1, pp. 127–148.

Andersen E.S., Holm, J. R. (2014), "The signs of change in economic evolution: An analysis of directional, stabilizing and diversifying selection based on Price's equation", *Journal of Evolutionary Economics*, Vol. 24, No. 2:291–316.

Atiyas, İ., Bakis, O. (2013), "Structural Change and Industrial Policy in Turkey", *REF Working Paper*, No. 2013-3, http://ref.sabanciuniv. edu/sites/ref.sabanciuniv.edu/files/str_ch_refwp.pdf.

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

Bottazzi, G., Dos, i. G., Jacoby, N., Secchi, A., Tamagni, F. (2010), "Corporate performance and market selection: Some comparative evidence", *Industrial and Corporate Change*, Vol. 19, No. 6, pp. 1953–1996.

Cantner, U., Kruger, J. (2008), "Micro-heterogeneity and aggregate productivity development in the German manufacturing sector", *Journal of Evolutionary Economics*, Vol. 18, No. 2, pp. 119–133.

Celasun, M. (1983), *Sources of Industrial Growth and Structural Change: The Case of Turkey*, The World Bank, Washington, D.C.

Disney, R., Haskel, J., Heden, Y. (2003), "Restructuring and productivity growth in UK manufacturing", *Economics Journal*, Vol. 113, No. 489, pp. 666–694.

Fagerberg, J. (2000), "Technological progress, structural change and productivity growth: a comparative study", *Structural Change and Economic Dynamics*, Vol. 11, pp. 393–411.

Foster, L., Haltiwanger, J., Krizan, C. J. (1998), "Aggregate productivity growth: Lessons from microeconomic evidence", *NBER Working Paper Series*, No. 6803.

Griliches, Z., Regev, H., (1995), "Firm productivity in Israeli industry 1979–1988", *Journal of Econometrics*, Vol. 65, No. 1, pp.175-203.

Holm, J. R. (2014), "The Significance of Structural Transformation to Productivity Growth", *Journal of Evolutionary Economics*, Vol. 24, pp. 1009–1036.

Kruger, J. (2008), "The sources of aggregate productivity growth: US manufacturing industries, 1958-1996", Bulletin of Economic Research, Vol. 60, No. 4, pp. 405–427.

Kuznets, S. (1971), *Economic Growth of Nations: Total Output and Production Structure*, Harvard University Press, Cambridge, MA.

Lewis, A. (1954), "Economic development with unlimited supplies of labor", *Manchester School of Economic and Social Studies*, Vol. 28, pp. 139–191.

Moalla, M. (2020), "Mechanısms 0f Schumpeterian Competitıon in Turkısh Manufacturıng Industries", *Mersin University Journal of Social Sciences Institute*, Vol. 4, No. 1, pp.121-135 (in Turkish).
Negishi, T. (2000), "Adam Smith's division of labor and structural changes", *Structural Change and Economic Dynamics*, Vol. 11, No. 1-2, pp. 5-11. doi: 10.1016/s0954-349x (99)00012-0
Peneder, M. (2003), "Industrial structure and aggregate growth", *Structural Change and Economic Dynamics*, Vol. 14, No. 4, pp. 427–448.
Rodrik, D. (2010), *Structural Transformation and Economic Development*, TEPAV, Ankara (in Turkish), https://www.tepav.org.tr/upload/files/12935384464.Yapisal_Donusum_ve_Iktisadi_Kalkinma.pdf
Silva, E., Teixeira, A. (2008), "Surveying structural change: seminal contributions and a bibliometric account", *Structural Change and Economic Dynamics,* Vol 19, pp. 273–300.
Smith, A. (1976), *An Inquiry into the Nature and Causes of the Wealth of Nations*, Oxford University Press, London.
Timmer, M., P., Szirmai, A. (2000), "Productivity growth in Asian manufacturing: the structural bonus hypothesis examined", *Structural Change and Economic Dynamics*, Vol. 11, pp. 371–392.
Tuncer, İ., Moalla, M., (2020a) "Structural Change and Growth Prospects in the Turkish Manufacturing Industry", *Bulletin of Economic Theory and Analysis*, Vol. 5, No. 1, pp.1-20.
Tuncer, İ., Moalla, M., (2020b), "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, No. 1, pp.155-173.

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. The number of the firms during the period from 2010 to 2015

	2010	2011	2012	2013	2014	2015
10	3456	3911	4202	4528	4236	4342
11	266	330	352	344	360	369
12	22	23	24	30	28	31
13	3022	3692	3681	4014	3856	3914
14	4482	6407	6240	6688	6181	5946
15	848	1009	1134	1237	1259	1202
16	906	932	1134	1212	1254	1143
17	724	857	913	965	1059	1061
18	936	1051	1101	1149	905	916
19	131	168	172	173	170	174
20	973	1110	1221	1278	1317	1267
21	179	179	189	228	212	231
22	2076	2378	2398	2637	2519	2598
23	2432	3094	3032	3334	3345	3422
24	963	1042	1113	1332	1276	1402
25	3412	4475	4715	4983	4642	4847
26	320	362	391	472	486	579
27	1302	1568	1697	1849	1834	1882
28	2304	2712	3148	3460	3365	3380
29	1093	1087	1170	1354	1346	1305
30	449	394	476	466	500	563
31	1716	2094	2298	2480	2408	2407
32	875	1103	1150	1359	1272	1291