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Wage inequality in Turkey, 2002–10[1]

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Abstract

This paper studies the evolution of wage inequality in Turkey using household labour force survey data from 2002 to 2010. Between 2002 and 2004, the relative supply of more-educated workers to less-educated workers remained constant while their relative wages decreased in favour of less-educated workers. However, between 2004 and 2010, the relative supply of more-educated workers to less-educated workers rose, while their relative wages remained constant or kept increasing in favour of more-educated workers. This suggests factors other than those implied by a simple supply-demand model are involved, such as skill-biased technical change or minimum wage variations. The decomposition of wage inequality reveals that the price (wage) effect dominates the composition effect particularly in the first period. Our results show that the real minimum wage hike in 2004 corresponds to a major institutional change, which proved to be welfare-increasing in terms of wage inequality. The upper-tail (90/50) wage inequality decreased between 2002 and 2004 and stayed constant thereafter, whereas the lower-tail (50/10) wage inequality decreased throughout the period. Our findings thus provide evidence supporting the institutional argument for explaining wage inequality.

JEL classifications: J23, J31.
Keywords: Wage inequality, wage structure, labour demand, decomposition, Turkey.

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1. Introduction

Turkey is one of the OECD countries with the highest income inequality (others being Chile, Mexico, USA and Israel).[2] Although, from the mid-1990s to the late 2000s, Turkey's income inequality has decreased more than in other OECD countries like Chile, Mexico, Greece and Hungary (see Figure 1). According to the OECD Income Distribution database[3] Turkey's Gini coefficient dropped from 0.49 in 1994 to 0.43 in 2004 and 0.41 in 2009.

Employment earnings constitute the main component of household income in Turkey. Filiztekin (2013) reports that this share in total household income has also increased over time, reaching 46 percent in 2011. He also notes that 75 percent of households had positive salary income in 2011. Between 2002 and 2010, the share of wage earners in the total labour force increased by 12 percent (from 49 to 61 percent), while the share of unpaid family workers, which is a major indicator of agricultural employment, particularly for women, decreased by 8 percent (from 21 to 13 percent). These figures confirm the secular downward trend in self-employment and the secular upward trend in wage-earning. According to the OECD Factbook (2009, 2013), the share of self-employment decreased from 61 percent in 1990 to 38.3 percent in 2011.[4] These developments naturally make wage dynamics a key factor in analyzing inequality trends in Turkey.

The growth of GDP per worker remained relatively high, at 3.7 percent on average, during the 2002–10 period. Descriptive statistics derived using the Household Labor Force Surveys (HLFS) for the period 2002–10 show that the log of the ratio of the 90th percentile of wages to the 10th percentile, the so-called 90–10 wage gap, decreased over the period. There is also evidence that the 50–10 wage gap decreased, whereas the 90–50 gap remained relatively stable. These observations imply that wage inequality fell in favour of workers at the lower end of the distribution.

The sub-periodization of 2002–10 reveals that most of the reduction in wage inequality occured in the first sub-period, 2002–04. We claim that this decrease in inequality was mainly caused by the minimum wage increase in 2004. Using decomposition techniques developed by DiNardo *et al.* (1996) and Juhn *et al.* (1993), we show that the main drivers of this decline are changes in the structure of wages (prices) rather than changes in the composition of the labour force (quantities), and that the reduction in wage inequality was more pronounced for women.

The demand curve is not likely to be stable in the second sub-period of 2004–10. The relative supply of more-educated workers to less-educated workers rose while their relative wages remained constant or kept increasing in favour of

[2] See 'Income inequality' chapter in OECD (2013) for details.
[3] http://stats.oecd.org/Index.aspx?DataSetCode=IDD.
[4] See tables from the following links: http://dx.doi.org/10.1787/542746080432 and http://dx.doi.org/10.1787/888932708560.

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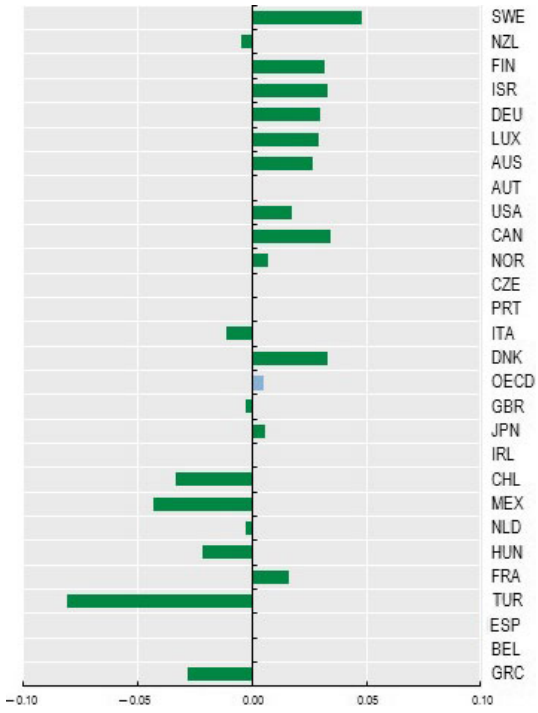
Figure 1. Trends in income inequality



***Source*:** OECD (2013), http://dx.doi.org/10.1787/888932707040

more-educated workers. This pattern is particularly strong toward the end of the period, which suggests that demand shifted toward skilled labour. A standard shift-share analysis is used to decompose these demand shifts into 'between industry' and 'within industry' components for each education group. Our results show that the 'between industry' component forms the bulk of these demand shifts toward more-educated workers.

The paper is organized as follows. In Section 2, we provide a review of the wage inequality literature regarding Turkey. In Section 3, we introduce the dataset and discuss recent trends in inequality measures. Section 4 discusses relative changes in supply and demand, respectively. Section 5 discusses the results of the decomposition analysis, while the final section concludes.

2. Literature review

Early studies dealing with wage inequality, by Katz and Murphy (1992, hereafter KM), Bound and Johnson (1992) and Juhn *et al.* (1993, hereafter JMP) suggest that

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changes in demand and supply for skills explain the rise in wage inequality during the 1980s in the US. These papers use a standard neoclassical framework to analyze whether changes in relative demand can explain changes in relative wages. The general agreement is that observed patterns of wage inequality in the US are a result of a bias favouring more skilled and more-educated workers. In these papers, this bias is assumed to come from technological improvements which favour more skilled workers, hence the name, skill-biased technical change (SBTC). Rising wage inequality is, therefore, considered to be structural and permanent. However, during the 1990s, these arguments were challenged by the 'revisionists' (Card and DiNardo, 2002; Lemieux, 2006) claiming that the increasing trend in inequality started to slow down despite greater SBTC and globalization. Evidence challenging the SBTC argument also came from other industrial countries, primarily in Europe, where changes in inequality remained modest.

DiNardo *et al.* (1996, DFL hereafter) and Lee (1999) suggest that increased inequality in the 1980s was largely due to institutional changes in the labour market, emphasizing the role of a falling real minimum wage or lower unionization in the US. Lemieux (2006) emphasizes the role of the decline in real minimum wage and changes in labour force composition in explaining the increase in residual wage inequality during the 1980s and 1990s. The revisionist view argues that the wage setting schedule is affected by other factors as well, such as minimum wage legislation, collective bargaining or legal contract enforcements on labour costs. Freeman (1980) and a more comprehensive study by Card *et al.* (2004) conclude that unionization had an equalizing effect on wage dispersion across different skill groups, and produced within-group effects across sectors.

Institutional changes can affect wage distribution, and thus wage inequality, particularly when they target different types of workers. For instance, a real minimum wage increase might narrow the pay gap by affecting the wage schedule of wage earners at the lower end of the distribution (Fortin and Lemieux, 1997). Another example is a decrease in collective bargaining, which might produce a similar effect, widening the gap between unskilled and skilled workers. Freeman (1980) claims that, overall, unions tend to reduce wage inequality among male workers since the inequality-increasing 'between-sector' effect is smaller than the dispersion-reducing 'within-sector' effect. In the case of developing countries, various studies emphasize the role of institutional factors in explaining earnings inequality (Freeman, 2009).

There are only a limited number of studies addressing overall wage inequality in Turkey. Filiztekin (2013) decomposes income inequality using the 1994 and 2003 Household Budget Surveys, and stresses the importance of wage income. He argues that a growing share of wage-earners in employment increases the contribution of wages to overall income. Most other recent studies have focused on the gender wage gap, based on various sources of microdata. For example, Ilkkaracan and Selim (2007) analyze the sources of the gender wage gap using matched employer–employee data (the Employment and Wage Structure Survey, 1994) and standard Mincerian estimations, as well as the Oaxaca decomposition. Their major finding is

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that a substantial portion of the gender wage gap is attributable to type of firm, sector and collective labour bargaining status. Kara (2006) finds that, after correcting for selection bias, the gender wage gap remains significantly high after controlling for education, experience, occupation and region.

The limited availability of microdata is an important issue. The HLFS that include wage earnings information covers only the period from 2002 onwards. For this reason, most studies use the Household Income and Consumption Expenditure Survey (HICES) of 1994 and the 2002 Household Budget Survey (HBS). Thus, Tansel and Bodur (2012) analyze the return to education and residual wage inequality by using OLS and quantile regressions based on the 1994 HICES and the 2002 HBS. They conclude that male wage inequality remained high, with a small decline keeping the wage gap unchanged. Their most important finding is the positive contribution of education to wage inequality through both within-group and between-group components. They argue that the decline in return to education can be explained by a rise in educational attainment and the effect of the 2001 crisis.

Meschi *et al.* (2011) study the relationship between trade openness and wage inequality using firm-level data over the period 1980–2001. In support of the SBTC argument, they claim that there has been a major shift in labour demand towards more skilled workers. The paper also contributes to the discussion by providing evidence that R&D, FDI, trade and technology are the driving sources behind the demand shift towards skilled labour, which also complements the SBTC.

Although the SBTC argument seems to be the most plausible for Turkey during the 1980–2001 period, it needs to be discussed in the context of recent data and within the changing economic and institutional context. The role of relative supply and demand, as well as education dynamics in wage inequality needs to be reconsidered for the 2000s. As mentioned above, the share of skilled workers has increased as a result of young cohorts' greater educational attainment, and it is likely that this structural change has produced inter-generational effects on wage inequality. Using the HLFS data, Bakis *et al.* (2013) argue that post-secondary wage inequality increased from 2004 to 2010, and that the wage gap widened between the lower and upper quantiles.

3. Wage distribution and wage inequality trends in Turkey

3.1 Background information

Since 2002, Turkey has benefited from both sustained growth and economic stability compared to previous periods. Turkey has undergone significant structural transformations since 1980. Before 1980, its economic policy regime was guided by an industrialization strategy based on import substitution. This regime involved high import tariffs, quantitative restrictions on trade, a heavy state presence in business and a fixed exchange rate. After 1980, however, the economy experienced radical

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structural changes: trade liberalization, liberalization of domestic goods and financial markets and liberalization of international finance. The 1990s were characterized by unprecedentedly high inflation and real interest rates, high budget deficits, rapidly accumulating public debt and very volatile economic growth. In addition, hot money inflows and outflows caused stop-and-go cycles and macroeconomic instability.

In 2001, following the crisis, a recovery programme was launched, resulting in smoother and faster average economic growth, a substantial decline in the ratio of public debt to GDP, and dramatic decreases in inflation and real interest rates. During this stable growth period, the economy experienced some important structural transformations: the share of wage earners in the total labour force increased by 12 percentage points while the share of unpaid family workers decreased by 8 percentage points (Filiztekin, 2013). Besides the transition of unskilled labour force into paid work, the qualified labour force, measured as the share of college graduates in total employment, rose by 5 percentage points (from 10 percent in 2002 to 15 percent in 2010).

In 1997, Turkey implemented crucial education reforms that increased compulsory education from 5 to 8 years. Given the relatively large share of young people in the country's population, this affected a significant part of the current labour force. Kirdar *et al.* (2014) show that the reform has had a strong effect on enrolment rates for grades 6–8 (the new compulsory levels) as well as for grades 9 and 10 (the non-compulsory levels), and that this impact is stronger for boys than girls. The authors argue that this policy is likely to be reflected in higher wage rates for males. On these grounds, we may expect a change in the skill composition of workers, especially for the years following the reform, which in turn is likely to affect wage inequality.

Figures 2 and 3 can help to understand the institutional role of the minimum wage in the Turkish Labour Market. Figure 2 gives the minimum wage relative to the average wage in Turkey compared to the OECD between 2000 and 2012. Figure 3 shows the evolution of the real minimum wage and other wages between 2000 and 2012 in Turkey. It is clear from these figures that the real minimum wage had significantly increased in 2004 compared to the OECD average and regarding previous years in Turkey. Following 2004 and onwards, it has a smooth increasing trend. This is why we divide the 2002–10 period into two sub-periods: 2002–04 and 2004–10.[5]

Figure 3 presents the real minimum wage trends compared to real public and private worker wages and real civil servant wages between 2000 and 2012.[6] Using

[5] Ideally, we would like to include as many years as possible, but unfortunately 2002 is the first year for which we have wage information in the HLFS data.

[6] Note that Figure 3 is not derived from microdata (such as HLFS or HBS) so the numbers are calculated by the Ministry of Development (previously State Planning Organization) using the information gathered through 'Public Sector Employer Unions', 'Turkish Confederation Of Employer Associations' and Ministry of Finance. Unfortunately, there is no labour force or budget survey including households earnings at national level before or during the 2001 crisis. Available labour force surveys for 2000 and 2001 do not include wage earnings and provide solely the labour status and typical worker characteristics.

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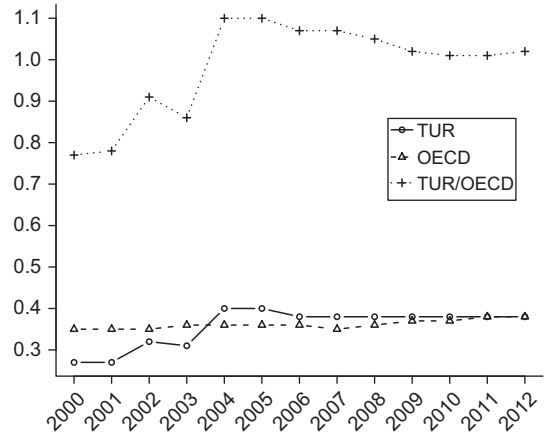
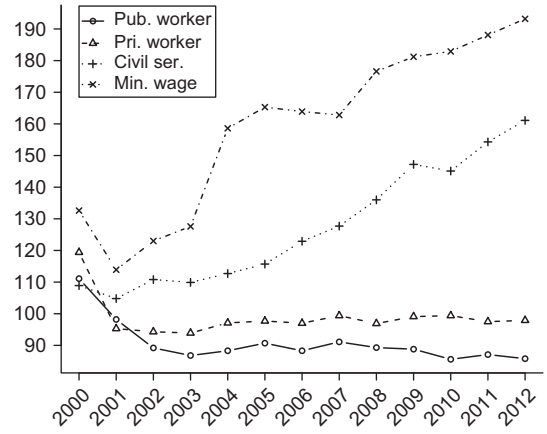
Figure 2. The minimum wage relative to average wages of full-time workers



Source: OECD Stat Extracts, https://stats.oecd.org/Index.aspx?DataSetCode=MIN2AVE

Figure 3. Evolution of real wages in Turkey (1994 = 100)



Source: Ministry of Development, http://www.mod.gov.tr

HLFS, we separately calculated the ratio of minimum public and private sector wages to average wages (Figure 4). Calculations from the HLFS are in parallel with Figure 3 for the 2002–05 period regarding average wage in the public and private sectors. However, the figures do not correspond with those of the Ministry of Development for the rest of the period. HLFS microdata show that, after a real minimum wage increase in 2004, the ratio of minimum wages to average wages (both public and private) started to decrease and then remained almost constant.

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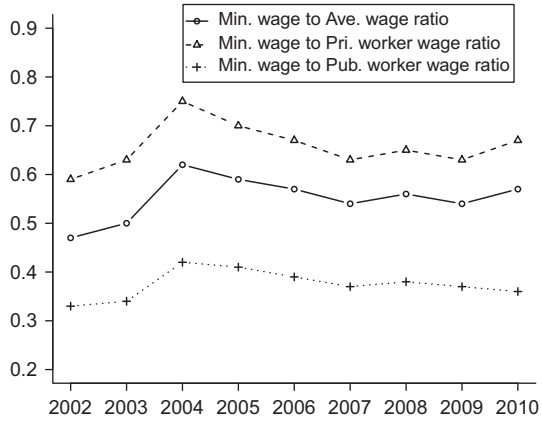
Figure 4. Evolution of real wages in Turkey



***Notes*:** Workers declaring having worked less than 8 regular hours and more than 84 hours are excluded. Percentages are calculated on the basis of monthly wages and using sampling weights. The yearly minimum wage is taken to be the average of two minimum wages for years, set biannually.
***Source*:** HLFS (2002–10) .

As discussed at length below, it is likely that an institutional change in the minimum wage level in 2004 is responsible for the real wage recovery for workers at the bottom of the distribution, particularly at the 10th and 25th even covering the median wage earners. Table 1 shows how binding the minimum wage is in Turkey's labour market. The percentage of workers earning below or equal to the monthly minimum wage ranges between 32 and 18 percent, and accounts for a significant bulk of wage earners. There is a downward trend in the share of workers earning less than the minimum wage. However, this downward trend is broken in 2004 and 2005. This is expected given the jump in the real minimum wage in 2004. Regarding gender, more female workers earn below the minimum wage than male workers. The last column in Table 1 shows the ratio of the average low wage to the minimum wage for each year. Surprisingly, the average low wage closely tracks the minimum wage. This ratio oscillates between 0.69 and 0.79 with an average of 0.74. More importantly, there is no sudden decline in 2004 or 2005. These observations reinforce the institutional argument that the minimum wage serves as a reference point where collective wage bargaining is weak or non-existent, particularly for workers at the bottom of the distribution.

3.2 Data description

We use the yearly cross-sectional data of the HLFS covering the post-crisis period, 2002–10 because it provides more comprehensive information on Turkey's labour

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Table 1. Percentage of workers earning a wage below monthly minimum wage and the average low wage relative to minimum wage ratio

Year	Men	Women	Total	Ave. low wage/ Min. wage
2002	22.2	32.4	24.4	0.69
2003	21.3	31.6	23.4	0.74
2004	29.2	38.5	31.1	0.75
2005	30.5	40.1	32.5	0.79
2006	22.7	32.6	24.8	0.77
2007	19.8	28.2	21.7	0.78
2008	18.4	26.4	20.2	0.73
2009	17.8	25.8	19.7	0.73
2010	16.4	25.3	18.5	0.70

***Notes*:** Workers declaring having worked below 8 regular hours and above 84 hours are excluded. Percentages are calculated on basis of monthly wages and using sampling weights. The yearly minimum wage is taken to be the average of two minimum wages for years, it is set biannually. Average low wage is computed as the weighted average of wages below minimum wage for each year using sampling weights.

market. The surveys include monthly individual wages in paid jobs[7] and provide detailed information on worker characteristics. Before moving to data description, some issues must be addressed related to our use of the data. First, as noted in the wage inequality literature, how the hourly wage is constructed is important since raw wage data include misreporting, either as wages or actual working hours.[8]

In order to avoid possible biases, we restrict our sample to wage earners working 8 hours or more (full-day working hours) and 84 hours or less a week.[9] After restricting the sample to individuals working regular working hours,[10] outlier observations in hourly wage distributions at the bottom and top 1 percent are trimmed as well.[11] The hourly wage data used are summarized in Appendix A. We

[7] The wages of self-employed workers are missing in HLFS, although their share of employment is 22 percent on average over the period.

[8] According to the legal regulations, working hours above 45 hours a week must be compensated with extra-premium, while for a single day, working hours must not exceed 11 hours. In our sample, there is some over-reporting exceeding 11 hours per day, which is above the legally mandated ceiling. This represents approximately 5 percent of each cross-sectional sample.

[9] Biases may also emerge due to temporary reallocation of working hours inside a firm during the reference week the survey is undertaken. Nevertheless, for the majority of workers, declared regular working hours and actual hours are very similar.

[10] Our results are not significantly altered by these restrictions. Once workers working regular hours are trimmed, the percentage of workers declaring working part-time is about 1–3 percent across years, which is not surprising, given that part-time work legislation does not exist in Turkey.

[11] Trimming 1 percent of extreme values (top and bottom) does not change the order of wages which is crucial for the inequality measures.

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calculate the hourly nominal wage by dividing net monthly wage income (wage and/or salary plus any extra income, such as bonus pay, premiums, etc.) by the average number of hours worked per month in the main job. The latter is computed by multiplying the 'usual hours worked in the main job a week' by 4.33. The nominal hourly wage is then divided by the GDP deflator to derive the real hourly wage rate, expressed in 2002 Turkish Liras.

The HLFS give detailed information on individual characteristics such as gender, age (grouped at 5-year intervals for ages 15–64 years), schooling (coded in seven education levels),[12] marital status, urban residence (population over 20,000), a dummy indicating social security status, a dummy for workers having an additional job, firm size, occupation (ISCO 88) and sectoral (NACE Rev.1) classifications.[13]

Table 2 summarizes the sample to be used throughout the analysis for 2002, 2004 and 2010. The educational level of more than half of the male workers is below primary schooling, with most working in small-scale firms (fewer than 25 employees). The female sample differs in size and composition, with the average female worker (Table 2) being younger, less likely to be married and more educated, consistent with female participation pattern in Turkey (Tansel, 2002; Tunali and Baslevent, 2006). Other variables show less divergence in terms of gender.

3.3 Trends in wage inequality

There are three widely used measures for wage inequality in the literature (see Autor *et al.*, 2008, among others). These are the 90/10 log wage differential (also called overall wage inequality), between-group wage inequality (wage differentials by educational levels) and within-group or residual wage inequality (90/10 log wage differentials after controlling for education, potential experience or age, and gender). Both overall and residual wage inequality can be further decomposed into two parts: upper-tail inequality (90/50) and lower-tail inequality (50/10).

In terms of wage percentiles, Figure 5 shows that both overall wage inequality (90/10 log wage differential) and lower-tail wage inequality (50/10 log wage differential) decreased from 2002 to 2010. However, upper-tail inequality has remained almost constant since 2004. All residual wage inequality measures (90/10, 90/50, 50/10) varied in tandem and decreased during 2002–10. Several observations can be made regarding these raw wage inequality measures. Over the entire period, wages

[12] Illiterates, literates without a grade, junior primary school, primary school, high school, vocational high school, and college and above.

[13] Until 2009, TurkStat coded economic activities at four-digit level according to NACE Rev.1. Since 2009 NACE Rev.2 is used, but the published microdata CDs contain only nine main groups until 2009 and 88 divisions (2-digit codes) from 2010 onwards. To create compatible data, we use the following nine-sector classification: (1) agriculture and fishing, (2) mining, (3) manufacturing, (4) electricity, gas and water supply, (5) construction, (6) trade, hotels and restaurants, (7) transportation, communication and storage, (8) financial intermediation, real estate, rental and business services, and (9) community services and social and personal activities. See http://www.turkstat.gov.tr/MetaVeri.do?alt_id=25 for further details.

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Table 2. Summary statistics for years 2002, 2004 and 2010

	Women			Men		
Years:	2002	2004	2010	2002	2004	2010
Schooling						
Illiterate	0.04	0.06	0.05	0.03	0.03	0.03
Primary or less	0.36	0.38	0.32	0.57	0.58	0.51
Secondary	0.17	0.17	0.14	0.14	0.15	0.12
Secondary occup.	0.12	0.12	0.12	0.12	0.11	0.14
Tertiary	0.30	0.27	0.37	0.14	0.13	0.19
Age (years)						
15–19	0.10	0.10	0.07	0.07	0.06	0.06
20–24	0.21	0.20	0.16	0.10	0.11	0.10
25–29	0.19	0.19	0.20	0.18	0.17	0.17
30–34	0.16	0.16	0.17	0.17	0.18	0.18
35–39	0.14	0.14	0.16	0.16	0.16	0.16
40–44	0.11	0.10	0.12	0.14	0.15	0.13
45–49	0.06	0.06	0.07	0.10	0.10	0.11
50–54	0.02	0.03	0.03	0.05	0.05	0.06
55–59	0.01	0.01	0.01	0.02	0.02	0.03
60–64	0.00	0.00	0.00	0.01	0.01	0.01
Marital status						
Never married	0.44	0.42	0.39	0.21	0.22	0.24
Married	0.50	0.52	0.54	0.78	0.78	0.75
Divorced	0.04	0.04	0.06	0.01	0.01	0.01
Spouse died	0.02	0.03	0.02	0.00	0.00	0.00
Residing in urban area	0.89	0.83	0.88	0.85	0.79	0.82
State employee	0.33	0.29	0.27	0.32	0.30	0.23
Having social security	0.71	0.68	0.78	0.71	0.69	0.77
Having additional work	0.01	0.01	0.01	0.02	0.02	0.04

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Table 2. (Continued)

	Women			Men		
Years:	2002	2004	2010	2002	2004	2010
Job tenure in years	6.21	5.99	5.23	8.31	8.06	6.63
Industry						
Agriculture, forestry and fishing	0.05	0.06	0.04	0.02	0.03	0.02
Mining and quarrying	0.00	0.00	0.00	0.01	0.01	0.01
Manufacturing	0.28	0.29	0.22	0.27	0.27	0.25
Electricity, gas and water	0.00	0.00	0.00	0.01	0.01	0.02
Construction and related	0.01	0.01	0.01	0.10	0.09	0.09
Trade, restaurants and hotels	0.15	0.15	0.17	0.20	0.19	0.20
Transportation, communication and storage	0.03	0.02	0.03	0.07	0.07	0.07
Finance, insurance and real estate	0.08	0.08	0.19	0.04	0.04	0.22
Community, social and personal services	0.40	0.38	0.33	0.27	0.27	0.12
Occupation						
Legislators, managers and officials	0.03	0.02	0.03	0.04	0.04	0.05
Professionals	0.18	0.17	0.17	0.09	0.08	0.08
Technicians and asso. professionals	0.14	0.14	0.14	0.08	0.07	0.08
Clerks	0.19	0.18	0.21	0.09	0.08	0.09
Service, shop and sales workers	0.12	0.12	0.16	0.17	0.16	0.17
Skilled agricultural workers	0.00	0.00	0.00	0.01	0.01	0.01
Craft and related trades workers	0.13	0.10	0.06	0.24	0.23	0.20
Plant, machine operators and assemblers	0.05	0.09	0.06	0.15	0.17	0.16
Elementary occupations	0.15	0.19	0.17	0.14	0.16	0.16
Firm size						
Less than 25	0.40	0.44	0.42	0.48	0.49	0.46
25–50	0.17	0.19	0.20	0.14	0.15	0.18
50 and more	0.43	0.37	0.38	0.39	0.36	0.36
No. obs	9,674	13,210	18,441	33,943	51,971	62,573

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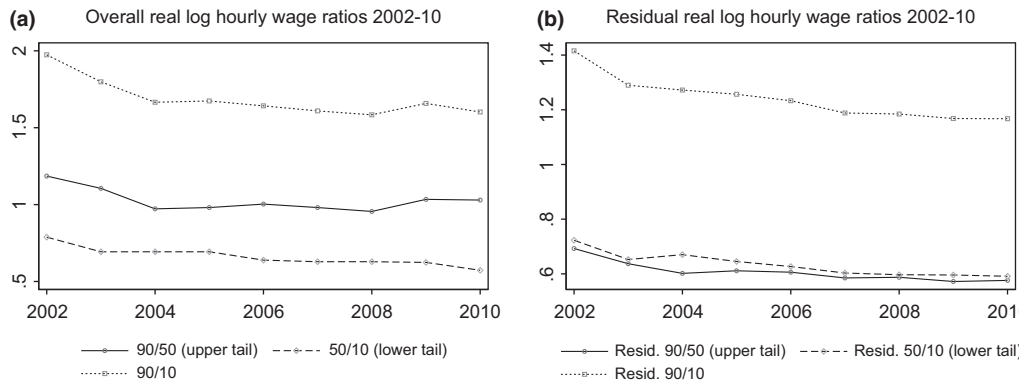
Figure 5. Overall and residual wage inequality



***Notes*:** The overall 90/10 wage inequality measure depicts log wage differentials for the 90th and 10th percentiles. Similarly, the residual 90/10 measure is computed as the difference between the log wages of the 90th and 10th percentiles in a regression of the log wage on a full set of interactions between age groups and education levels.

at the lower end of the distribution increased while the wage gap between deciles (10, 50 and 90) narrowed.

The decline in inequality is more evident when we compare 2002 and 2004 due to two factors: one is the real wage increase in the lower percentiles; the other is the real wage decrease in the upper percentiles (see Figure 6). While real wages did not change much for the 50–80 percentiles, wages below the median wage grew faster. As for the second period, 2004–10, it seems that both ends of the wage distribution benefited relatively more than segments around the median.

For 2002–04, several candidate, and possibly complementary, explanations can be suggested for the rapid decline in wage inequality. The most plausible argument concerns the substantial increase in the real minimum wage in 2004. Between 2003 and 2004, this rose by 24.3 percent while the average wage remained broadly unchanged.[14] The combined effect caused a jump in the level of the minimum wage relative to the average wage (see Figures 2 and 3 for details). This institutional change particularly favoured unskilled workers at the lower end of the wage distribution.

A second explanation could be that there was a rebound following the severe crisis of 2001. That is, it is possible that, following a real wage erosion during the crisis, real wages were readjusted as the economy started to recover. Note that, prior to the 2001 crisis, the economy had also suffered from a recession in 1999 due to the Russian default and the severe earthquake in Kocaeli (Turkey's most industrialized

[14] Between 2003 and 2004, the average wage increase was 1.7 percent for public sector workers and 3.5 percent for private sector workers. For details, see 'Developments In Labour Cost and Net Wages' at the Ministry of Development website, http://www.mod.gov.tr/Pages/ContributionstoOfficialStatisticsProgramme.aspx.

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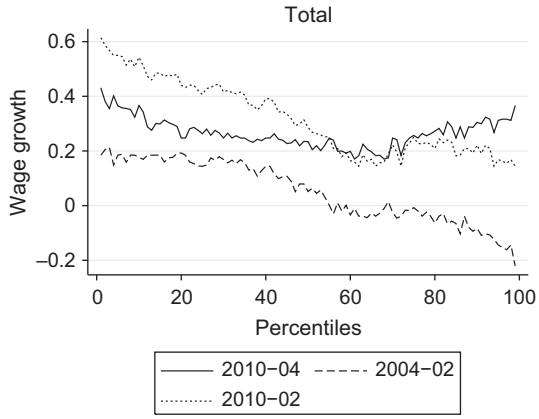
Figure 6. Percentile wage growth, 2010–02



region). However, even if such an adjustment occurred, Figure 3 makes it clear that the effect did not happen immediately after the 2001 crisis, and that the minimum wage increase in 2004 is the only important increase in low wages. Other real wages did not vary much between 2001 and 2005.

Third, changes in the international trade context might also have affected demand for unskilled labour. A real adjustment of the exchange rate (depreciation) could have been responsible for higher labour demand in labour-intensive export sectors, driving wages to rise steadily. However, according to the 'real effective exchange rate' index published by the OECD (2013), the Turkish Lira appreciated between 2002 and 2004: the value of this index passed from 82.3 in 2002 to 89.9 in 2004 (taking 2005 as the base year with a value of 100).[15] Moreover, there were no substantial changes in Turkey's external trade policy (such as quantitative restrictions, tariffs) between 2002 and 2004. Consequently, changes in international trade have, at best, little to do with the decrease in wage inequality between 2002 and 2004. Even if we cannot exclude the possibility that each of these alternative explanations has a role in decreasing wage inequality in Turkey, the most plausible explanation seems to be the minimum wage increase in 2004. That being said, of course, these alternative explanations do not need to be mutually exclusive, as many may be operating simultaneously.

Table 3 shows that the stable growth period has produced real wage gains for all groups in the 2004–10 period – albeit at different magnitudes. However, only low wages (10th, 25th and 50th percentiles) increased in real terms in the 2002–04 period. Higher wage percentiles either stayed constant or decreased in the same sub-period.

[15] Real effective exchange rates, OECD (2013), http://dx.doi.org/10.1787/888932707838.

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Table 3. Raw log wage inequality measures (2002–04–2010): Difference between years and percentiles

	Men			Women		
Years:	**2002–10**	**2002–04**	**2004–10**	**2002–10**	**2002–04**	**2004–10**
Min	0.558	0.251	0.307	0.554	0.251	0.302
Max	0.007	−0.277	0.284	0.006	−0.281	0.287
SD	−0.126	−0.105	−0.021	−0.132	−0.109	−0.023
Variance	−0.173	−0.147	−0.026	−0.198	−0.167	−0.032
p5	0.576	0.251	0.325	0.671	0.251	0.420
p10	0.487	0.231	0.256	0.595	0.203	0.393
p25	0.405	0.186	0.218	0.469	0.225	0.244
p50	0.253	0.100	0.153	0.294	0.107	0.187
p75	0.153	0.002	0.151	0.263	0.025	0.238
p90	0.161	−0.063	0.224	0.253	−0.055	0.308
p95	0.112	−0.085	0.197	0.201	−0.069	0.269
p90/p10	−0.327	−0.294	−0.033	−0.344	−0.258	−0.087
p90/p50	−0.094	−0.163	0.069	−0.041	−0.162	0.121
p50/p10	−0.233	−0.131	−0.102	−0.303	−0.095	−0.208
p75/p25	−0.252	−0.184	−0.068	−0.206	−0.200	−0.006
p95/p05	−0.460	−0.336	−0.124	−0.471	−0.320	−0.151

In terms of gender, the picture does not change much, although the reduction in inequality was sharper for women throughout the period. For both genders, it seems that the reduced wage gap between upper and lower percentiles (both 90/10 and 75/25) resulted from a combination of two effects. Between 2002 and 2004, real wage growth was negative for the percentiles above 70−80 (Figure 6), whereas in the same period, there was substantial increase in real wages in the lower percentiles. If this does not result from a composition effect, we may argue that skill prices have been altered by a structural adjustment in the wage schedule.

4. Changes in relative wages and relative supplies

This section develops a supply–demand analysis as in KM to study the determinants of wage inequality. We examine whether relative changes in supply and demand can explain relative changes in wages for different demographic groups. If not, then we can consider alternative explanations of changes in the minimum wage.

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4.1 Supply and demand framework

Following KM and Acemoglu and Autor (2011, AA hereafter) we construct two samples, a wage and a count (quantity) sample, in order to quantify the role of relative wages and supply. The wage sample is used to measure a wage index while the count sample is used to determine the amount of supplied labour in each demographic group. A demographic group is a cell in an array whose dimensions are education, gender and age group.[16] We group education into five categories: less than primary (below 8 years), primary school (8 years), high school (11 years), vocational high school (12 years) and university or above (15+ years). There are 10 age groups, from 15–19 years to 60–64 years. Thus, in total we obtain $N = 100$ education-by-age-by-gender cells for each year. The wage measure is real hourly wages as detailed in the data section above. Self-employed workers and unpaid family workers are excluded from the wage sample.

We assume that each cell represents a particular type of labour input $k = 1, 2, \ldots, N$. In a given cell k, we have N_k observations. In order to study how labour supply affects wages, we create a wage and a supply index for each cell. Following KM, we use two separate samples for each index. When computing the wage index, the concern is to find a relatively constant composition through time. This is why we focus on workers whose wages are determined in the labour market by excluding self-employed and unpaid family workers. Regarding the supply index, our concern is to compute a relevant aggregate measure.

The weighted average (aggregate) hourly wage for cell k, W_k is given by:

$$W_k = \frac{\sum_{i=1}^{N_k} \lambda_{ik} w_{ik}}{\sum_{i=1}^{N_k} \lambda_{ik} h_{ik}}, \quad k = 1, 2, \ldots, N,$$

where λ_{ik} represents sample weight, w_{ik} real wage and h_{ik} hours worked in the reference period for agent i in cell k where $k = 1, 2, \ldots, N$ (the survey questionnaire asks for monthly wage and hours worked in the reference period).[17] The matrix of these aggregate real hourly wages, $\mathbf{W}$, is an $N \times T$ matrix summarizing the wage or *price sample* formed by the average hourly wage of each cell.

To obtain a supply or *quantity sample*, we first compute total hours worked in each cell k (h_k) and in the overall economy using sample weights λ . $\mathbf{H}$ is an $N \times T$ matrix summarizing the total labour supply in Turkey. This quantity sample is defined in *levels*. Since we are interested in relative supplies we transform this quantity sample into a relative supply index using *shares* instead of levels. For this, we deflate the total hours worked in each cell divided by total hours worked over all

[16] Since age is grouped in 5-year intervals (15–19 years, 20–24 years, etc) in HLFS, we prefer using age group instead of experience group. However, using potential experience defined as `max(min(age-school year-6, age-15), 0)`, yields similar results.

[17] When clear from the context, time scripts will be omitted to simplify notation.

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cells in the economy and get the employment share of cell k in each year (denoted as ℓ_k). **L** is an $N \times T$ matrix summarizing our supply index based on employment shares.

To compute a supply index for a broad category (like college graduates) we use a *fixed-wage* approach, where fixed wages are the average relative wage for each cell. Taking a simple average of labour supplies within each broad category would be misleading, given that workers with different skill levels are not homogeneous within the category. We, therefore, need a measure to express an hour worked, say, by a worker with 40 years experience in terms of hours worked by, say, a worker with 5 years of experience. These measures, called *efficiency units*, are proxied by the arithmetic mean of the *relative wages* for each cell.

Once a reference wage is chosen,[18] we deflate the aggregate wage of cell k by the value of this reference wage for that year to get the relative wage of cell k, z_k. The $N \times T$ matrix formed by relative wages of all demographic groups in each year, is denoted as **Z**. The average values of these relative wages, Z, (an N-element column vector) across years provide our *efficiency units*. Using these efficiency units, we then construct aggregate supply indexes (in efficiency units) for more aggregate groups. First, the efficient labour supply of cell k is obtained from the product of the labour supply measure in each cell and the *fixed wage* of the same cell, ($E_k = h_k z_k$). Then, the total supply of efficient labour is obtained by summing over all groups: $Z'\mathbf{H}$ (a T-element row vector). By deflating the efficient labour supply of each cell by the corresponding total *efficient* labour supply we get **E**, which is an $N \times T$ matrix formed by relative supplies (measured in efficiency units) of all demographic groups in each year. Finally, summing over the sub-cells forming our broad categories (for example, skilled/unskilled) we get efficient labour supply indices for these broad categories.

Following the above approach, the wage index for a broad category (like college graduates), is computed using a *fixed-weight* approach. The aggregate wage for broad categories is a weighted average where the weights are the arithmetic means of raw employment shares, L (an N-element column vector). The objective in using fixed weights is to control for changes in the composition of the different education-age-gender cells. Such aggregates are qualified as *composition adjusted* or composition constant. In other words, we control for changes in composition, that is, by keeping the composition of the broad categories of education constant across time. With this adjustment, we are sure that any change in the relative wages of aggregate groups does not come from a compositional change, in other words, a shift in education, experience or gender composition.

[18] KM combine the arithmetic mean of employment shares, L (an N-element column vector), and the wage matrix **W** to obtain an aggregate wage index that can be used as a *reference wage* (base group) for creating relative wages: $L'\mathbf{W}$ (an $1 \times T$ row vector). AA use the average hourly wage of the cell with white males who have 12 years of schooling and 5 years of experience. Since the only purpose of this reference wage is as a normalization, relative wages should not depend on the choice of the base group.

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4.2 *Relative wage and supply changes*

Table 4 summarizes the main facts about real wages and relative supplies, where we observe substantial changes. We see a similar pattern to the one detailed in the previous section: real wages increase for all groups, though with different magnitudes, while the relative composition of supply shows a different pattern of change between periods. The share of females decreased by 10 points between 2002 and 2004 before returning to close to its initial level between 2004 and 2010. This decline can be attributed to increasing female participation rates in the crisis period. Female workers may have served as buffer labour supply, known as the added worker effect, during the recession. For males, their share first increased by three points before returning back to its initial level. Lines 3–7 show the evolution of relative wages/shares by education level. The relative share of less-educated female workers (below primary) decreased between 2002 and 2010, while the share of all other levels except HSG increasd, whose share remained almost constant. For males, the picture is very similar: the share of less-educated workers decreased substantially while the share of HSG decreased only slightly. The share of other education groups increased significantly, though their real wage gains differed in extent. Most of the compositional change in terms of education can be attributed to generational differences,

Table 4. Log changes in real wages and relative shares measured in efficiency units, 2002–2004–2010

	Changes in log(wages)			Changes in log(shares)		
	2002–04	**2004–10**	**2002–10**	**2002–04**	**2004–10**	**2002–10**
Female	14.75	25.00	39.75	−10.50	11.30	0.81
Male	7.37	22.49	29.86	3.04	−3.29	−0.25
Below-PSG	14.54	27.04	41.58	−5.47	−30.42	−35.90
PSG	8.94	21.72	30.66	8.85	18.10	26.95
HSG	3.92	14.84	18.76	13.47	−17.47	−3.99
VHS	1.87	13.15	15.01	−2.73	25.93	23.20
CLG	−3.85	23.25	19.41	0.96	39.89	40.85
20–24, Below-HSG	18.92	25.12	44.04	−6.90	−42.81	-49.71
50–54, Below-HSG	15.09	30.13	45.22	−0.01	−8.21	−8.22
20–24, HSG	10.47	23.50	33.97	−11.40	−21.07	−32.47
50–54, HSG	7.11	23.56	30.66	46.41	29.51	75.92
20–24, CLG	3.74	15.03	18.77	9.06	42.81	51.87
50–54, CLG	3.41	28.73	32.14	11.50	42.54	54.03

***Note*:** Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

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particularly to the arrival of new, relatively more educated cohorts. The rest of the table compares the evolution of the relative wages/shares of age groups 20–24 years and 50–54 years for HSG, below-HSG and CLG. It might be reasonable to think that large educational inter-generational differences would produce some kind of rejuvenation favouring the recruitment of younger workers, which would possibly lead to a partial exclusion of older workers. Counter-intuitively, however, the share of younger HSG decreased, while that of older ones increased throughout the period. Between 2002 and 2010, the relative share of young workers is positively correlated with education level, while the opposite is true for relatively old workers. A striking fact is that, despite the opposite movements in the relative shares of young (20–24 years) and old (50–54 years) workers with high school diploma or below (−32.47 percent vs. 75.92 percent), their wage increases were almost equal (33.97 percent vs. 30.66 percent). Another interesting finding is that the increasing share of both young and old college-graduates coincides with relatively increasing real wages, which suggests an SBTC framework.

Figure 7 presents the evolution of real log wages by education level and gender. Before analyzing *relative* wages, we focus on *real* wages in order to draw out the aggregate trends in the labour market. To facilitate comparison, each series is normalized to zero in 2002, with the following years showing the cumulative log change of real wages in comparison with 2002 levels. First, real wages increased for all education groups and both genders. Second, there seems to be a negative correlation between real wage growth and education level for both genders. Third, for males, vocational high school graduates have lower growth rates than high school graduates, whereas for females the picture is the opposite. Fourth, when we look at relative supply, measured in efficiency units, we see that both male and female shares of below-PSG workers decreased, and HSG have an almost constant share in the female labour force but a slightly decreasing one for male workers after 2004. This decrease is less pronounced than for below-PSG ones however. Shares for the other education levels increased for both genders.

Figure 8 plots the composition-adjusted log hourly wage differences for CLG/Below-CLG, CLG/HSG, CLG/Below-HSG and HSG/Below-HSG. The adjustment involves keeping constant the relative employment shares of the demographic groups (defined by gender, education, experience and year). This adjustment ensures that the observed evolution of the college premium is not due to a change in the experience, education or gender composition of the college and/or high school graduates (say, an increase in the experience level of more-educated workers). Mean wages are aggregated into broader groups (CLG, HSG etc.) using a weighted average scheme where weights are fixed-employment shares.

The comparison of aggregate groups reveals a number of patterns. The log wage gap between HSG (high school graduates) and below-HSG decreased steadily. The log wage gap between CLG (college graduates) and HSG exhibits two asymmetric trends: it first decreased between 2002 and 2005 before increasing after 2005. CLG/

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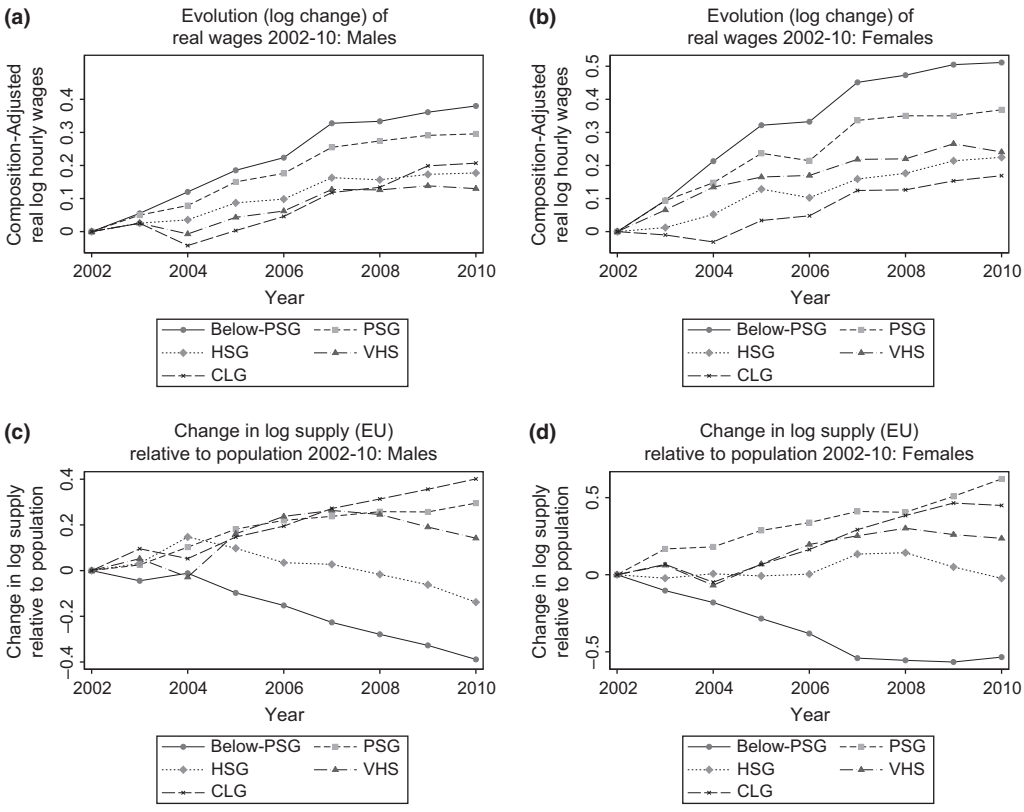
Figure 7. Evolution of real wages and labour shares (in efficiency units): Males and females separately



***Note*:** Below-PSG, PSG, HSG, VHS and CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

Below-HSG and CLG/Below-CLG wage ratios follow similar trends: between 2002 and 2005 they decreased but after 2005 they remained almost constant.

Figure 8 shows how the relative price of education across groups has evolved. In order to see whether changes in relative prices can be explained by changes in relative supplies one needs to look at the relative supply by education group measured in efficiency units (see Figure 9). The use of efficiency units as aggregated allows us to take into account changes in the labour force composition. Each demographic group is weighted by its average relative quality (wage). We observe a steep and almost uniform increase in the log relative supply of CLG workers beginning from 2004 compared to below-CLG, below-HSG and HSG workers (see Figure 9). The HSG/below-HSG log relative supply index increases between 2002 and 2004 but stays approximately constant after 2004.

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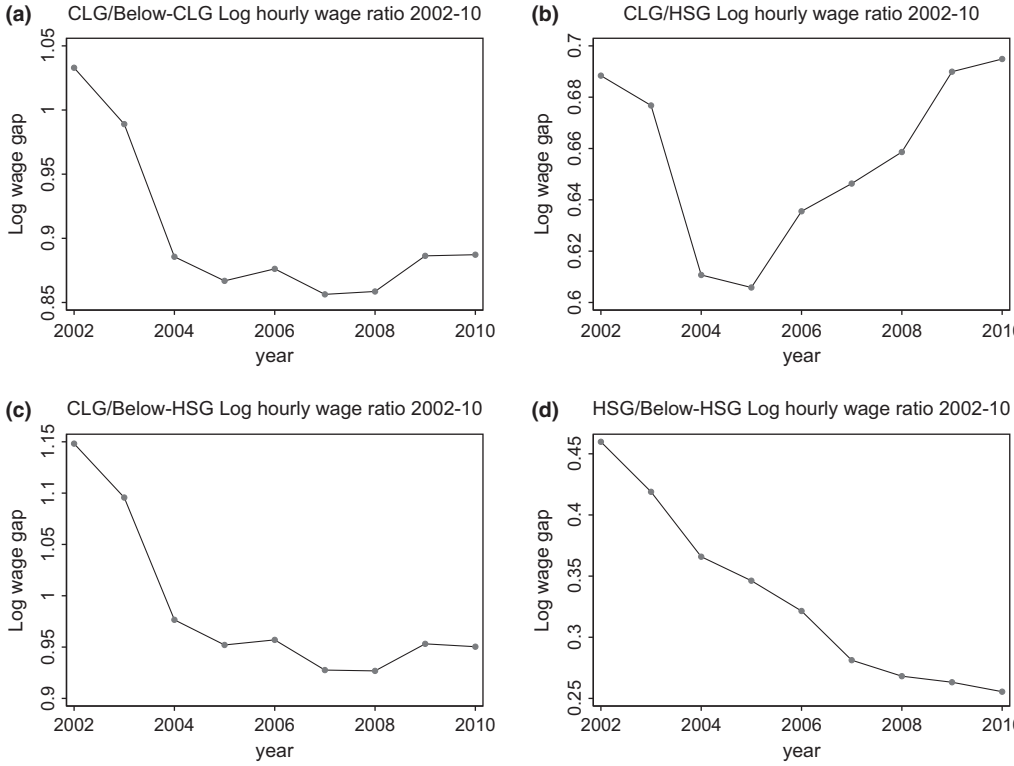
Figure 8. Composition adjusted wage ratios



***Notes*:** Mean real hourly wages are computed for 100 gender–education–experience demographic groups: 2 genders, 5 education groups (below primary school, primary school, high school, vocational high school and college-and-plus) and 10 age groups (15–19, 20–24, . . ., 60–64). Total (weighted sum of) wage income is divided by total (weighted sum of) hours worked in each cell, where weights are sample weights of the HLFS. The mean log real hourly wages for broader (more aggregate) categories (college graduate, below college graduate, below high school graduate) are computed as a weighted average of the mean log wages where weights are given by average employment shares of the relevant gender–education–experience demographic groups. Below-PSG, PSG, HSG, VHS and CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

At the aggregate level, the evolution of relative supplies provides an interesting feature of Turkey's labour market. Excluding 3 years (2002–04), the relative share of all three groups, namely CLG/below-HSG, CLG/HSG and HSG/below-HSG, increased possibly due to structural and demographic changes in Turkey. The share of less-educated workers (illiterate, literates without a diploma and junior primary school graduates) decreased while the average education level (and years of schooling) gradually increased. We can make three major observations from Figures 8 and 9. First, between 2002 and 2004, the log relative supply index had a very similar

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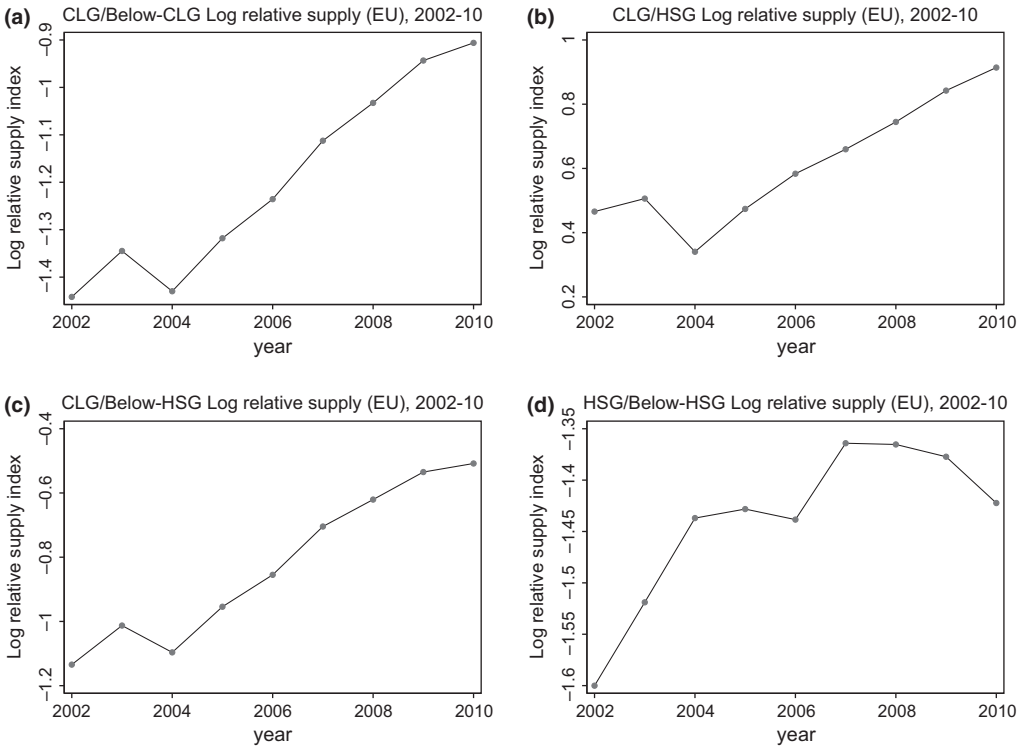
Figure 9. Relative supplies in efficiency units



***Notes*:** Labour supply is computed using all workers aged 15–64 years who worked between 35 and 84 hours as wage earner, self-employed or unpaid family worker. For each year, 100 gender–education–experience cells are created: 2 genders, 5 education groups (below primary school, primary school, high school, vocational high school and college-and-plus) and 10 age groups (15–19, 20–24, . . ., 60–64 years). The total actual hours worked by each demographic group are computed taking into account sample weights. Then, these hours are converted into efficiency units by multiplying the total hours in each cell by the average relative wage (fixed wage) of the cell. The efficient labour supply of each cell is then deflated by the sum of total efficient labour supply over all cells so that we get the share of efficient labour supply for each cell. The labour supply (in efficiency units) of each aggregate group (such as college graduates) is computed as the sum of labour shares forming this aggregate group (all gender–experience cells that are college graduate). Below-PSG, PSG, HSG, VHS and CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

shape for CLG/below-CLG, CLG/HSG and HSG/below-HSG in that the 2004 value is very close to the 2002 value for each of these three comparison groups. That is, there was no significant change in terms of relative supplies. However, in each case, the relative wages of lower education levels increased more than those of college graduates. This observation suggests that factors other than relative supplies might be affecting the wage schedules of these education groups. Second, during the

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2004–10 sub-period, the log relative supply indices of CLG/below-CLG, CLG/HSG and HSG/below-HSG followed very similar increasing trends. However, the log relative wage indices of CLG/below-CLG and HSG/below-HSG remained almost constant, while the CLG/HSG log relative wage index increased. Once more, a simple supply–demand framework cannot explain these asymmetric behaviours if we assume stable demand schedules. Third, a simple supply–demand framework with a stable demand can partially explain the evolution of relative wages in terms of changes in relative supply in the case of HSG vs. below-HSG workers. However, even this is incomplete because trends after 2007 are not consistent with this simple framework.

Table 5 is computed as the inner product of changes in the relative wages and changes in relative shares (measured in efficiency units) of the demographic groups. When we consider 2002–08 (the first six rows of Table 5), nearly all entries are negative, which is compatible with a stable demand curve hypothesis. The only positive entry is the one relating to 2003 and 2004. If there is no measurement error specific to this entry, then one can claim that changes in relative supplies can explain all changes in relative wages except for 2004. A second important finding concerns the two most recent years (2009 and 2010), presented in the last two rows. From 2004 onwards, all corresponding entries have positive values. This picture confirms our earlier findings: firstly, the minimum wage increase in 2004 caused a decrease in inequality by increasing low wages substantially. And secondly, there seems to be a shift in the demand schedule after 2008.

Figure 10 also yields a partial support for the above claims. It shows how changes in log relative supplies are related to changes in log relative wages for education-by-age-by-gender demographic groups for the 2002–04 and 2004–10 sub-periods. When both males and females are considered there is no clear trend between relative supply and relative wage changes (results not reported here). However, if we consider only males, then the slope is positive in each sub-period. The slope is also steeper between 2004 and 2010, which implies that the demand curve may not be stable in this sub-period. Hence, we can say that the male workers whose relative labour share increased the most, also experienced the largest increase in relative wages. Remember that the expected slope is negative in Figure 10, once demographic groups are considered as distinct and imperfect substitutes in the production process and assuming a stable demand curve.

To sum up, the analysis so far (Figures 8, 9, 10 and Table 5) confirms that a simple supply–demand framework with a stable demand schedule cannot fully explain the evolution of Turkey's wage structure during the period 2002–10. We also think that it is convenient to consider 2002–04 and 2004–10 separately. We claim that the decrease in the wage gap between more-educated workers and less-educated workers in 2002–04 was due to the sharp increase in the real minimum wage in 2004. To explain the wage dynamics in 2004–10, we rely on demand shifts favouring skilled workers. The co-movement of relative supply and relative wages during 2004–10 in the case of CLG/HSG, and the nearly constant trend of relative wages in the case of

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Table 5. Inner product of changes in relative wages with changes in relative supply for 100 (= 2 × 5 × 10) demographic groups

	2002	2003	2004	2005	2006	2007	2008	2009
2003	−0.0009							
2004	−0.0035	0.0011						
2005	−0.0124	−0.0049	−0.0011					
2006	−0.0161	−0.0078	−0.0007	0.0001				
2007	−0.0267	−0.0154	−0.0021	−0.0004	−0.0017			
2008	−0.0299	−0.0179	−0.0023	−0.0014	−0.0032	−0.0007		
2009	−0.0243	−0.0120	0.0073	0.0062	0.0021	0.0020	0.0015	
2010	−0.0225	−0.0106	0.0101	0.0098	0.0060	0.0043	0.0039	−0.0002

CLG/below-CLG and HSG/below-HSG, despite their relative supply increasing, requires a shift in the relative demand for skilled workers. However, neither argument can explain the downward trend in the HSG/below-HSG log relative wage index after 2004, despite an almost stable HSG/below-HSG log relative supply index. A possible explanation is that a pooling equilibrium made the sorting (by ability) less likely due to compulsory education reform which increased education levels.

In short, the analysis so far calls for a detailed analysis of changes in relative demand for different skill groups. In the following section, we document the evolution of relative labour demand for different demographic groups.

4.3 Changes in relative demand for labour

To this end, we decompose changes in relative demand into 'within industry shifts' (changes in relative demand occurring within each industry) and 'between industry shifts' (changes in relative demand due to reallocation of labour across industries). For a given vector of wages, we may observe a shift in the labour demand for more-educated workers resulting from the adoption of a new technology more complementary to highly educated workers. A typical example may be the SBTC due to the rise of computer-related technologies in production processes, in which case the expected impact would be an increase in labour demand for college graduates within each sector. Other cases for within-industry demand shifts are price changes in non-labour inputs (for example, computers) and off-shoring.

Another reason for changes in relative labour demand concerns between-industry shifts. For any given relative wages, we can observe a change in relative labour demand (say, an increase in the share of college-educated workers) if industries vary in skill composition and if shifts in industrial employment distributions occur over time. This would be the case, for instance, if consumers' preferences about different

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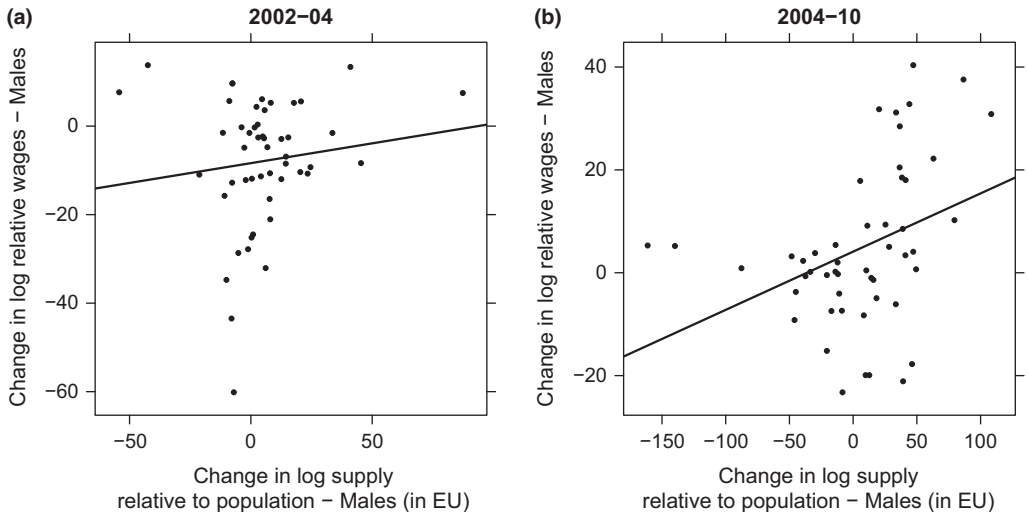
Figure 10. Changes in relative supply in efficiency units vs. changes in relative wages (males only).



commodities change over time. Another example would be changes in production structure as a result of international competition.

At the one-digit level, there are nine sectors for economic activity reported by TurkStat in the HLFS data, in conformity with the International Standard of Economic Activities in the European Union (NACE) classification of economic activities.[19] The occupation classification follows the *International Standard Classification of Occupations* (ISCO-88) at the one-digit level. We grouped the nine occupations into four broad categories, by combining KM and the European Working Conditions Surveys classifications.[20]

Table 6 shows the average employment in different sectors and occupations for the 2002–10 period. This indicates the magnitude of demand shifts between sectors. Given that there are substantial differences between the average employment shares of educational groups across sectors and/or occupations,

[19] See footnote 12 for details.

[20] KM divides workers into three broad categories: (i) professionals, (ii) clerical and sales workers, (iii) production and service workers. The European Working Conditions Surveys distinguish between 'high skilled white collar' workers (ISCO codes 1–3, including legislators, senior officials and managers, professionals and technicians and associate professionals), 'low skilled white collar' workers (ISCO codes 4 and 5 including clerks and service workers and shop and market sales workers), 'high skilled blue collar' workers (ISCO codes 6 and 7, skilled agricultural and fishery workers and craft and related trades workers), and finally 'low skilled blue collar' workers (ISCO codes 8 and 9, plant and machine operators and assemblers and elementary occupations). We define the following four broad categories: (i) 'professionals, technical and managers' (ISCO codes 1-3), (ii) 'clerical, sales and services' (ISCO codes 4 and 5), (iii) 'production workers' (ISCO codes 6-8), (iv) 'Unskilled workers - Other' (ISCO code 9). Accessed on 17 October 2012.

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one expects that the reallocation of labour from one sector to another might have an important impact on wage inequality. For instance, an increase in the share of agriculture would favour low-educated workers (40 percent of below-PSG work is in agriculture), while an increase in the share of services will boost demand for highly educated workers, as half of college graduates are employed in this sector.

Table 7 presents the evolution of sectoral and occupational shares in Turkey between 2002 and 2010. This is a direct measure of between-industry shifts in labour demand. As it shows, agriculture's share in employment decreased sharply from 33 to 22 percent, while construction, trade and manufacturing each gained almost 2 percent, and services grew by 5 percent. The conclusion that emerges from Tables 6 and 7 seems to be the following: there has been a labour shift from the resource-based, low-technology sector (agriculture) towards medium-technology sectors. The evolution of occupations yields a similar picture. The share of relatively low-skill occupations (production workers) decreased by 10 percentage points, while all others' shares increased to a small extent.

To compute between- and within-industry demand shifts, following Autor *et al.* (1998), we use a standard shift-share analysis. [21] We can decompose the change in education group k's relative share between years s and t as follows:

$$\frac{\Delta E_{kt}}{E_{ks}} = \sum_j \frac{\gamma_{kj}\Delta E_{jt}}{E_{ks}} + \sum_j \frac{\Delta \gamma_{kjt} E_j}{E_{ks}}$$

where j indexes industries, E_{jt} and E_{kt} are, respectively, the share of industry j and education group k employment in total employment in year t (all measured in efficiency units), $\gamma_{kjt} = E_{kjt}/E_{jt}$ is the education group k's share of employment in industry j in year t, γ_{kj} and E_j refer to the arithmetic averages of years s and t.

Table 8 shows the results of a standard shift-share analysis for each education-by-gender groups for different sub-periods. For each period and demographic group, we report the overall demand shift and decompose it into 'between-industry' and 'within-industry' components. Our results for the entire period, 2002–10, show that both overall and between-industry demand shifts increased with the education level. College graduate (CLG) males have seen their demand increase by approximately 21 percent between 2002 and 2010 compared to workers with just a high

[21] KM derives a variant of the 'fixed-coefficient manpower requirements index' based on efficiency units to compute between and within components when employment is measured in efficiency units. They define demand shifts between occupation-by-industry cells as total (overall) demand shifts, and between-industry effects as demand shifts between industry cells only. Thus, in KM's approach, the within-industry component measures only shifts in employment between occupations within industries. See Bakis and Polat (2014) for a comparison of the standard shift-share analysis with the fixed-coefficient manpower requirements index. Both methods yield very similar results.

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Table 6. Average employment shares of education groups across industries and occupations, 2002–10

Indust./occup.	Below-PSG	PSG	HS	VHS	CLG
Agriculture	40.04	17.19	8.35	6.90	1.64
Mining	0.56	0.66	0.53	0.64	0.43
Manufacturing	18.96	24.30	17.70	27.35	12.00
Electricity and gas	0.26	0.39	0.57	1.50	0.65
Construction	7.15	6.46	4.14	4.71	3.01
Trade	18.71	28.59	34.10	26.07	13.90
Transportation	5.25	6.67	7.59	6.32	4.43
Finance	1.33	2.68	7.14	6.37	12.12
Other services	7.74	13.05	19.87	20.14	51.82
Prof. & Tech.	6.43	10.24	21.66	25.33	71.97
Cler.& Serv.	10.73	23.98	42.19	31.26	21.51
Prod. workers	63.95	50.22	26.91	35.81	5.47
Unskilled workers	18.88	15.56	9.23	7.60	1.05

***Note*:** Below-PSG, PSG, HSG, VHS anc CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

Table 7. Overall industry and occupation employment distributions, 2002–10

Indust./occup.	2002	2004	2006	2008	2010	Total change
Agriculture	33.43	31.41	24.57	20.38	21.58	−11.86
Mining	0.57	0.52	0.61	0.60	0.57	−0.00
Manufacturing	18.27	18.32	19.80	21.36	20.20	1.92
Electricity and gas	0.47	0.36	0.40	0.43	0.79	0.32
Construction	4.81	5.23	6.27	6.43	6.93	2.12
Trade	19.82	20.87	22.95	23.51	21.27	1.45
Transportation	5.23	5.67	5.83	5.65	5.92	0.69
Finance	3.03	3.46	4.37	5.38	3.37	0.34
Other services	14.37	14.17	15.18	16.27	19.38	5.01
Prof. & Tech.	15.85	16.68	18.22	18.86	18.38	2.53
Cler. & Serv.	17.52	17.16	19.49	21.11	21.38	3.86
Prod. workers	54.88	52.51	47.71	44.24	44.32	−10.56
Unskilled workers	11.76	13.65	14.57	15.79	15.93	4.17

***Note*:** Below-PSG, PSG, HSG, VHS anc CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

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Table 8. Between- and within-industry decomposition of changes in employment shares of demographic groups (multiplied by 100) using a standard shift-share approach, 2002–04–2010

		Between-industry			Within-industry			Overall effect		
	Educ.	2002–04	2004–10	2002–10	2002–04	2004–10	2002–10	2002–04	2004–10	2002–10
F	Below-PSG	−5.67	−8.12	−13.10	−4.51	−0.04	−3.89	−10.19	−8.17	−16.99
	PSG	0.15	1.01	1.17	0.15	1.27	1.31	0.30	2.28	2.48
	HSG	0.08	0.37	0.54	−0.16	0.08	−0.10	−0.08	0.45	0.43
	VHS	−0.02	0.12	0.10	−0.03	0.08	0.05	−0.05	0.20	0.16
	CLG	−0.49	4.37	4.73	−0.45	2.65	2.54	−0.94	7.02	7.27
M	Below-PSG	−4.51	−180.38	−189.04	−3.74	−125.30	−131.88	−8.25	−305.67	−320.93
	PSG	0.22	0.68	0.91	0.16	0.57	0.71	0.37	1.25	1.61
	HSG	3.74	−4.94	−1.04	3.07	−6.63	−3.07	6.81	−11.57	−4.11
	VHS	−0.39	3.17	2.80	−0.37	1.96	1.45	−0.76	5.13	4.24
	CLG	0.65	10.23	11.68	0.79	4.71	6.01	1.44	14.94	17.69

Note: Employment is measured in efficiency units. Below-PSG, PSG, HSG, VHS anc CLG denote, respectively, below primary school, primary school, high school, vocational high school and college graduates.

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school degree (HSG), although for CLG females the difference is only about 8 percent. A general observation is that between-industry demand shifts are stronger than within-industry ones. Within-industry effects are positively significant only for CLG males and females between 2004 and 2010. Meanwhile, relative demand for male HSGs, and both male and female with below-PSG education levels fell.

To the extent that between-industry effects fail to confirm the SBTC argument, we can claim that Table 8 shows a shift in product demand (rather than SBTC), which causes the reallocation of labour across sectors. Nevertheless, note that, since we use only nine sectors, it is possible that our within-industry shifts mask some between-industry effects as well. Clearly, for a deeper analysis distinguishing within- and between-effects, one should use a more disaggregated dataset, such as firm- or plant-level data.

5. Decomposing wage inequality

5.1 Methodology

In this section, we decompose wage inequality in order to analyze how changes in individual attributes affect wage distribution. Among various decomposition strategies, we choose to follow techniques developed by DFL and JMP for two reasons. First, both of these techniques are generalizations of the Oaxaca decomposition, but with the difference that they estimate entire wage distributions instead of just the mean. This allows them to measure wage inequality at different percentiles using counterfactual wage distributions. Second, their use of both techniques helps to compare the consistency of obtained results.[22]

To give a brief account, JMP proposes an imputation approach where the wage from a given period t is replaced by a counterfactual wage at $t + 1$ where the returns to both observables and unobservables are set to be as in $t + 1$. The implementation of this procedure follows two steps: first, unobservables (residuals) are replaced by counterfactual unobservables; second counterfactual returns to observables are imputed.[23] Let us assume that we have information about wages w and individual attributes x, given at time t.[24] The density of wages at one point in time $g(w|t)$ can be written as the integral of the density of wages conditional on a particular set of workers' attributes at a certain time t, $g(w|x,t)$ over the distribution of characteristics $dF(x|t)$:

[22] JMP and DFL methodologies have had a decisive impact on later improvements in the decomposition literatures. For further discussions, see Fortin *et al.* (2011).

[23] The details of the JMP decomposition will be skipped and the study will concentrate on the DFL decomposition since it is more widely used in the literature. See Fortin *et al.* (2011).

[24] The individual attributes are described in the data section. The same set of variables for both JMP and DFL decomposition are treated.

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$$g(w|t) = \int_x g(w|x, t_{w|x}) dF(x|t_x). \tag{1}$$

The construction of the counterfactual density entails using a different date for different parts of the integral. Therefore, while $g(w|t_{w|x} = 10, t_x = 10)$ represents the density of wages in 2010, given the distribution of attributes at 2010, $g(w|t_{w|x} = 10, t_x = 02)$ represents the density of wages that would have prevailed while holding the 2010 wage structure constant but assuming that the composition of attributes remained as in 2002 $F(x|t_x = 02)$. Using the notation above,

$$\begin{aligned} g(w|t_{w|x} = 10, t_x = 02) &= \int_x g(w|x, t_{w|x} = 10) dF(x|t_x = 02) \\ &= \int_x g(w|x, t_{w|x} = 10) \frac{dF(x|t_x = 02)}{dF(x|t_x = 10)} dF(x|t_x = 10). \end{aligned} \tag{2}$$

By applying Bayes rule, we can construct the counterfactual density, re-weighting the real wage distribution with the actual year:

$$\begin{aligned} dF(x|t) = \frac{g(x,t)}{P(t)} &= \frac{g(x)P(t|x)}{P(t)} g(w|t_{w|x} = 10, t_x = 02) \\ &= g(w|x, t_{w|x} = 10)\theta(x) dF(x|t_x = 10) \end{aligned} \tag{3}$$

where

$$\theta(x) = \frac{P(t = 02|x)}{P(t = 10|x)} \frac{P(t = 10)}{P(t = 02)}. \tag{4}$$

DFL suggests a parametric approach to estimate the weighting factor. Assuming that the choice of estimation procedure may affect the results, it is common practice to opt for a probit model estimation. We follow the same procedure, using the set of individual controls given in Table 2 to estimate differences by controlling for the composition effect within years. The probit results are summarized in the Appendix B, Table B1. We can now rewrite the differences in wage densities as a decomposition of the two effects: composition and price (or wage structure):

$$\begin{aligned} &g(w|t_{w|x} = 10, t_x = 10) - g(w|t_{w|x} = 02, t_x = 02) = \\ &\underbrace{\left(g(w|t_{w|x} = 10, t_x = 10) - g(w|x, t_{w|x} = 10)\theta(x) dF(x|t_x = 10)\right)}_{compositioneffect} \\ &+ \underbrace{\left(g(w|x, t_{w|x} = 10)\theta(x) dF(x|t_x = 10) - g(w|t_{w|x} = 02, t_x = 02)\right)}_{priceeffect}. \end{aligned} \tag{5}$$

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The first of term of Equation (5) is the composition effect where the wage schedule in 2010 is kept identical but the distribution of attributes is re-weighted according to the distribution prevailing in 2002. The second term is the price effect, for which the distribution of attributes is similar to that in 2002 but with different wage schedules. The benefit of DFL's decomposition is that the wage effect can now be interpreted as a kind of treatment effect that includes the contribution of unobservable factors. However, before proceeding, several shortcomings of the counterfactual analysis need to be acknowledged. First, the the DFL decomposition, like other techniques, makes the simplifying step of ignoring possible general equilibrium effects on prices when the composition of quantities change. Second, besides being intuitive, the technique does not justify causal inferences. Bearing these caveats in mind, in the following section, we discuss the size of composition and price (or wage structure) effects on the wage inequality in Turkey.

5.2 Findings

First, we present the results of the JMP decomposition for three different periods before carrying out a similar exercise using the DFL procedure. The sub-periodization discussed above is helpful in two ways. First, it allows us to disentangle when the effect of economic recovery helped reduced wage inequality. Second, it helps to capture which particular institutional changes contributed to the reduction of inequality for specific groups at different segments of the wage distribution. This makes the analysis complementary to our previous discussion emphasizing the changing structure of price (or wage) schedules. For both the JMP and the DFL decomposition, the same set of individual covariates is used in order to avoid any confusion in comparing both techniques. The JMP decomposition describes changes in the components of wage density that can be attributed to measured prices and quantities, and residuals which are referred to as unmeasured prices and quantities.

In the case of male wage inequality, the JMP decomposition clearly shows (Table 9) that differences in observable prices contributed most to the reduction in inequality between the 90/10 percentiles between 2002 and 2010. The total contribution of differences in quantities and residuals were lower than those of prices. The same result holds for female wage inequality for the 90/10 percentiles. As for the decrease in inequality for the 50/10 percentiles, the contribution of quantities is almost equal to those of prices and residuals (or unobservables).[25] The change for the 90/50 wage gap for both genders is greater than for the wage gap between other percentiles, at least for 2002–10.

The results of the DFL decomposition largely back those using the JMP technique. Table 10 shows that the price effect dominates the composition effect

[25] One of shortcomings of the JMP procedure is that the total contribution of components may not add up to one, so the contribution of each factor is not given as the percentage of the total change.

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Table 9. JMP decomposition results: Changes in wage inequality

	Years 2010–02				Years 2004–02				Years 2010–04			
	Total	Quantities	Price	Unobserv.	Total	Quantities	Price	Unobserv.	Total	Quantities	Price	Unobserv.
						Men						
p90/10	−0.328	−0.032	−0.175	−0.122	−0.294	−0.051	−0.155	−0.089	−0.035	0.014	−0.009	−0.039
p50/10	−0.233	−0.078	−0.072	−0.082	−0.131	−0.045	−0.029	−0.056	−0.102	−0.034	−0.038	−0.031
p90/50	−0.095	0.047	−0.102	−0.040	−0.163	−0.005	−0.125	−0.033	0.068	0.048	0.028	−0.009
p75/25	−0.252	−0.078	−0.108	−0.066	−0.184	−0.044	−0.094	−0.046	−0.068	−0.017	−0.028	−0.023
Std.	−0.126	−0.012	−0.064	−0.050	−0.105	−0.014	−0.059	−0.033	−0.021	0.004	−0.005	−0.020
Mean	0.300	−0.004	0.304	0.000	0.092	−0.018	0.110	0.000	0.208	0.017	0.191	0.000
						Women						
p90/10	−0.346	−0.067	−0.176	−0.104	−0.260	−0.031	−0.177	−0.052	−0.087	−0.024	−0.009	−0.054
p50/10	−0.303	−0.111	−0.092	−0.100	−0.095	0.002	−0.034	−0.063	−0.208	−0.095	−0.075	−0.037
p90/50	−0.043	0.044	−0.083	−0.004	−0.164	−0.033	−0.143	0.011	0.121	0.071	0.066	−0.016
p75/25	−0.205	−0.076	−0.096	−0.034	−0.199	−0.068	−0.109	−0.021	−0.006	0.008	−0.004	−0.010
Mean	0.362	0.043	0.319	0.000	0.109	−0.015	0.123	0.000	0.254	0.072	0.181	0.000
Std.	−0.132	−0.019	−0.072	−0.042	−0.109	−0.021	−0.068	−0.020	−0.023	0.004	−0.003	−0.024

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throughout the period particularly for the shrinking wage gap between the 90/10 percentiles. Regarding our earlier discussion, it would be more informative to look at the evolution of wage inequality by dividing the period 2002–10 in two: 2002–04 and 2004–10. The first sub-period, 2002–04, coincides with the episode where a real minimum wage hike took place. Keeping in mind that during the second sub-period, minimum wages were set above the inflation rate (Table 3), the impact on the wage schedule turns out to be real rather than nominal. Clearly, a reduction in the wage gap between the 90/10 percentiles occured between the years 2002 and 2004. A similar observation can be made for the male wage gap between 50/10, except that price effect made a lower contribution than for the 90/10 wage gap. This result is quite intuitive since the real minimum wage increase might also have affected the wages of workers paid around the median of the distribution. Hence, we can expect that the contribution of prices will become less important while the difference of quantities will have a larger effect on the reduction of inequality.

In a similar way, we can detect further evidence of the decreasing effect of the real minimum wage increase by looking at changes in the wage gap for the 90/50 percentiles. The results show that real wages at the median situated at the 50th percentile were also affected by the change in minimum wage legislation in the first semi-annual term of 2004. Thus, the 90/50 wage gap decreased between 2002 and 2004, in contrast with 2004–10 period, where a combination of price and composition effects offset the reduction in inequality. Therefore, as far as male wage inequality is concerned, one can argue that the reduction in 90/10 and 90/50 throughout the period is the result of a price effect, mainly due to the minimum wage increase. The DFL composition results confirm this argument more robustly in the sense that the composition effect remains relatively small compared to the wage effect.

Turning to female wage inequality, the same pattern can be traced from both the JPM and DFL decompositions, with the exception that the inequality reduction is much sharper, and that the 50/10 wage gap continued to decrease between 2004 and 2010, again largely due to a wage effect. The 90/50 gap widened significantly during 2004–10, mainly due to differences in prices, contrary to the male case. For the female case, then, the price effect clearly dominates the composition effect throughout 2004–10. We can thus argue that the sharp decline in wage inequality, particularly between the 10th percentile and upper percentiles may have contributed to the convergence between male and female wages (Table 3). In Turkey's labour market, female labour force participation typically increases with education level. This peculiarity is reflected in the wage distribution as well: as we move along the wage distribution, female hourly wages are higher compared to male wage earners. We will not further investigate any gender wage convergence, since it needs different elaboration with regards to labour force participation.

When the results of the decompositions are combined with the raw wage inequality in Table 3 and a visual inspection of Figure 6, we can affirm that one other reason why wage inequality has decreased, stems from the reference wage effect of the minimum wage. Thanks to the regulation of minimum wages, the

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Table 10. DFL decomposition results: Changes in wage inequality

	Years 2010–02				Years 2004–02				Years 2010–04			
	Total	Composition	Price	% of Price	Total	Composition	Price	% of Price	Total	Composition	Price	% of Price
						Men						
p90/p10	−0.3285	−0.0587	−0.2698	82.1	−0.2939	−0.0492	−0.2447	83.3	−0.0329	−0.0053	−0.0276	83.9
p50/p10	−0.2332	−0.0443	−0.1889	81.0	−0.1309	−0.0423	−0.088	67.2	−0.1023	−0.0284	−0.0739	72.2
p90/p50	−0.0953	−0.0144	−0.0809	84.9	−0.163	−0.0069	−0.1561	95.8	0.0694	0.0231	0.0464	66.9
p75/p25	−0.2518	−0.1292	−0.1226	48.7	−0.1845	−0.0404	−0.144	78.0	−0.0677	−0.0207	−0.047	69.4
Variance	−0.1733	−0.0437	−0.1296	74.8	−0.1471	−0.0185	−0.1286	87.4	−0.0264	−0.0188	−0.0076	28.8
Std.	−0.1263	−0.0342	−0.0922	73.0	−0.1056	−0.0142	−0.0914	86.6	−0.0209	−0.0149	−0.0059	28.2
						Women						
p90/p10	−0.3505	−0.1409	−0.2096	59.8	−0.2639	−0.0447	−0.2191	83.0	−0.0829	−0.0688	−0.0141	17.0
p50/p10	−0.3032	−0.1007	−0.2025	66.8	−0.0954	−0.0264	−0.069	72.3	−0.2041	−0.0584	−0.1458	71.4
p90/p50	−0.0473	−0.0402	−0.007	14.8	−0.1685	−0.0183	−0.1501	89.1	0.1212	−0.0105	0.1316	108.6
p75/p25	−0.2052	−0.1272	−0.078	38.0	−0.1996	−0.0538	−0.1458	73.0	−0.0063	−0.0645	0.0583	−925.4
Variance	−0.1993	−0.0624	−0.1368	68.6	−0.1688	−0.0288	−0.14	82.9	−0.032	−0.0275	−0.0045	14.1
Std.	−0.1326	−0.0441	−0.0884	66.7	−0.1105	−0.02	−0.0905	81.9	−0.023	−0.0198	−0.0032	13.9

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decrease in the real wage of upper percentiles (starting from 60th percentile) did not affect the lower percentiles in 2002–04. Rather, the substantial improvement in the real wages of mostly lower-skilled workers during this period had a welfare increasing effect on wage earnings.

Figures 11, 12 and 13 display the wage distribution for each year and the counterfactual distribution re-weighted, with individual attributes held in their previous year composition with the current year pay schedule. Between 2002 and 2004, the counterfactual distribution shows that the composition effect nearly matches the actual distribution, which implies that the shift in wage distribution and the change at lower percentiles are predominately the result of a wage effect (Figure 12). When compared with the rest of the distribution, the shift in the upper percentiles from 2002 to 2004 is less clear. As discussed above, for the female wage distribution, the shift at the lower percentiles is more visible from 2002 to 2004. This visual representation confirms our argument that the most important wage effect occurred around the median, but mainly at lower percentiles. The position of the minimum wage in the entire distribution is thus very relevant in this context. The hourly real minimum line for the reference year given in each graph helps to assess how minimum wage regulation may have had a dispersed impact on the wage distribution. For 2004–10, it seems that the distribution shift was more than proportional, except that the composition effect is more evident for women, particularly at lower percentiles (Figure 13). The composition effect dominates the inequality increasing contribution of price change, while the overall effect is a reduction in the 90/10 wage gap for women. Figure 14 clearly shows that, between 2004 and 2010, the composition effect at lower percentiles is very limited, whereas it produces a counteracting effect for the upper percentiles.

Among the limited number of studies of developing countries, Bosch and Manacorda (2010) find that real minimum wage erosion has contributed to an increase in

Figure 11. Wage distribution, 2002–10

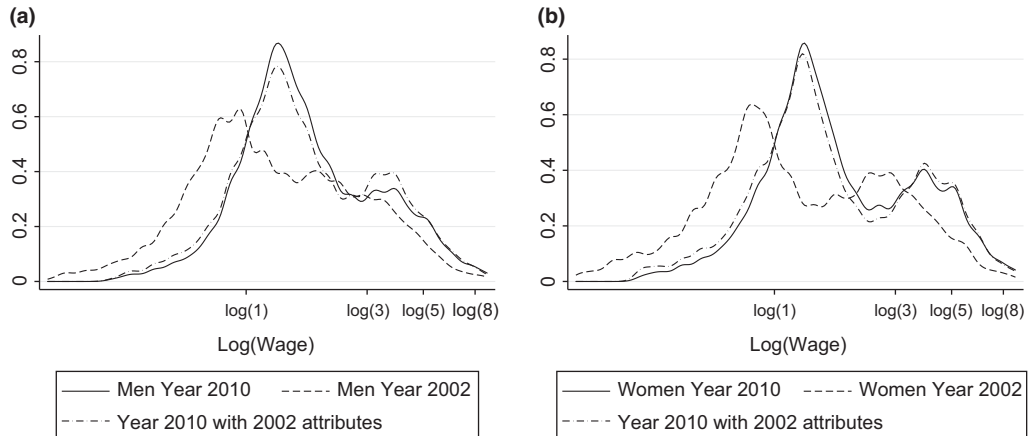

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Figure 12. Wage distribution, 2002–04

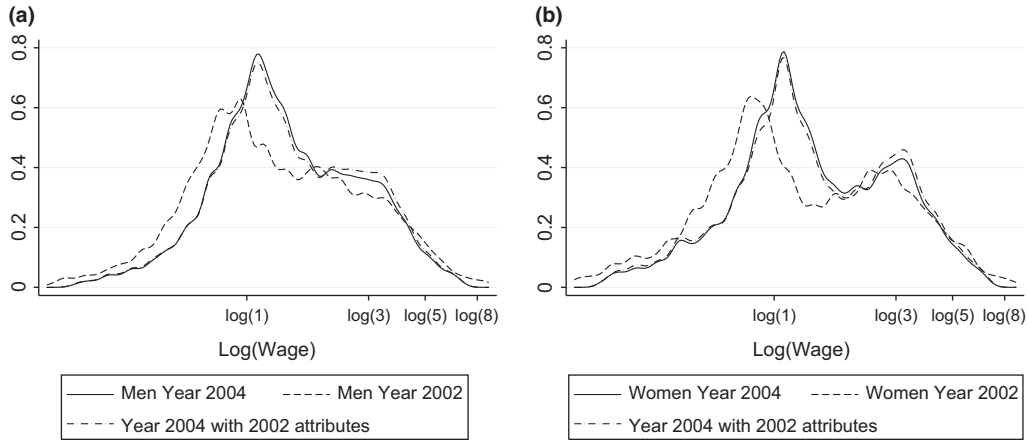
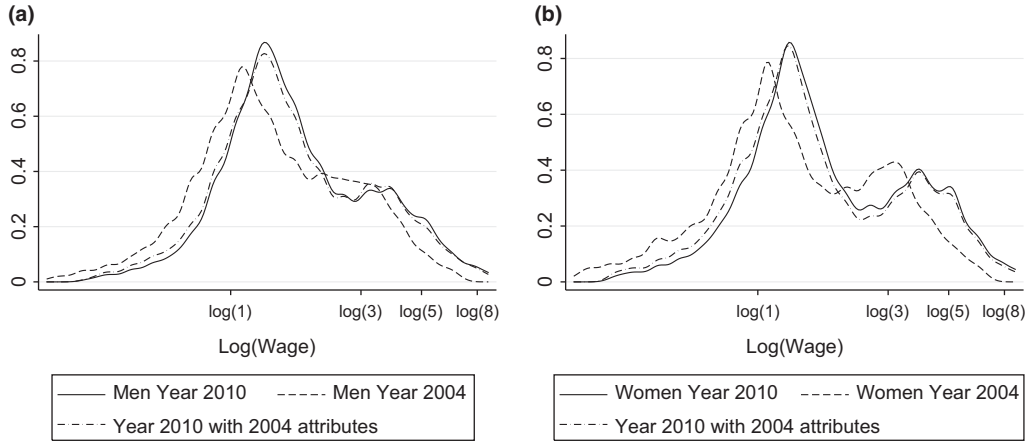


Figure 13. Wage distribution, 2004–10



inequality at the bottom end in Mexico. For female wage inequality, the effect of institutional change is stronger, consistent with DFL's (1996) findings that a decrease in the real minimum wage affects women's wage inequality more than men's. A welfare improving asymmetric gender effect of minimum wage can also be found in Ganguli and Terrell (2006), who found a similar positive effect of the minimum wage on inequality in Ukraine, particularly for female wage earners. It is worth noting that a real minimum wage indexation helped to keep the wage gap stable from 2004 to 2010 after the real minimum wage hike in Turkey. Another important finding is that the composition effect is relatively small compared to the price effect,

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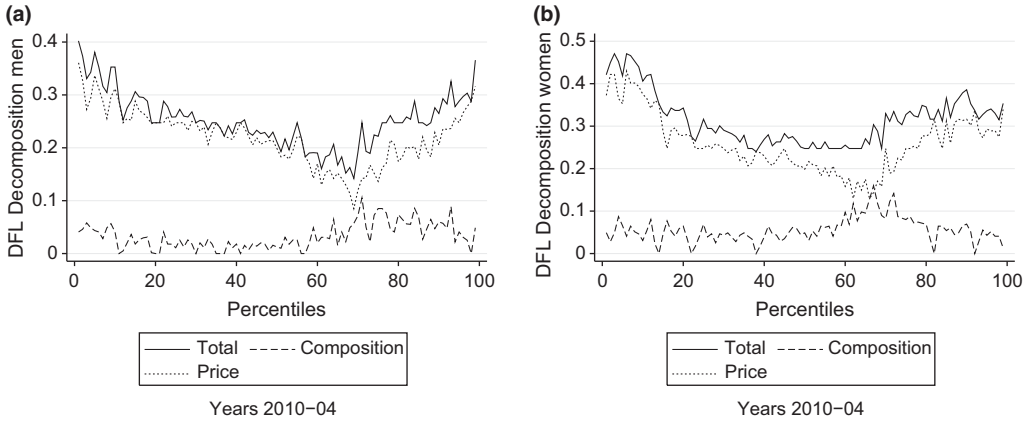
Figure 14. Decomposition of effects by percentiles, 2004–10



particularly between 2002 and 2004. In a similar vein, Xing and Li (2012) argue that, although educational attainment has increased in China, the composition effect has remained smaller than the price effect.

To conclude this section, it is important to discuss the role of informal contracts in analyzing the implementation of a minimum wage policy in terms of compliance and enforcement. In an economy like Turkey's, where informal contracts are common, it is likely that a real minimum wage increase leads to a reallocation of unskilled workers towards the informal sector. The size of this swing could be considerable. Unlike the case of a decrease in the real minimum wage, any increase must be coupled with strict enforcement. In Turkey's case, the enforcement capacity has been quite efficient so that the share of the formal sector has increased over the 2002–10 period (Table 11) except for the decline in 2004. However, the decrease in the share of formal contracts was limited and proved to be temporary, gradually increasing over the period. One last point should be underlined: the stable growth period contributed to welfare as an improving outcome of the structural changes in the labour market. In contrast, it would be hard to argue in favour of institutional change in an environment of loose enforcement capacity and recessionary pressure.

6. Conclusion and discussion

The literature emphasizing the role of institutional factors suggests that the rise in inequality at the bottom of the wage distribution is potentially linked to the erosion of the real value of the minimum wage. Our major finding is consistent with the literature in the US (Card and DiNardo, 2002; Lemieux, 2006) based on the work of DiNardo *et al.* (1996) and Lee (1999), who support the institutional argument. The present study shows that the real minimum wage increase in Turkey in 2004 explains the significant decrease in the wage gap between the 90/10 and 50/10

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Table 11 . Share of formal contracts, 2002–10

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total	71.0	70.8	68.4	69.8	70.9	73.3	76.6	77.6	78.1
Private sector	58.2	58.5	57.6	59.9	62.1	66.1	70.7	72.0	73.0

percentiles observed among both male and female wage earners between 2002 and 2010. Turkey's case is a positive example demonstrating that a sharp increase in the real minimum wage is likely to contribute to a narrowing of the wage gap with the upper percentiles. However, further investigation is needed to see whether disemployment and informality played a role during this institutional change. It would also be useful to investigate whether there was any polarization effect during the period, since it is possible that the rise in both extremities of the distribution might have been detrimental to the employment share of middle occupational groups as well as their real wages. To this end, Household Budget Surveys could be used to generalize the results obtained from Household Labor Force Surveys.

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Appendix A

Table A1. Log hourly wages

Year	p5	p10	p25	p50	p75	p90	p95	SD	Variance	Min.	Max.
2002	0.832	1.110	1.664	2.497	4.993	8.089	9.987	3.028	9.170	0.357	19.973
2003	1.013	1.294	1.800	2.700	5.109	7.970	9.620	2.847	8.103	0.450	17.722
2004	1.030	1.351	1.950	2.803	4.955	7.478	9.009	2.556	6.531	0.450	14.866
2005	1.122	1.472	2.136	3.005	5.300	8.161	10.096	2.788	7.771	0.481	16.827
2006	1.283	1.596	2.199	3.078	5.387	8.414	10.261	2.908	8.457	0.550	17.443
2007	1.449	1.739	2.415	3.320	5.796	8.887	10.867	3.072	9.438	0.690	18.184
2008	1.438	1.797	2.426	3.428	5.822	9.164	10.997	3.141	9.866	0.647	19.406
2009	1.521	1.877	2.560	3.511	6.144	9.830	12.287	3.416	11.670	0.670	20.479
2010	1.538	1.923	2.564	3.462	6.294	10.033	12.115	3.480	12.107	0.641	20.769

***Note*:** Real hourly wages 2002–10 (using 2010 prices and sample weights).

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Appendix B

Table B1. Probit estimation

	Men			Women		
	2010–02	**2004–02**	**2010–04**	**2010–02**	**2004–02**	**2010–04**
Schooling						
Primary or less	−0.535***	-0.529***	0.002	−0.771***	−0.533***	−0.282***
	−0.006	−0.006	−0.005	−0.008	−0.008	−0.006
Secondary	−0.949***	−0.251***	−0.649***	−1.131***	−0.428***	−0.733***
	−0.008	−0.007	−0.007	−0.01	−0.01	−0.009
Secondary Occup.	−1.072***	−0.622***	−0.376***	−0.996***	−0.748***	−0.230***
	−0.007	−0.007	−0.007	−0.01	−0.01	−0.009
Tertiary	0.028	−0.491***	0.612***	0.144**	0.345***	−0.220***
	−0.035	−0.053	−0.035	−0.049	−0.056	−0.032
Age (years)						
20–24	0.654***	−0.024**	0.683***	0.456***	−0.070***	0.568***
	−0.008	−0.009	−0.006	−0.01	−0.012	−0.009
25–29	0.016*	−0.345***	0.419***	−0.310***	−0.852***	0.534***
	−0.008	−0.008	−0.007	−0.012	−0.015	−0.013
30–34	−0.137***	−0.298***	0.183***	−0.748***	−0.159***	−0.562***
	−0.008	−0.008	−0.007	−0.013	−0.012	−0.012
35–39	−0.121***	−0.063***	−0.016*	−0.532***	−0.222***	−0.329***
	−0.008	−0.008	−0.007	−0.011	−0.011	−0.01
40–44	0.091***	0.044***	0.079***	−0.405***	−0.166***	−0.148***
	−0.008	−0.008	−0.007	−0.01	−0.011	−0.009
45–49	0.015	−0.157***	0.182***	−0.297***	−0.091***	−0.285***
	−0.008	−0.008	−0.008	−0.011	−0.011	−0.01

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Table B1. (Continued)

	Men			Women		
	2010–02	**2004–02**	**2010–04**	**2010–02**	**2004–02**	**2010–04**
50–54	−0.181***	−0.092***	−0.018*	−0.131***	−0.024	−0.149***
	−0.009	−0.009	−0.008	−0.013	−0.012	−0.011
55–59	−0.006	−0.104***	0.108***	−0.264***	−0.169***	0.022
	−0.01	−0.009	−0.009	−0.015	−0.014	−0.013
60–64	−0.045***	−0.046***	0.131***	−0.518***	−0.452***	−0.031
	−0.012	−0.011	−0.011	−0.019	−0.017	−0.018
Having social security	0.232***	−0.146***	0.425***	0.052***	−0.230***	0.291***
	−0.005	−0.005	−0.005	−0.008	−0.009	−0.008
Additional work	0.420***	0.170***	0.262***	−0.057***	−0.073***	0.091***
	−0.002	−0.002	−0.002	−0.007	−0.008	−0.008
State employee	−0.584***	−0.158***	−0.430***	−0.342***	−0.127***	−0.228***
	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
Tenure years	−0.028***	−0.004***	−0.025***	−0.041***	−0.003***	−0.035***
	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
Urban	0.135***	0.351***	−0.186***	0.121***	0.315***	−0.190***
	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
Marital status						
Married	−0.267***	−0.083***	−0.190***	0.005**	0.007***	−0.002
	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
Divorced	−0.031***	−0.220***	0.191***	0.152***	−0.037***	0.181***
	−0.004	−0.004	−0.004	−0.003	−0.004	−0.003
Spouse died	−0.564***	−0.049***	−0.514***	−0.219***	0.024***	−0.238***
	−0.008	−0.007	−0.008	−0.005	−0.005	−0.005

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Table B1. (Continued)

	Men			Women		
	2010–02	2004–02	2010–04	2010–02	2004–02	2010–04
Industry						
Mining and quarrying	0.059***	−0.124***	0.180***	0.179***	−0.281***	0.375***
	−0.004	−0.004	−0.004	−0.015	−0.019	−0.019
Manufacturing	−0.057***	−0.168***	0.090***	0.231***	0.141***	0.106***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004
Electricity, gas and water	0.350***	−0.190***	0.560***	0.792***	0.361***	0.516***
	−0.004	−0.004	−0.004	−0.012	−0.014	−0.012
Construction and related	0.106***	−0.149***	0.239***	0.522***	0.153***	0.395***
	−0.003	−0.002	−0.002	−0.007	−0.007	−0.006
Trade, restaurants and hotels	0.040***	−0.140***	0.164***	0.357***	0.218***	0.146***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004
Transportation, communication and storage	0.045***	−0.166***	0.194***	0.429***	0.193***	0.241***
	−0.003	−0.003	−0.003	−0.005	−0.005	−0.005
Finance, insurance and real estate	1.031***	−0.098***	1.052***	0.817***	0.194***	0.598***
	−0.003	−0.003	−0.003	−0.004	−0.004	−0.004
Community, social and personal services	−0.373***	−0.085***	−0.285***	0.169***	0.142***	0.023***
	−0.003	−0.002	−0.002	−0.004	−0.004	−0.004
Occupation						
Professionals	0.073***	−0.025***	0.042***	0.224***	0.226***	0.023***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004
Technicians and asso. professionals	−0.003	−0.036***	0.002	0.420***	0.293***	0.105***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004
Clerks	−0.066***	−0.043***	−0.061***	0.326***	0.226***	0.101***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004

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Table B1. (Continued)

	Men			Women		
	2010–02	**2004–02**	**2010–04**	**2010–02**	**2004–02**	**2010–04**
Service, shop and sales workers	0.123***	−0.015***	0.111***	0.584***	0.146***	0.430***
	−0.002	−0.002	−0.002	−0.004	−0.004	−0.004
Skilled agricultural workers	0.515***	0.229***	0.309***	0.818***	0.416***	0.412***
	−0.004	−0.004	−0.004	−0.011	−0.012	−0.011
Craft and related trades workers	0.067***	0.006**	0.031***	0.024***	0.048***	−0.041***
	−0.002	−0.002	−0.002	−0.004	−0.005	−0.005
Plant, machine operators and assemblers	0.211***	0.106***	0.080***	0.657***	0.518***	0.136***
	−0.002	−0.002	−0.002	−0.005	−0.005	−0.005
Elemantary occupations	0.191***	0.031***	0.119***	0.487***	0.291***	0.169***
	−0.002	−0.002	−0.002	−0.004	−0.005	−0.004
Firm size						
25–50	0.184***	0.114***	0.071***	0.093***	0.055***	0.053***
	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
50 and more	−0.052***	−0.003***	−0.048***	−0.143***	−0.095***	−0.040***
	−0.001	−0.001	−0.001	−0.002	−0.002	−0.002
Constant	0.289***	0.262***	0.039***	−0.019*	−0.109***	0.104***
	−0.006	−0.006	−0.005	−0.008	−0.009	−0.008
No. obs	33,943	51,971	62,573	9,674	13,210	18,441
Pseudo R^2	0.128	0.017	0.106	0.097	0.023	0.071

***Notes*:** The omitted category for dummies; having no schooling for education, 15–19 years for age interval, less than 10 workers for firm size, unmarried for marital status, agricultural sector for industry, executive manager for occupation. Age-education dummies and education-social security pairs are interacted but their coefficients are not reported due to limited space. Sample weights are used.
***$P < 0.01$, **$P < 0.05$, *$P < 0.1$. Robust standard errors in parentheses.

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