Journal of Research in Economics • İktisat Araştırmaları Dergisi • Cilt: 5 / Issue • Sayı: 2 October • Ekim 2021 • ss/pp. 129-145
ISSN: 2636-8307 • DOI: http://dx.doi.org/10.29228/JORE.7

ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

WAGE INEQUALITY IN TURKISH MANUFACTURING INDUSTRY*

TÜRK İMALAT SANAYİDE ÜCRET EŞİTSİZLİĞİ

Altan BOZDOĞAN**

Abstract

Wage inequality is one of the most tempting field of labour economics. However, wage inequality studies, predominantly, remained limited to developed countries due to lack of data in developing countries. This study, using the Household Labour Force Surveys, aims at extending the time scope of previous researches conducted for the Turkish manufacturing sector, and adding new dimensions simultaneously in terms of skill and technology levels besides utilizing the conventional dimension of education level. From this point of view, an eclectic approach applied to sketch the general picture of male wage inequality from 2004 to 2015 in the manufacturing sector by employing a generalized entropy-based inequality index, that is to say, the Theil index, which enables us to look at within – and between-group inequalities as well. One of the pattern found in this study is that within-group wage inequalities alleviated while between-group wage inequalities deteriorated over time. There were also significant changes in the employment structure in favor of white-collars, medium low technology industries, and better-educated workers except for regular high schooling.

Keywords: Wage Inequality, Wage Structure, Manufacturing Industry
JEL Classification: J24, J31, L60

Öz

Ücret eşitsizliği, çalışma ekonomisinin en cezbedici alanlarından biridir. Ancak, ücret eşitsizliği çalışmaları, gelişmekte olan ülkelerdeki veri eksikliği nedeniyle, büyük bir çoğunlukla gelişmiş ülkelerle sınırlı kalmıştır. Bu çalışma, Hanehalkı İşgücü Anketlerini kullanarak, daha önce Türk imalat sanayi için yapılan çalışmaların zaman kapsamını genişletmeyi ve eğitim düzeyinin geleneksel boyutunu kullanmanın yanı sıra, eşzamanlı olarak beceri ve teknoloji düzeylerine göre yeni boyutlar eklemeyi amaçlamaktadır. Bu açıdan hareketle, genelleştirilmiş entropi esaslı bir endeksi, bir başka ifadeyle grup içi ve gruplar arası eşitsizliğe de bakmayı mümkün kılan Theil endeksi kullanarak 2004'ten 2015'e imalat sektöründeki erkek ücret eşitsizliğinin genel resmini çizmek için eklektik bir yaklaşım uygulanmıştır. Bu çalışmada bulunan yapılardan biri şudur, gruplar arası ücret eşitsizliği zamanla kötüleşirken, grup içi

* This paper was adapted from a part of Altan Bozdoğan's PhD dissertation submitted in February 2021 at Marmara University, Department of Economics.

** Marmara University, Faculty of Economics, E-mail: altan.bozdogan@marmara.edu.tr

Makale Gönderim Tarihi: 27.01.2021
Yayına Kabul Tarihi: 27.09.2021

ücret eşitsizliğinin hafiflemesidir. İstihdam yapısında da beyaz yakalıların, orta düşük teknoloji yoğun endüstriler ve düz lise eğitimi dışında daha iyi eğitimli işçilerin lehine önemli değişiklikler vardır.
Anahtar Kelimeler: Ücret Eşitsizliği, Ücret Yapısı, İmalat Sanayi
JEL Sınıflandırması: J24, J31, L60

1.Introduction

One of the evergreen topic in economics is inequality, in particular wealth, income and wage inequalities. The amount of studies on the wage inequality is quite abundant especially for developed countries. There are some fully-fledged literature reviews such as Aghion, Caroli and Garcia-Penalosa (1999), Hornstein, Krusell and Violante (2005), Chusseau, Dumont and Hellier (2008), and Förster and Tóth (2015) that enumerate factors causing to wage inequality. Technological change and its effects on the relative demand for skilled labour, principally skill-biased technical change, are generally taken as the main determinants of wage inequality besides of the characteristics of workers. A growing body of literature also exists that pays regard to the role of globalization, institutional changes, changes in the organizational structure of firms, outsourcing etc. Recent inequality trend is also attributed to the fiscal redistribution through taxes and transfers, changes in the wage distribution, job creation – job destruction levels of the industries (International Labour Office, 2016).

The goal of this study is to explore male wage inequality in Turkey between 2004 and 2015, using individual-level data on wages in the manufacturing sector. Looking at the relative position of the manufacturing sector in Turkey could give some traces of gross wage differential between sectors. The manufacturing sector share in gross domestic product (GDP) did not change from 2004 to 2015. In this period of time, it slightly decreased from 16.9% to 16.7%. Although real GDP growth on average was 5.31%, growth rate of manufacturing sector could not follow the overall tendency of the economy and had the growth rate of 5.11%. More importantly, gross wage-salaries in the manufacturing industry grew annually only 3.27% [3]. Additionally, manufacturing employment increased yearly at the rate of 1.89% while the total hours worked in the manufacturing sector expanded by 1.25%.

Despite the existence of wage studies focusing directly on the Turkish manufacturing sector such as Aksoy (2009), Dervişen (2011), Meschi, Taymaz and Vivarelli (2011), and Meschi, Taymaz and Vivarelli (2016), their time scope generally terminated at the beginning of 2000s. This study extends the time period and attempts to demonstrate the general structure of wage inequality at the micro-level from various perspectives. Theil index is used to calculate the inequality because it allows for a detailed inquiry by separating between-group and within-group components. Inequality decomposition for different categories of individuals assists to assess the relative

3 Real growth rates are calculated by adjusting the nominal data into real data using the CPI index (1994=100). Calendar adjusted gross wages-salaries index in the manufacturing industry is used to find the growth rate. The index is constructed for nominal gross wage-salaries and the Turkish Statistical Institute announced between 2005 and 2017. Therefore, the average growth of the index includes the period of 2005-2015.

contributors. The existing state and evolution of wage inequality are searched for education, skill, and technology levels. When considered from this point of view, this work is just a primary step into skill-biased technical change.

The remainder of this paper is structured as follows. Next section is devoted to reviewing pioneering empirical wage inequality researches conducted for Turkey. Introduction of data, identification of skill, technology, and education groups, and quantification of wage inequality are the topics of Section 3. Section 4 presents empirical findings for each group both in terms of inequality and employment shares. Last section briefly summarizes and discusses the results.

2. Empirical Literature Review

Even though wage inequality literature in Turkey and its interaction with the distinctive features of the labor market is quite voluminous, there is still enough room for maneuver to make inroads into new territories. Building a unified framework to examine wage inequality in every respect is tough, and, in general, studies focus on some specific sides. Influential studies of the wage inequality in Turkey, approaching from different perspectives, can be listed as follows.

Tansel (2005) captured the facet of the public and private wage differentials for males and females. 1994 Household Expenditure Survey used, and wages in the public sector were found higher than wages in the private sector. There was an exception for college graduates working in the public administration whose wages were not necessarily higher than their private-sector counterparts. The study also manifested significant discrimination against women, especially in the private sector. İlkkaracan, Levent and Polat (2013) derived wage curves for Turkey between 2005 and 2010, by constructing the relationship between real wage level and local unemployment rate with respect to three main educational categories. They found different elasticities for the lower and the upper end of the wage distribution using the Household Labour Force Survey.

Dervişen (2011) estimated the elasticity of substitution between the skilled and unskilled labour for the Turkish manufacturing sector over the period of 1992-2001. Because of lack of data, the skilled-unskilled difference was constructed according to production and administrative workers. Production and administrative workers were taken as skilled labour while unskilled labour was assumed as being paid minimum wage. Aksoy (2009) also used the production workers as unskilled labour while nonproduction employees as skilled to understand the demand for skilled labour in the Turkish manufacturing sector between 1995 and 2001 at the four-digit industry level. Furthermore, Meschi *et al.* (2011), using Annual Manufacturing Industry Statistics at the two-digit level, regarded aggregate cost share of production workers as the share of unskilled workers in the total wage bill, and the same procedure was applied for the administrative workers to find a proxy for the share of skilled workers in the total wage bill. Meschi *et al.* (2011) aimed at a comprehension of the relations between trade openness, technology adoption, and demand for skilled labour in the Turkish manufacturing sector and found pieces of evidence for skill-biased technical change hypothesis as well as skill-enhancing trade hypothesis through the agency

of system GMM for the period of 1980-2001. Meschi *et al.* (2016) borrowed the structure of Meschi *et al.* (2011) and slightly reviewed it for 1992-2001. The widening skill-unskilled wage gap resurfaced, and relative skill bias was found, according to Meschi *et al.* (2016: 657) "a change in technology (or trade) would be…a relative skill bias…when both the coefficients for both skilled and unskilled workers are positive and significant but differ in their magnitude, with the coefficients for the unskilled workers being significantly lower."

The gender wage gap is another strand in wage inequality and Kara (2006), İlkkaracan and Selim (2007), Aktaş and Uysal (2016), and Tekgüç, Eryar and Cindoğlu (2017) are the main Turkish examples. Aktaş and Uysal (2016), using quantile regression and the Machado-Mata decomposition for the 2006 Wage Structure Survey, found an unremarkable wage gap at the lower tail of the wage distribution and controlling for education increased the wage gap. The Oaxaca decomposition method was implemented by the other three studies. Turkish Household Expenditure and Income Survey was employed by Kara (2006) while İlkkaracan and Selim (2007) used the Employment and Wage Structure Survey and both were held for 1994, listing several factors for the gender wage gap. Tekgüç *et al.* (2017), using the Household Labour Force Survey from 1994 to 2011, ascertained that aggregated data made, especially the females, overqualified.

Tansel and Bodur (2012) used Household Income and Consumption Expenditure Survey for 1994 and Household Budget Survey for 2002 to estimate a Mincerian wage equation by the quantile regression to investigate male wage inequality. Education was found as a notable factor behind wage inequality, and over the period, between-group wage inequality alleviated whereas within-group inequality deteriorated. By the same token, wage inequality at the lower end of the wage distribution decreased, and an increase at the upper end was obtained. Thereafter, Daş and Doğruel (2017) adopted the similar structure of Tansel and Bodur (2012) and extended the period to 2002-2011. Daş and Doğruel (2017) drew an inference for an increase in the overall wage inequality.

Derivation of wage distributions and factors that shifted wage distributions were investigated by Bakış and Polat (2015), Bozdoğan (2021), and Pelek (2018) using a novel approach of constructing counterfactual wage distributions based on DiNardo, Fortin and Lemieux (1996). Bakış and Polat (2015) studied overall ($90^{th}/10^{th}$), lower ($50^{th}/10^{th}$) and upper tail ($90^{th}/50^{th}$) wage inequalities between 2002 and 2010, and attributed the reduction in lower and upper tail wage inequalities to the real minimum wage hike in 2004. Pelek (2018) ended up with the similar conclusion that the minimum wage rise of 2004 was the main determinant of wage inequality decline for 2003-2005. Bozdoğan (2021) tested the "skill-biased technical change" notion for the Turkish manufacturing sector, over the period of 2004 and 2015, and its impacts on the overall, lower and upper tail male wage inequalities. The analyses were conducted for both technology and skill fractions. The technology dimension was found to be more resistant to changes than the skill counterpart and a trade-off existed between initial wage level and wage inequality. Popli and Yılmaz (2017) also incorporated occupational features into their analyses as abstract, routine, and service for the years 2002 and 2010 using Household Labour Force Survey. They used Firpo, Fortin and Lemieux (2009) decomposition method and arrived at the conclusion of a decrease in both upper tail and lower

tail wage inequality. Education and experience were responsible for the decline in the lower tail inequality while returns to routine jobs paved the way for a decline in the upper tail inequality.

Elveren and Galbraith (2009) scrutinized pay inequality in sub-sectors of the Turkish manufacturing industry between 1980 and 2001 with the help of Annual Manufacturing Industry Statistics at two-digit ISIC categorization. Between-group pay inequalities were calculated via the Theil index. Sectors of wood, food, and textiles had lower wages than the average wage while sectors of chemicals, machinery and equipment, glass and pottery, metals, and paper had higher wages than the average wage in the manufacturing industry. The textile sector was seen as the main contributor to the inequality with respect to sub-sectors and the increasing size of the textile sector amplified its influence.

Filiztekin (2020) paid particular attention to income inequality using the Survey of Income and Living Conditions, and the Household Budget and Expenditure Survey for two separate periods: 2003-2007 and 2008-2015. Inequality was quantified by the Gini Index and three indices derived from the generalized entropy class. Those indices are mean logarithmic deviation, The Theil index, and half of the square of the coefficient of variation. The median wage converged to the 90th percentile income and diverged from the 10th percentile income for the first period. For the latter episode, the results reversed due to the increase in the university graduates with high incomes that became the leading factor of wage deterioration.

Kent and Sefil-Tansever (2021), using the Structure of Earnings Survey for 2006 and 2014, focused on the different parts of wage distribution to explore wage inequality in Turkey. They found an increase in overall and lower tail wage inequalities whereas wage inequality decreased at the upper tail. Kent and Sefil-Tansever (2021) also employed the quantile regression method to analyze the impacts of educational attainment on the male wage inequality along the wage distribution and remarkable education wage premia were obtained both in between and within groups. The supply and demand framework proposed by Katz and Murphy (1992) to explain rising wage inequality was adopted as well in a tentative way. Occupations were grouped into high skill white collar, high skill blue collar, low skill white collar, and low skill blue collar groups to reflect skill levels. They found shreds of evidence for over-education, in other words, recent university graduates employed in low skill white collar occupations. That led to a relative decline in the demand for skilled labour while the supply of it highly educated continued to grow, displaying the fall in wage inequality within the higher education category. Besides, the increase in the supply of skilled labour was attributed to the doubling of the number of universities during the period.

3. Data and Methodology

3.1. Data

Household Labour Force Survey, hereinafter referred to as HLFS, retrieved from the Turkish Statistical Institute (TurkStat), is used to reveal the panorama of male wage inequality in the Turkish

manufacturing industry for 2004 and 2015. Despite wage is not a direct and separate variable in the survey, "total net income from the main job in the past month" can be a measure for the wage when only "paid, salaried or casual workers" having a "regular job" are taken into consideration. Monthly net income also includes periodic bonuses and premiums, etc. and they cannot be decomposed from the data. The refinement process of the wage data is adopted from Tansel and Bodur (2012) and Bakış and Polat (2015). Full-time wage earners between the age of 15 and 65, reporting a positive income in the reference week are only kept while working hours less than 8 or more than 84 are dropped. Second job holders, self-employed, temporary, or unregular workers are removed. 1% of the data from the lower and upper tails of the wage distribution is also trimmed to get rid of outliers. The nominal hourly wage is estimated by dividing monthly nominal wage with monthly hours worked in the main job, which is obtained via multiplying reference week work hours with 4.33. Last but not least, the real hourly wage is constructed by deflating the nominal hourly wage by the Consumer Price Index of 2003 which is chosen as the base year. The reason for the selection of the years as 2004 and 2015 is due to mild changes in the minimum wages in that period.

3.2. Methodology

Instead of adopting a holistic approach, this article aims at probing into wage inequality with respect to different facets of the labour market such as skill and technology. In particular, skill dimension cannot be directly observable in the HLFS; thus, a proxy is obtained according to occupations and by doing so we implicitly treat occupation reflecting skill level. International Labour Office (2012: 11), hereinafter ILO, follows a similar logic by stating that "*skill level* is defined as a function of the complexity and range of tasks and duties to be performed in an occupation." ILO (2012) constructs a skill ranking as in Table 1. According to the skill level column in Table 1, "1" corresponds to unskilled workers having only primary education, while "2" stands for lower and upper secondary schooling including post-secondary schooling without tertiary education, categorized as semi-skilled labour. Skilled labour in broad manner classified with first stage tertiary education and second stage tertiary education, denoted by "3" and "4", respectively. In addition to the education-skill nexus, the occupation-collar distinction can be utilized as displayed in the third column. To avoid a debate as to whether white-blue collar or high-low skilled perspective captures a better representation of duality, we make use of quadruple refraction: high skilled white-collar (HSWC), high skilled blue-collar (HSBC), low skilled white-collar (LSWC), and low skilled blue-collar (LSBC).

Table 1: ISCO-08 Classification to Skill Specification

Occupations	Education Level	Skill Level
Managers	3+4	High Skilled White Collar
Professionals	4	
Technicians **and Associate Professionals**	3	

Skilled Agricultural, Forestry, and Fishery Workers	2	High Skilled Blue Collar
***Craft* and Related Trades Workers**	2	
***Clerical* Support Workers**	2	Low Skilled White Collar
***Services* and Sales Workers**	2	
***Plant* and Machine Operators and Assemblers**	2	Low Skilled Blue Collar
***Elementary* Occupations**	1	

Source: International Labour Office (2012)

Notes: Names of ISCO-08 occupations at one-digit are abbreviated in the rest of the tables for convenience concerns. Italic words are chosen to represent each occupation. There is only one exception for Skilled Agricultural, Forestry and Fishery Workers which is abbreviated as *Nature*.

Dumont (2006) also showed empirically that high-low skilled, white-blue collar, or quadruple groupings had no advantage over each other. HLFS reports two-digit occupation data in terms of ISCO classification; however, in 2012, HLFS started to employ the ISCO-08 structure rather than the ISCO-88. The correspondence between both structures does not match exactly; however, classification of a high skilled or white-collar occupation in 2004 as a low skilled or blue-collar in 2015 is still in line with the skill perspective approach, because we want to follow consistency in skill/collar rather than in occupations throughout the years. Furthermore, aggregation into the one-digit division could eliminate potential problems, because changes generally take place within groups rather than between groups, particularly in higher digit divisions.

The second aspect is the technology, and four basic technology intensity levels are designated according to NACE Rev. 2 at two-digit manufacturing industry classification. A similar revision in industry classification was launched in 2006 and TurkStat published HLFS until 2010 with both classifications of NACE Rev. 2 and NACE Rev.1.1. We used only the new version to bring in compliance with the post-2010 data. Industries that comprise high technology (HT), medium high technology (MHT), medium low technology (MLT), and low technology (LT) are listed in Table 2 below.

Although our ultimate objective is to make wage inequality apparent with regard to skill and technology levels, five educational categories are also identified. Those are below primary school (Below_PS), primary school (PS), regular high school (HSC), vocational high school (VHS), and college graduation (COL). They are constructed with the intent of finding the least common denominator across survey years. At least 8 years of schooling in secondary education is counted as the primary schooling while illiterate and less than 8 years of schooling as the below primary schooling, to reconcile with the changes in the survey structure. Finally, the college contains college and faculty graduation as well as upper education.

Wage inequality can be estimated mainly with two methods: the construction of an index based upon Kakwani, Piesch, Mehran, Gini, Atkinson, or Theil, or simple statistical measures such as coefficient of variation, standard deviation, relative mean deviation, or decile dispersion ratios. Index-based

inequality measures are lacking in the information of what happens along the wage distributions. Since the departure point of this study is to have a glance at wage inequality from different perspectives, it becomes necessary to refine not only the survey data but also the inequality criterion. The mainstay of this work is to insight into the evolution of wage inequality across groups over time; for this reason, the selection of inequality measurement relies on between and within structures rather than along the wage distribution. The basis for the wage inequality of the next section is a specific case of the generalized entropy class index, that is to say, Theil index which enables us to investigate within and between wage inequalities for skill, technology, and education specifications.

Table 2: Aggregation of Manufacturing Industries by Technology Level

Manufacturing Industries	NACE Rev. 2 Codes 2-digit level	Aggregations of Manufacturing based on NACE Rev. 2
High-Technology	21	Manufacture of basic *pharmaceutical* products and pharmaceutical preparations;
	26	Manufacture of *computer, electronic and optical* products
Medium High-Technology	20	Manufacture of *chemicals* and chemicals products;
	27 to 30	Manufacture of *electrical equipment*; Manufacture of *machinery and equipment* n.e.c.; Manufacture of *motor vehicles*, trailers, and semi-trailers; Manufacture of *other transport* equipment
Medium Low-Technology	19	Manufacture of *coke* and *refined petroleum* products;
	22 to 25	Manufacture of *rubber* and *plastic* products; Manufacture of other *non-metallic* mineral products; Manufacture of *basic metals*; Manufacture of *fabricated metals* products except *machinery and equipment*;
	33	*Repair and installation* of machinery and equipment
Low-Technology	10 to 18	Manufacture of *food* products, *beverages*, *tobacco* products, *textile*, *wearing apparel*, *leather* and related products, *wood* and products of wood, *paper* and paper products, *printing* and reproduction of recorded *media*;
	31 to 32	Manufacture of *furniture*; *other manufacturing*

Source: Eurostat (2019)

Notes: Names of NACE Rev.2 manufacturing industries at two-digit are abbreviated in the rest of the tables for convenience concerns. Italic words are chosen to represent each industry.

The general formula is as the following equation:

$$GE(a) = \frac{1}{a(a-1)}\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\bar{y}}\right)^a - 1\right] \qquad [1]$$

α is a sensitivity parameter attributed to the weight indicating the distance between different income segments along the wage distribution. Thus, generalized entropy (GE) is sensitive to the tails of the distribution. Cowell and Flachaire (2015) point out that changes in the lower tail of the wage distribution are more sensitive for the lower values of α whereas, for higher values,

the upper tail of wage distribution gets more sensitive. When the value of zero is given to the α, it turns out to be the mean logarithmic deviation. For the value of one, it becomes the Theil index, and equation [1] can be rewritten as equation [2]. The first term stands for within-group inequality, and the second term corresponds to between-group inequality. If α is equal to two, it becomes half of the square of the coefficient of variation. The lower and the upper bound for the value of GE are zero and infinity, respectively. When GE takes the value of zero, it means a perfect egalitarian distribution; on the other hand, the higher α leads to greater levels of inequality.

$$T = \sum_j \left(\frac{Y_j}{Y}\right) T_j + \sum_j \left(\frac{Y_j}{Y}\right) \ln\left[\frac{Y_j/Y}{N_j/N}\right] \qquad [2]$$

4. Empirical Results

A brief overview of the structure of labour in the manufacturing sector in terms of technology and skill levels would be useful before proceeding to wage inequality decompositions. Although to be able to get a more insightful understanding of overall technology pattern, it should be necessarily reckoned in value-added created in each technology group; however, more emphasis was put on the inequality concept rather than the productivity-related issues which are left for further studies.

The Turkish manufacturing industry can be described by low technological intensity. 54.60% of the overall employment took place in low technology in 2004 and with a slight improvement, the same ratio became 50.53% in 2015. Employment share in the high technology remained almost constant, 1.5% and 1.47%, in 2004 and 2015, respectively. The second largest technology group that created jobs was medium low technology and it became the absorption sector as the increment only existed in medium low technology from 2004 to 2015. The employment share grabbed by the medium low technology was 23.12% in 2004 and rose to 28.74% in 2015. Medium high technology constituted 20.78% of the overall manufacturing employment in 2004 while decreased to 19.26% in 2015.

From the perspective of skill dimension, a prominent decline was experienced in high skilled blue-collar and low skilled blue-collar workers. The former ratio decreased from 40.84% to 38.83%, while a decrement from 42.41% to 40.64% was seen in the latter. Apart from this, similar but reverse shifts occurred in white-collar counterparts. In particular, high skilled part of the white-collar encountered with a substantial rise to 12.13% of overall manufacturing employment from only 9.06%. A moderate increase in low skilled white-collar ratio came into existence in 2015 with a ratio of 8.40% from 7.77% in 2004. In the light of these results, collar distinction was at the epicenter of the switch in the employment share rather than the broad skill level distinction of high-low.

To place discussion in context, as a final step, the educational structure of the Turkish manufacturing industry is also questioned. In line with the low technology dominance, at the

beginning of the period, 52.30% of total employment in the Turkish manufacturing industry had below the primary level schooling. On the other hand, while the majority of the industry was still characterized by low technology in 2015, below primary schooling composed only 35.48% of the total manufacturing employment. A reasonable explanation of this fall can be attributed to the delayed impact, on the labour market, of the compulsory 8-year education enacted in 1997. Alongside of below primary schooling, the only drop in employment share was present in the regular high schooling from 11.17% to 8.92%. A significant redistribution eventuated in the rest of the educational categories. Vocational high schooling strengthened its ranking, 14.48% in 2004 increased to 18.14% in 2015. The bulk of the decline in below primary schooling was captured by the primary schooling, reaching 25.76% in 2015 which was only 17.04% in 2004. The most outstanding transformation was taken place on the college side with a more than doubling change in employment share. College, having the least share of 5.01% in 2004, even surpassed the regular high school in 2015 with the ratio of 11.70%, becoming of the fourth largest educational group.

Tabulations of the results obtained from wage inequality decompositions are listed in Tables 3 to 7. Tables displaying the evolution of the Theil index have four columns respectively as follows: GE(1) standing for the Theil index, population share, income share, and mean wage. The relative weight of the wage earners with respect to skill, technology, or educational categories are represented as the population share. In the same vein, the proportions captured from the total income generated in the overall manufacturing industry are reflected as the income share. Bold numbers in tables account for increases to a higher level in the related classes from 2004 to 2015. Thus, the bold numbers in the GE(1) column of 2015 correspond to a rise in wage inequality, otherwise, it means a reduction in wage inequality. As the mean wage followed a perpetual rise path, we do not prefer to bold that column.

Narrow skill and technology categories from 9 occupations and 24 manufacturing industries, respectively, are examined in the first instance in Table 3 and Table 5. Then, we aggregate them into broad formations in Table 4 and Table 6 to directly reflect skill and technology intensities. Except for *Services and Sales Workers*, the Theil index showed in Table 3, decreased for all occupations, indicating an amelioration in wage inequality. It should come as no surprise that alleviation in within-group inequality was obvious. Additionally, a significant deterioration in between-group inequality was witnessed in 2015. *Skilled Agricultural, Forestry, and Fishery Workers* was the most equally paid occupation group, while, on the contrary, *Managers*, *Professionals*, and *Technicians and Associate Professionals* were paid most unequally. The only exception was that *Services and Sales Workers* took third place from the *Managers* in 2015. *Craft and Related Trades Workers* and *Plant and Machine Operators and Assemblers* characterized the vast majority of the Turkish manufacturing sector by an employment share up to 74% in 2004 which decreased to 64% in 2015. Aside from *Craft and Related Trades Workers, Plant and Machine Operators and Assemblers*, and *Skilled Agricultural, Forestry, and Fishery Workers*, all occupation groups captured higher shares in the overall employment.

Table 3: Wage Inequality by Occupations

	GE(1)		Pop. Share		Income Share		Mean Wage	
Occupations	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**
Managers	0.1350	0.0967	0.0179	**0.0258**	0.0383	**0.0606**	3.9342	6.0141
Professionals	0.1409	0.1127	0.0154	**0.0262**	0.0301	**0.0567**	3.5849	5.5570
Technicians	0.1378	0.1093	0.0573	**0.0693**	0.0762	**0.0960**	2.4371	3.5557
Clerical	0.1318	0.0916	0.0420	**0.0476**	0.0532	**0.0540**	2.3211	2.9148
Services	0.0892	**0.0994**	0.0350	**0.0365**	0.0326	0.0319	1.7100	2.2440
Nature	0.0789	0.0289	0.0015	0.0009	0.0012	0.0008	1.5528	2.1753
Craft	0.1097	0.0826	0.4069	0.3874	0.3669	0.3522	1.6531	2.3331
Plant	0.0930	0.0579	0.3312	0.2563	0.3229	0.2279	1.7872	2.2817
Elementary	0.0881	0.0540	0.0929	**0.1501**	0.0785	**0.1199**	1.5494	2.0501
Theil (between)	0.0219	**0.0420**						
Theil (within)	0.1071	0.0796						

Source: Author's own calculations.

For the skill level analysis, the trajectory of wage inequality was mainly determined by collar distinction. Although wage inequalities among white-collar workers were greater than blue-collar workers, improvements in equality at all skill levels can be seen in Table 4. Low skilled blue-collar workers were the most equally paid category for both years and also the greatest decline in wage inequality, both in absolute and comparative terms, occurred in that group. Aggregate division according to collar type leads to the conclusion of only 17% of workers were white-collar while the remaining 83% were blue-collar in 2004. The proportion of the white collars rose to 21%, and blue collars experienced a fall to 79%. Nearly three-fourths of the total decline in blue-collar share was absorbed by the high skilled white collars. In terms of broad skill classification, high skilled and low skilled workers captured almost equal shares from total manufacturing employment. High skilled parts collectively grabbed an additional 1% in 2015 exceeding 51%. In a nutshell, despite the fact that the reduction in all within-group wage inequalities, a salient deterioration in between-group inequality existed.

Table 4: Wage Inequality by Skill Level

	GE(1)		Pop. Share		Income Share		Mean Wage	
Skill Level	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**
HSWC	0.1617	0.1365	0.0906	**0.1213**	0.1447	**0.2132**	2.9275	4.5114
HSBC	0.1096	0.0825	0.4084	0.3883	0.3682	0.3530	1.6528	2.3327
LSWC	0.1268	0.1027	0.0770	**0.0840**	0.0858	**0.0859**	2.0434	2.6237
LSBC	0.0937	0.0579	0.4241	0.4064	0.4014	0.3478	1.7351	2.1962
Theil (between)	0.0168	**0.0345**						
Theil (within)	0.1122	0.0872						

Source: Author's own calculations.

The same approach is also carried on for the two-digit Turkish manufacturing industries, seen in Table 5. *Manufacture of Wearing Apparels*, *Manufacture of Textile*, and *Manufacture of Food Products* were the three most populated industries in both years. On the side, in 2015, *Manufacture of Food Products* was located at the top instead of *Manufacture of Wearing Apparels*. *Manufacture of Basic Pharmaceutical Products and Preparations* and *Manufacture of Computer, Electronic, and Optical Products* are high technology industries having very low employment shares. *Manufacture of Tobacco Products* and *Manufacture of Coke and Refined Petroleum Products* were the least labour-creating industries due to their unique structures. When we look at it categorically, income shares of all industries in high technology and medium high technology exceeded population shares. The exact inverse pattern was not available in low and medium low technology industries.

From 2004 to 2015, only 9 out of 24 industries suffered from the escalation in wage inequality. Wage inequality worsened only for *Manufacture of Wood and Products of Wood*, and *Manufacture of Paper and Paper Products* in 11 low technology industries. Aside from *Manufacture of Coke and Refined Petroleum Products*, and *Manufacture of Other Non-Metallic*, the remaining four medium low technology industries enjoyed diminished wage inequality. There are five medium high technology industries, and *Manufacture of Electrical Equipment* was the only sub-sector that became evident of lower wage inequality. Two industries on the high technology had the opposite development in inequality. A decrease in wage inequality was seen in *Manufacture of Basic Pharmaceutical Products and Preparations*, whereas an increase in *Manufacture of Computer, Electronic, and Optical Products*. Between-group inequality surged slightly to the index number of 0.0127 from 0.0101, indicating that industry classification with respect to technology rather than skill classification with respect to occupation resulted in more homogenous and egalitarian groups, at least in terms of wage differences. Within wage inequality was again higher than between-group but experienced a decline which was another pattern that was found in skill dimension as well.

Table 5: Wage Inequality by Industry

		GE(1)		Pop. Share		Income Share		Mean Wage	
	Nace2	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**
10	**Food**	0.1333	0.1110	0.1122	**0.1269**	0.0973	**0.1097**	1.5900	2.2186
11	**Beverages**	0.1485	0.1367	0.0077	0.0047	0.0097	0.0055	2.2852	3.0068
12	**Tobacco**	0.1069	0.1032	0.0016	0.0013	0.0028	**0.0030**	3.1209	6.0405
13	**Textiles**	0.1019	0.0736	0.1070	**0.1170**	0.1021	**0.1079**	1.7502	2.3667
14	**Wearing App.**	0.0996	0.0805	0.1472	0.0952	0.1356	0.0818	1.6890	2.2049
15	**Leather**	0.0982	0.0519	0.0345	0.0239	0.0304	0.0188	1.6157	2.0094
16	**Wood**	0.0709	**0.0985**	0.0336	0.0254	0.0259	0.0217	1.4153	2.1935
17	**Paper**	0.1408	**0.1518**	0.0141	**0.0172**	0.0161	**0.0197**	2.0906	2.9347
18	**Print. & Media**	0.1271	0.1202	0.0205	0.0151	0.0201	0.0158	1.8016	2.6821
19	**Coke, Ref. Petro.**	0.1442	**0.1681**	0.0020	**0.0027**	0.0032	**0.0051**	2.9121	4.8540

20	**Chemicals**	0.1325	**0.1599**	0.0533	0.0221	0.0578	0.0276	1.9880	3.2080
21	**Pharmaceutical**	0.1613	0.1313	0.0054	**0.0054**	0.0083	0.0075	2.8266	3.5707
22	**Rubber & Plastic**	0.1681	0.0903	0.0475	0.0472	0.0496	0.0436	1.9121	2.3702
23	**Nonmetallic M.**	0.1150	**0.1198**	0.0696	**0.0887**	0.0680	**0.0900**	1.7929	2.6011
24	**Basic Metals**	0.1430	0.1241	0.0461	**0.0637**	0.0565	**0.0766**	2.2488	3.0888
25	**Fabricated M.**	0.1141	0.0831	0.0642	0.0670	0.0615	0.0607	1.7558	2.3259
26	**Comp, Elct & Op.**	0.1858	**0.2202**	0.0096	0.0093	0.0126	**0.0140**	2.4008	3.8807
27	**Electrical Eq.**	0.1243	0.1131	0.0312	**0.0388**	0.0355	**0.0425**	2.0837	2.8130
28	**Machinery & Eq.**	0.1197	**0.1267**	0.0431	**0.0568**	0.0463	**0.0634**	1.9706	2.8647
29	**Motor Vehicles**	0.1230	**0.1352**	0.0721	0.0658	0.0911	0.0820	2.3176	3.1966
30	**Other Transport**	0.1068	**0.1184**	0.0082	**0.0091**	0.0095	**0.0119**	2.1373	3.3544
31	**Furniture**	0.0754	0.0738	0.0532	**0.0656**	0.0434	**0.0576**	1.4926	2.2527
32	**Other Manufact.**	0.1155	0.1124	0.0144	0.0131	0.0146	0.0126	1.8592	2.4616
33	**Repair & Install.**	0.2074	0.1712	0.0018	**0.0181**	0.0021	**0.0211**	2.1766	2.9802
	Theil (between)	0.0101	**0.0127**						
	Theil (within)	0.1189	0.1090						

Source: Author's own calculations.

According to Table 6, the aggregation of 24 manufacturing industries into four technology groups intensified the outcomes that had been found previously. On the one hand, the between-group Theil index approached to the total equality case more than disaggregated individual industries reported in Table 5; on the other hand, within-group wage inequality was reduced. In 2015, higher technology levels generated higher wage inequality; however, medium level technologies violated that order in 2004 since the Theil index was greater for medium low technology than medium high technology. Workers in the high and medium high technologies were afflicted with worse wage distribution in 2015 than in 2004. Remarkable recovery in wage inequality for the low and medium low technologies was also evident. When the labor market structure is further analyzed, a shift in the employment share to medium low technology from the other three technology intensity levels was revealed clearly. For aggregated groups, the most prominent difference between employment share and income share also belonged to the high technology group. Such a wide difference, in the disaggregated group, was observed in *Manager* and *Manufacture of Tobacco Products*.

Table 6: Wage Inequality by Technology Level

	GE(1)		Pop. Share		Income Share		Mean Wage	
Technology	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**
HT	0.1792	**0.1899**	0.0150	0.0147	0.0209	**0.0215**	2.5536	3.7664
MHT	0.1267	**0.1328**	0.2078	0.1926	0.2402	0.2274	2.1189	3.0302
MLT	0.1390	0.1223	0.2312	**0.2874**	0.2409	**0.2971**	1.9108	2.6521

LT	0.1115	0.0965	0.5460	0.5053	0.4979	0.4540	1.6719	2.3050
Theil (between)	0.0058	**0.0072**						
Theil (within)	0.1232	0.1144						

Source: Author's own calculations.

The other aspect that we lay stress upon is the exploration of wage inequality within the educational structure. According to Table 7, as we move to a higher education level, wage inequality generally got worse. The only exception was tracked in 2004 between regular high schooling and vocational high schooling, the former had more unequal wage distribution than the latter one. Except for the college degree, the rest four educational categories enjoyed lower Theil indexes in 2015, and the primary schooling was the best performer in that sense. Deterioration of wage inequality only in the college group, which had the smallest population share in 2004 and the second smallest in 2015, could be indicative of reverting to a more unfavorable situation in between-group inequality. Within-group inequality mitigated, as well, in accordance with the previous results of aggregations.

There is an incompatible case for the mean wage listed in the last column of Table 7. Considering that instead of mean wage, median could give better results for the wage distribution; however, despite the hierarchical mean wages, implying higher education pays more on average, primary schooling was paid less than below primary schooling in 2015. Turkish manufacturing sector turned out to be more educated, although approximately 61% of the total employees had still lower education than high school.

Table 7: Wage Inequality by Education Level

	GE(1)		Pop. Share		Income Share		Mean Wage	
Education	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**	**2004**	**2015**
Below_PS	0.0860	0.0566	0.5230	0.3548	0.4658	0.3041	1.6328	2.1993
PS	0.1144	0.0687	0.1704	**0.2576**	0.1549	**0.2096**	1.6668	2.0879
HSC	0.1391	0.0890	0.1117	0.0892	0.1196	0.0904	1.9626	2.5991
VHS	0.1284	0.0900	0.1448	**0.1814**	0.1699	**0.1990**	2.1506	2.8150
COL	0.1537	**0.1628**	0.0501	**0.1170**	0.0898	**0.1969**	3.2874	4.3195
Theil (between)	0.0190	**0.0320**						
Theil (within)	0.1100	0.0896						

Source: Author's own calculations.

5. Conclusion

This study aims at uncovering the evolutions of wage inequality, at a glance, from 2004 to 2015, in the Turkish manufacturing sector. Three different perspectives are employed with respect to

technology, skill, and education. The generalized entropy-based class index, particularly the Theil index, is calculated using HLFS. Occupations according to ISCO-08 classification at one-digit are used to construct a skill ranking. Similarly, NACE Rev. 2 at two-digit manufacturing industries are grouped to form a scale for technology intensities. Finally, we look at wage inequality with respect to five educational categories. Along with trajectories of wage inequality of individual groups derived from skill, technology, and education fractions, Theil index provides us with, also, the tool to decompose inequality into between-group and within-group components.

Wage inequality followed some specific patterns. As we move to lower skill, technology, or education level, wage inequalities become less disturbing. The underlying reason could be that poorly educated, lower technologies, or less skilled groups generally had lower average wages, meaning that those groups got stuck in a narrow wage area. Furthermore, wage inequalities deteriorated for all between-groups while reduction of within-group inequalities was independent of group specifications.

Individual investigations generated different structures within groups as well. In all four skill levels, wage inequalities decreased, although the reduction in white-collar counterparts remained limited. Additionally, the top two technology intensities suffered from increased wage inequality, while technology groups at the bottom part experienced relative alleviations. Efforts to shed further light on the nature of the education-inequality nexus ended up with changes in inequality against the college degree. Except for college, improvements in equality were observed, but those improvements remained limited compared to below primary schooling and primary schooling.

The employment character of the Turkish manufacturing sector also shifted considerably. There was a weak flow from white-collar to blue-collar; however, the great majority of workers employed as blue-collar at the low and medium low technology industries. The employment share of the high technology did not change indeed, whereas only medium low technology industries achieved to increase their share. Most of that increase came from low technology, but it was still the most labour-creation technology level with more than half. Moreover, manufacturing workers became better educated over time. Even though vocational high schooling initially had had a larger share than regular high schooling, the gap between them further increased. Regular high school was the only education level above primary schooling that lost importance. Albeit a substantial fall at below primary schooling employment share, more than one-third of workers still had that education level. The most notable rise, proportionately, was seen in the college graduates with more than doubling.

The transformation of the average education level did not complete with a technology promoting change in the manufacturing sector. We can interpret this situation in two ways. Firstly, highly educated labour, who were paid higher mean wages, started to be employed intensively in low and medium low technology industries. That could slow down the deceleration of wage inequality in this part of the economy. Secondly, on the other hand, low technology industries categorically paid lower wages on average and higher employment of better educated labour in those industries

could give rise to downward pressure on wages, contributing to the decline in wage inequality. Clearly, more work needs to be done to assess which explanation fits the reality.

References

Aghion, P., Caroli, E. and Garcia-Penalosa, C. (1999). Inequality and economic growth: the perspective of the new growth theories. *Journal of Economic Literature*, *37*(4), 1615-1660.

Aksoy, T. (2009). Technology and demand for skilled labor in Turkish private manufacturing industries. *Panoeconomicus, 56*(2), 261-279.

Aktaş, A. and Uysal, G. (2016). The gender wage gap in Turkey. *Marmara Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *38*(2), 1-19.

Bakış, O. and Polat, S. (2015). Wage inequality in Turkey, 2002–10. *Economics of Transition*, *23*(1), 169-212.

Bozdoğan, A. (2021). *Skill biased technical change and wage inequality: Evidence from Turkish manufacturing sector*, [Unpublished PhD Dissertation]. Marmara University.

Chusseau, N., Dumont, M. and Hellier, J. (2008). Explaining rising inequality: Skill-biased technical change and north–south trade. *Journal of Economic Surveys*, *22*(3), 409-457.

Cowell, F. A. and Flachaire, E. (2015). Statistical Methods for Distributional Analysis. In: Atkinson, A.B., Bourguignon, F. (eds.) *Handbook of Income Distribution*, vol. 2A, (pp. 359-465). Amsterdam: Elsevier.

Daş, Z. Ö. and Doğruel, F. (2017). Wage inequality in Turkey: What changed during 1994-2011. *Marmara Journal of Economics*, *1*(2), 171-194.

Dervişen, Z. D. (2011). *Skilled and unskilled labor efficiencies in Turkish manufacturing industry (1992-2001)*, [Unpublished PhD Dissertation]. Marmara University.

DiNardo, J., Fortin, N. M. and Lemieux, T. (1996). Labor market institutions and the distribution of wages, 1973-1992: A semiparametric approach. Econometrica: *Journal of the Econometric Society*, *64*(5), 1001-1044.

Dumont, M. (2006). The reliability–or lack thereof–of data on skills. *Economics Letters*, *93*(3), 348-353.

Elveren, A. Y. and Galbraith, J. K. (2009). Pay inequality in Turkey in the neo-liberal era, 1980-2001. *European Journal of Comparative Economics*, *6*(2), 177-206.

Eurostat (2019). Glossary: High-tech classification of manufacturing industries. (n.d.). Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:High-tech_classification_of_manufacturing_industries Access: 26.01.2021.

Förster, M. F. and Tóth, I. G. (2015). Cross-country evidence of the multiple causes of inequality changes in the OECD area. In: Atkinson, A.B., Bourguignon, F. (eds.) *Handbook of Income Distribution*, vol. 2B, (pp. 1729-1842). Amsterdam: Elsevier.

Filiztekin, A. (2020). Income Inequality in Turkey: 2003–2015. In: Parlar Dal. E. (eds.) *Turkey's Political Economy in the 21st Century*, (pp. 63-84). Cham: Palgrave Macmillan.

Firpo, S., Fortin, N. M. and Lemieux, T. (2009). Unconditional quantile regressions. *Econometrica*, *77*(3), 953-973.

Hornstein, A., Krusell, P. and Violante, G. L. (2005). The effects of technical change on labor market inequalities. In: Aghion, P., Durlauf, S. (eds) *Handbook of Economic Growth*, vol. 1B. (pp. 1275-1370). Amsterdam: Elsevier.

İlkkaracan, I., Levent, H. and Polat, S. (2013). Exploring different measures of wage flexibility in a developing economy context: The case for Turkey. *International Review of Applied Economics*, *27*(3), 297-315.

İlkkaracan, I. and Selim, R. (2007). The gender wage gap in the Turkish labor market. *Labour*, *21*(3), 563-593.

International Labour Office (2012). International Standard Classification of Occupations: Structure, Group Definitions and Correspondence Tables. ISCO-08, vol.1. Available at:https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_172572.pdf. Access: 26.01.2021.

International Labour Organization (2016). Global Wage Report 2016/2017: Wage inequality in the workplace. Available at: https://www.ilo.org/global/research/global-reports/global-wage-report/2016/WCMS_537846/lang—en/index.htm Access: 26.01.2021.

Kara, O. (2006). Occupational gender wage discrimination in Turkey. *Journal of Economic Studies*, *33*(2), 130-143.

Katz, L. F. and Murphy, K. M. (1992). Changes in relative wages, 1963–1987: supply and demand factors. *The Quarterly Journal of Economics*, 107(1), 35-78.

Kent, O. and Sefil-Tansever, S. (2021). Educational wage premia and wage inequality in Turkey. *Global Business and Economics Review*, 24(4), 360-381.

Meschi, E., Taymaz, E. and Vivarelli, M. (2011). Trade, technology and skills: Evidence from Turkish microdata. *Labour Economics*, *18*(1), 60-70.

Meschi, E., Taymaz, E. and Vivarelli, M. (2016). Globalization, technological change and labor demand: a firm-level analysis for Turkey. *Review of World Economi*cs, *152*(4), 655-680.

Pelek, S. (2018). The impact of the minimum wage on the wage distribution: Evidence from Turkey. *Ekonomi-Tek*, 7(1), 17-59.

Popli, G. and Yılmaz, O. (2017). Educational attainment and wage inequality in Turkey. *Labour*, *31*(1), 73-104.

Tansel, A. (2005). Public-private employment choice, wage differentials, and gender in Turkey. *Economic Development and Cultural Change*, *53*(2), 453-477.

Tansel, A. and Bodur, F. B. (2012). Wage inequality and returns to education in Turkey: A quantile regression analysis. *Review of Development Economics*, *16*(1), 107-121.

Tekgüç, H., Eryar, D. and Cindoğlu, D. (2017). Women's tertiary education masks the gender wage gap in Turkey. *Journal of Labor Researc*h, *38*(3), 360-386.