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Wage Inequality in Turkey: 2002-2010

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Özet: Bu çalışma Türkiye'de geçmiş on yıl içersinde ücret eşitsizliğinin nasıl evrildiğini 2002-2010 Hanehalkı Isgucu Anketleri kullanarak incelemektedir. 2002-2004 yılları arası dönemde, daha eğitimli işgücü arzı daha az eğitimlilere oranla nispeten sabit seyrederken göreli ücretler daha az eğitimli grup lehine artmıştır. Ne var ki 2004-2010 arası dönemde eğitimli iş gücü arzı göreli olarak artmaya devam ederken nisbi ücretler aynı seviyesini korumuş hatta bir miktar eğitimli kesim lehine artmıştır. Bu iki birbiri ile çelişen olguyu açıklamak için basit arz-taleb modelinin ötesinde geçmek ve beceri yanlı teknolojik değişim veya asgari ücret düzenlemesi gibi farklı hipotezlere başvurmak gerekmektedir. Ücret eşitsizliği ayrıştırma metodu kullanıldığında özellikle 2002-2004 dönemi için fiyat etkisinin kompozisyon etkisine baskın çıktığı ortaya çıkmaktadır. Sonuçlarımız ücret eşitsizliği anlamında 2004 reel asgari ücret sıçramasına sebeb olan kurumsal değişikliğin refah arttırıcı bir etki doğurduğunu göstermektedir. Genel olarak bakıldığında üst yüzdelik dilim (90/50) arasındaki ücret eşitsizliği 2002-2004 arası azalmış, daha sonra dönem sonuna kadar neredeyse aynı kalmıştır. Alt yüzdelik dilim (50/10) arasındaki ücret eşitsizliği ise dönem boyunca azalmaya devam etmiştir. Bulgularımız işgücü piyasasına kurumsal açıdan yaklaşan görüşü kuvvetlendirmektedir.

Anahtar Kelimeler: Ücret eşitsizliği; Ücret yapısı; İşgücü talebi; Dekompozisyon; Türkiye
JEL Kodları: J23; J31

Abstract:

This paper studies the evolution of wage inequality over the last decade in Turkey using household labor force survey between 2002 and 2010. During the period between 2002 and 2004, the relative supply of more educated workers to less educated workers stayed almost constant while their relative wages have decreased in the benefit of less educated workers. However, in the second period between 2004 and 2010 the relative supply of more educated workers to less educated workers had risen while their relative wages remained constant or kept increasing in the benefit of more educated workers. Both of these developments calls for factors other than those implied by a simple supply-demand model such as skill-biased technical change or minimum wage changes. The decomposition of wage inequality reveals that price(wage) effect is dominant over the composition particularly in the period between 2002 and 2004. Our results show that the real minimum wage hike in 2004 corresponds to a major institutional change which proves 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. The lower-tail (50/10) wage inequality decreased smoothly between 2002 and 2010. Our findings provide another evidence to the institutional view.

Keywords: Wage inequality; Wage structure; Labor demand; Decomposition; Turkey
JEL Classification: J23; J31

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1 Introduction

After the liberalization period in the second half of the 1980s, Turkish economy has undergone several major crises during almost two decades. In an environment of chronic inflation, major fiscal imbalances coupled with the banking crisis have produced severe economic outcomes, leading to lower growth rates and high income inequality. After the 2001 crisis, the economy showed steady growth until the global recession of year 2009. During this stable growth period, the Turkish economy experienced some important structural transformations: the share of wage earners in total labor force has increased by 12% points, (49% in year 2002 and 61% in year 2010), the share of unpaid family workers has decreased by 8% (21% in 2002 and 13% in 2010), which is a major indicator of agricultural employment particularly for women. Beside the transition of unskilled labor force in to paid work, the qualified labor force, the share of college graduates in total employment has gradually risen by 5% points (10% in 2002 and 15% in 2010).

Following the unstable decade of 90s, the growth of GDP per worker remained relatively high, 3.7% on average between 2002-2010 and inequality in wage earnings showed a decrease particularly in favor of the lower percentiles in Turkey. There may be several reasons that can explain this phenomenon: changes in international trade, technical change and institutions to count a few. Given the relatively new micro data series in Turkey there is a lack of studies on this issue. To be able to discuss "reasons behind changes in wage inequality" we need first basic characteristics and evolution of wage inequality. Thus, the goal of our paper is twofold: first, we give a detailed picture of the evolution of the labor market earnings since 2002 and analyze the impact of relative demand and supply . Second, we decompose the decrease in wage inequality both for males and females and adopt various methodologies to investigate the change in the entire wage distribution. Using the Household Labor Force Surveys (HLFS) cross-section data over the period 2002-2010, we observe that the overall wage inequality measure, the log of the ratio of the 90th percentile of wages to the 10th percentile, the so called 90-10 wage gap, has decreased over the period. Again, observation supports the fact that the 50-10 gap has decreased over the period as well, whereas the gap between 90-50 remained relatively stable. There is strong evidence that the wage inequality has dropped in favor of those workers at the lower bottom of the distribution. In terms of education, a similar observation can be made. The wage gap between education levels decreased in favor of less educated segment whereas the gap has increased in favor of college graduate possibly supporting the view that middle occupations have not benefited much during this period.

The sub-periodization of the 2002-2010 reveals that most of the reduction in wage inequality has coincided with the rise in real minimum wage hike that took place in 2004. The results of the decomposition analysis according to sub-periodization show that it is mainly the wage structure effect which drives the closing gap between lower and upper percentiles. The reduction in the wage inequality is more pronounced for women.

The paper is organized as follows. In the first section, we provide a brief review the wage inequality literature mentioning several studies on Turkey. In the second section, we introduce

the data set and discuss the recent trends in inequality measures. The third and fourth section discuss relative changes in supplies and demands, respectively. The fifth section discusses the results of the decomposition analysis. The final section concludes.

2 Literature Review

Early studies dealing with the wage inequality, Katz and Murphy (1992, hereafter KM), Bound and Johnson (1992) and Juhn, Murphy, and Pierce (1993, hereafter JMP) suggested that changes in demand and supply for skills can explain the rise in wage inequality during the 1980s in the US. These papers used a standard neoclassical framework to analyze whether changes in relative demand can explain changes in relative wages. Their consensus was that one needs a bias favoring more skilled and more educated workers to explain observed patterns of wage inequality in USA. In these papers, this bias is assumed to come from technological improvements which favor more skilled workers, hence the name, skill-biased technical change (SBTC).

The rising wage inequality has been seen as structural and permanent due to changes in production organization and technology. However during 1990s, the consensus on these arguments have been questioned by the "revisionists", (Card and DiNardo, 2002; Lemieux, 2006) claiming that the trend of increasing inequality has slown down whereas the SBTC or globalization are supposed to have accelerated in the same period. Again, the fact that during the same period, in other industrial, mostly european countries changes in inequality remained modest posed another challenging evidence for the SBTC argument. DiNardo, Fortin and Lemieux(1996, DFL hereafter) and Lee (1999) proposed that the increased inequality through the 1980s can be explained largely by institutional changes in the labor market, emphasizing the role of falling real minimum wage or lower unionization in the USA. Lemieux (2006) underlined the roles of both decline in real minimum wage and changes in labor 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 labor costs. Freeman (1980a) and more comprehensive study by Card et al. (2004) conclude that the unionization had an equalizing effect on the dispersion of wages across different skill groups, particularly produced within effects across sectors.

The institutional changes might affect the wage distribution and thus wage inequality particularly when they target different type of workers. For example, a real minimum wage increase might narrow the pay gap by affecting the wage schedule of mostly wage earners at the lower end of the distribution (Fortin and Lemieux, 1997). Another example is the decrease in collective bargaining which might produce a similar effect as well, widening the gap between unskilled and skilled workers. Freeman (1980a) claimed 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, e.g. Freeman (2009).

There are few studies addressing the overall wage inequality question. As for the literature on Turkey, most of the studies focus on the gender wage gap based on various sources of micro data. Ilkkaracan and Selim (2007) analyze the sources of the gender wage gap using matched employer-employee data (Employment and Wage Structure Survey, 1994) and the standard Mincerian estimations as well as the Oaxaca decomposition. Their major finding is that substantial portion of the gender wage gap is attributable to the type of firm, sector, and collective labor bargain status. Kara (2006) finds, after correcting for the selection bias, that gender wage gap is substantial after controlling for education, experience, occupation, region.

Limited availability of micro data is another issue. The Household Labor Force Surveys (HLFS) including wage earnings information covers only the last decade starting from 2002. For this reason, most studies use the Household Income and Consumption Expenditure Survey (HICES) of 1994 and the 2002 Household Budget Survey (HBS). Tansel and Bodur (2012) analyze the return to education and residual wage inequality by using OLS and quantile regressions based on the data from 1994 HICES and 2002 HBS with a total of 26,256 observation for both years. They conclude that the male wage inequality is high in levels and during the period 1994-2002, and that shows a small decline keeping the wage gaps unchanged. Their most important finding is the positive contribution of education levels to the wage inequality through both within and between dimensions. Another major finding is the decline in returns to education for the same period. The authors argue that the decline in returns to education can be explained by the rise in educational attainment rather and the crisis effect of 2001.

Meschi et al. (2011) study the relation between trade openness and wage inequality using firm-level data over the period 1980-2001. Their major finding is in support of the SBTC argument, claiming a major shift in the labor demand toward 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 of skilled labor in a complementing the SBTC argument.

Although the SBTC argument seems to be the most plausible one for Turkey during 1980-2001 period, it needs to be discussed in the context of new data (post 2001) and new economic and institutional conditions. The role of relative supplies and demands as well as education dynamics in wage inequality dynamics needs an update for 2000s. As mentioned above, the share of skilled workers are increasing due to rising educational attainment for young cohorts and it is likely that this structural change will produce inter-generational effects on wage inequality. A recent paper, Bakis et al. (2013) argues that the post-secondary wage inequality has increased over the last decade, using 2004-2010 HLFS data. They show that the wage gap widens between the lower and upper quantiles in 2000s.

3 Wage Distribution and Wage Inequality Trends in Turkey

3.1 Data Description

We use the yearly cross-section data of HLFSs covering the post-crisis period 2002-2010. The HLFSs provide more comprehensive information on the labor market in Turkey. The surveys include monthly individual wages in paid jobs and provide detailed information on workers characteristics. The wages of self-employed workers are missing in the data which has an employment share of 22% on average over the period. Before moving to data description, some issues must be addressed related to use of data. Firstly, as it is often raised as an issue in the wage inequality literature, how the hourly wage are constructed becomes important. The raw wage data usually include some miss-reportings either as of wages or of actual working hours.[1]

In order to avoid biases[2], we restrict our sample with the wage earners working above or equal to 8 hours (one full-day working hours) and less than or equal to 84 hours a week. After restricting the sample with working hours, outlier observations in hourly wage distributions at the bottom and top 1% are trimmed as well.[3] The hourly wage data used is summarized in the appendix (A). We obtain hourly nominal wage by dividing net monthly wage income (wage/salary plus any extra income like bonus pay, premiums etc. on addition to the salary) by the average number of hours worked in the month in the main job which we compute by multiplying "usual hours worked in the main job a week" by 4.33. The nominal hourly wage is divided by the GDP deflators to derive the real hourly wage rate, expressed in 2002 Turkish Liras.

The HLFSs give detailed information on indvidual characteristics such as gender, age (grouped at five year intervals for ages between 15-64), schooling (coded in 7 education levels)[4], marital status, urban residence (population over 20,000), a dummy indicating social security status and one dummy for workers having an additional job, firm size information, occupation (ISCO 88) and sectoral (NACE Rev.1) classifications.[5]

[1] According to legal regulation, working hours above the 45 hours within a week must be compensated with extra-premium and for a single day, working hours must not exceed 11 hours. In our sample there are some over-reporting exceeding 11 per day which is above the legally mandated ceiling. They represents nearly 5% of each cross-section sample.

[2] Biases might also emerge due to temporary reallocation of working hours inside the firm during the reference week the survey has been undertaken. Nevertheless, the majority of workers declares that their regular working hours are very similar to actual hours reported.

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

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

[5] Until 2009, TurkStat coded economic activities at four digit level according to NACE Rev.1. Beginning from 2009 NACE Rev.2 is used. But, published micro data CDs contains only 9 main groups until 2009 and 88 divisions (2-digit codes) for 2010 and afterward. To create a compatible data, we used the following 9 groups as our sectors: 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, 9. community services, and social and personal activities. See `http://www.turkstat.gov.tr/MetaVeri.do?alt_id=25` for further details.

3.2 Trends in Wage Inequality

There are 3 widely used measures for wage inequality in the literature. These are overall wage inequality (90/10 log wage differentials), between-group wage inequality (wage differentials by educations groups) 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 further be decomposed into 2 parts: upper-tail inequality (90/50) and lower-tail inequality (50/10).

In terms of wage percentiles, Figure 3 shows that both overall wage inequality (90/10 log wage differential) and lower-tail wage inequality (50/10 log wage differential) are decreasing over the 2002-1010 period. However, the upper-tail inequality is almost constant after 2004. All residual wage inequality measures (90/10, 90/50, 50/10) move in tandem and are decreasing during 2002-2010 period. Several observations can be made regarding the raw wage inequality measures. Over the entire period wages at the lower end of the distribution has increased and the wage gap between deciles (10,50 and 90) has narrowed.

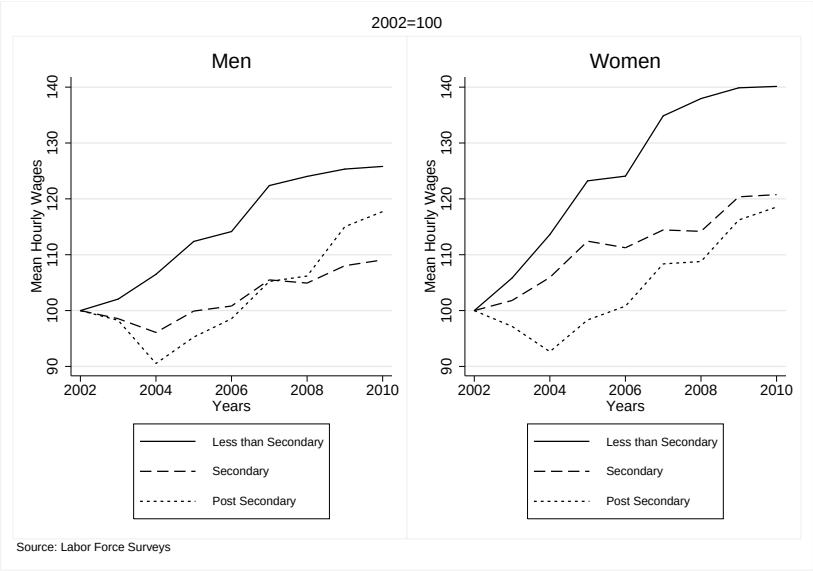

Figure 1: Evolution of Real Wages by Education Levels. Workers are regrouped into 3 broad education groups: less than secondary, secondary and post secondary.

We can see how between-group wage inequality real wages (as depicted in Figure 1), have evolved starting from the year 2002 where after effects of the crisis were still strong. Figure 1 show that workers are grouped into 3 broad education levels the real wages for both less educated male and female workers, compared to other education groups. The real increase is less pronounced for workers with secondary education level. With the exception of real wage erosion of post-secondary workers which lasted for two consecutive years until 2004, real wages kept rising for all education groups. The post-secondary/less-than-secondary relative wages decreases gradually up to 2004 and it starts to rise slightly only after 2008. The wage gap between secondary and less than secondary group declines gradually across years whereas

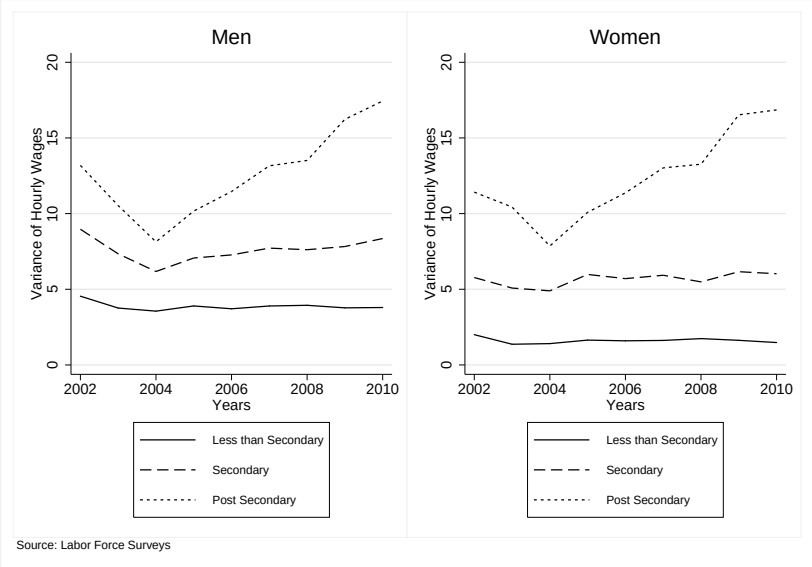

Figure 2: Variance of hourly wages by education level

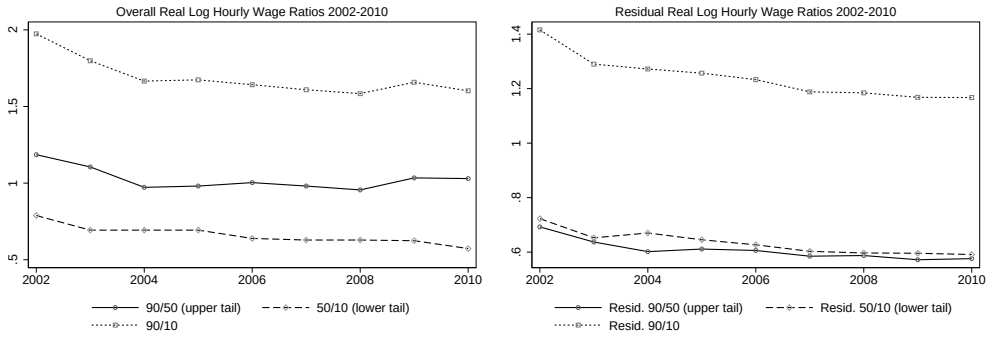

Figure 3: Overall and residual wage inequality. The overall 90/10 wage inequality measure depicts log wage differentials for 90*th* and 10*th* percentiles. Similarly, the residual 90/10 measure is computed as the difference between log wages of 90*th* and 10*th* percentiles in a regression of the log wage on a full set of interactions between age groups and education levels.

following a moderate decline, the post-secondary/secondary wage gap increases starting from the year 2004. From the overall picture, it is plausible to infer that the year 2004 is a decisive year in terms of real increases for the entire wage distribution. The overall picture is that from 2002 to 2004 real wage growth is inversely correlated with education level while after 2004 secondary level have the lowest real wage growth rates. We need some factors other than usual supply and demand ones to be able to explain these sharp changes in the real wage trends and large relative increases in wages of less skilled workers.

In terms of variance of wage, there is no clear tendency for secondary and below-secondary groups. But, the wage variance of post-secondary group decreases abruptly (from 2002 to 2004) before showing a clear upward trend between 2004-2010, which is likely to suggest an increasing *within* wage inequality for skilled workers as we see in Figure 2.

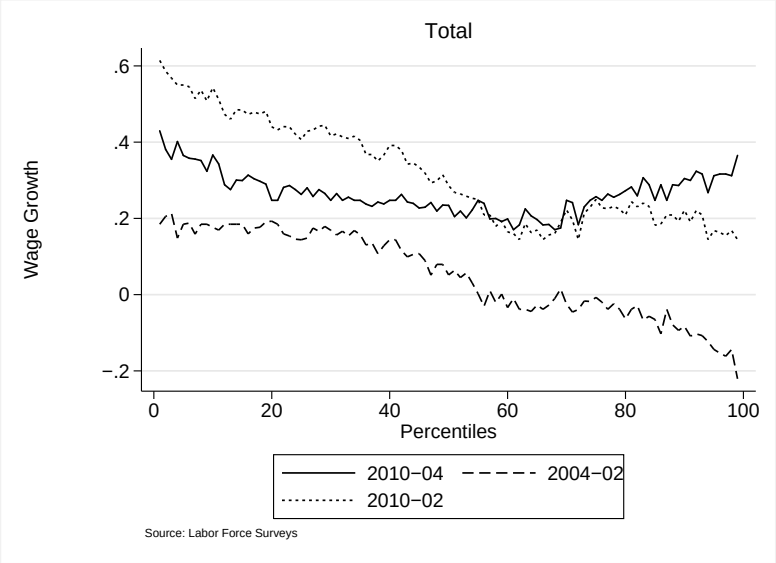

Figure 4: Percentile Wage Growth 2010-2002

The decline in inequality is more visible when we compare years 2002 and 2004. It is due to two reasons. One is the real wage growth of lower percentiles (Figure 4), the other one is the real wage decrease in the upper percentiles between two years. The real wages stayed almost the same for the percentiles above 50 and 80, whereas lower median wages grew faster within two years. Between 2004-2010, it seems that the two poles of the wage distribution relatively have benefited more than the segments around median. For the episode 2002-2004, several candidate explanations could be proposed for the rapid decline in wage inequality. First, it is possible that the real wages erosion during the crisis has ceased and a rebounding effect was in play as the economy started to recover. We do not have any micro-evidence to argue that the retake of the economy favored real wage growth of lower percentiles which were at very low levels.[6] It will be useful to remind the fact that before the 2001 crisis, the economy has also suffered from a recession in 1999 due to Russian default and the severe Kocaeli (the most industrial district) earthquake. Therefore it is reasonable to argue that the rebounding effect is likely. Secondly, while some institutional changes in the labor market particularly affecting the unskilled and lower end of wage distribution might helped real wages to increase, the real wages of the upper part of the distribution showed a decline. It needs a careful analysis to understand what had happened during the economic retake. The most plausible candidate for institutional change specific to the period is the minimum wage increases in 2004. Thirdly, the technological change or the international trade might have affected the demand for unskilled labor. The real adjustment of exchange rate (depreciation) could be responsible for the higher labor demand in labor-intensive export sectors, driving the wages to rise steadily. Of course, these alternative explanations do not need to be mutually exclusive, several may be effective

[6]There is no labor force or budget surveys including households earnings at national level before or after the 2001 crisis. Available labor force surveys for 2000 and 2001 do not include wage earnings and provide solely the labor status and typical workers characteristics.

in the same time.

	Men			Women		
Years	2002-2010	2002-2004	2004-2010	2002-2010	2002-2004	2002-2010
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
Std. Dev	-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

Table 1: Raw Log Wage Inequality Measures (2002-2004-2010) Difference Between Years and Percentiles

It is evident that the stable growth period has produced to real wage gains for all groups - albeit to different extents - and the entire real wage distribution has shifted to the right. This real gain for all workers reflects that the growth has been welfare increasing and macroeconomic stability has contributed to the shift as a level effect. Table 1 show that compared to difference between years 2004 and 2010, the real increase in 10^{th}, 25^{th} and 50^{th} have been sharper for the period 2002 and 2010. In terms of gender, the picture does not change much. It seems that the closing wage gap between upper and lower percentiles (e.g. 90/10 and 75/25) results from the combination of two effects. Between 2002 and 2004, the real wage growth is negative for the percentiles above $70 - 80$ (Figure 4), whereas in the same period, there is substantial increase in the real wages in the lower percentiles. If this does not result from a composition effect, we could say that the skill prices have been altered by a structural adjustment in wage schedule.

The figure 5 shows the trend of the real minimum wage starting from the year 1999 up to the end of the period under study. It is clear that during the turbulent years of banking crises and fiscal imbalances, the real minimum wage erosion has lasted until the year 2002 and then real minimum wage has started to rebound swiftly by the year 2004. It kept an unsteady increase until the end of the period 2010. The real minimum wage has reached its initial 1999 level almost a decade later in 2010, supporting the view that the real wage erosion of unskilled labor is compensated during the stable growth. It can be regarded as the reversal of the trend started one decade ago. Nevertheless, the wage inequality figure (figure 4) implies that during the last decade the institutional changes in the labor market might be responsible for the real wage recovery for those workers at the bottom of the distribution, particularly at the 10^{th} and 25^{th} percentiles even covering the median wage earners. This observation reinforces the

Figure 5: Evolution of Real Wage (Semi-annually adjusted)

institutional argument that particularly in the absence of collective wage bargaining which is more decisive for workers at the bottom of the distribution, the minimum wage might serve as a reference pay for a developing economy like Turkey.

4 Changes in Relative Wages and Relative Supplies

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

4.1 Supply and demand framework

Following KM and Acemoglu and Autor (2011, AA hereafter) we create 2 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 create the amount of supplied labor by each of demographic group. A demographic group is a cell in an array whose dimensions are education, gender, and age group[7]. We group education into 5 categories: less than primary (below 8 years), primary school (8 years), high school (11 years, including vocational high school (12 years), and university and plus (15+). There are 10 age groups, beginning from 15-19 up to 60-64. So, in total we have $N = 100$ education-by-age-by-gender cells each year. The wage measure is the real hourly wages as it was detailed in the data section. Self-employed workers and unpaid family workers are excluded from wage sample.

[7] Since age is grouped by 5 year intervals (15-19, 20-24, 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 as well.

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

The aggregate average 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 $k = 1, 2, \ldots, N$ (in Turkish data, the questionnaire asks monthly wage and hours worked in the reference period).[8] The matrix of these aggregate real hourly wages, $\mathbf{W}$, is an $N \times T$ matrix summarizing the wage or *price sample* formed by average hourly wage of each cell.

To obtain a supply or *quantity sample*, first, using sample weights λ we compute total hours worked in each cell and in the overall economy. This quantity sample is in levels. Since we are interested in relative supplies we will transform this quantity sample into a relative supply index by using shares instead of levels. For this, we deflate the total hours worked in each cell divided by total hours worked over all cells in the economy and get the employment share of cell k in each year (denoted as ℓ_k). $\mathbf{L}$ 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 aveage relative wages for each cell. Taking simple averages of labor supplies within each broad category would be misleading given that workers with different skill levels are not homogeneous within the category. We 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 year experience. These measures, called *efficiency units*, are proxied by the arithmetic mean of *relative wages* for each cell.

Once a reference wage is chosen[9], 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 each demographic group in each year, is denoted as $\mathbf{Z}$. The average of these relative wages, Z, (an N-element column vector) across years are our *efficiency units*. Using these efficiency units we construct aggregate supply indixes (in efficiency units) for more aggregate

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

[9] KM combine arithmetic mean of employment shares, L, (an N-element column vector) and the wage matrix $\mathbf{W}$ to obtain an aggregate wage index that can be used as *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 just a normalization, the relative wages should not depend on the choice of the base group.

groups. First, the efficient labor supply of cell k (E_k) is obtained by weighting the labor supply measure in each cell by the *fixed wage* of the same cell. Then the total supply of efficient labor is obtained by summing over all groups: $Z'\mathbf{L}$ (a T-element row vector). By deflating the efficient labor supply of each cell by the corresponding total *efficient* labor supply we get $\mathbf{E}$ which is an $N \times T$ matrix formed by relative supplies (measured in efficiency units) of each demographic group in each year. Finally, summing over sub-cells forming our broad categories (e.g. skilled/unskilled) we get efficient labor supply indeces for these broad categories.

The wage index for a broad category (like college graduates), following the above approach, is computed using *fixed-weight* approach. The aggregate wage for broad categories is a weighted average where weights are the arithmetic mean 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 called *composition adjusted* or composition constant. This is, we control for changes in composition, i.e. we keep the composition of these 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 compositional change, i.e. a shift in the education, experience or gender composition.

4.2 Relative wage and supply changes

	Changes in log(wages)			Changes in log(shares)		
	d0402	d1004	d1002	d0402	d1004	d1002
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

Table 2: Log changes in relative wages and shares, 2002-2004-2010. d0402 is used to denote the difference between 2004 and 2002. The same logic applies to d1004 and d1002 as well. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

Table (2) summarizes the main facts about relative wages and relative supplies. There are substantial changes in the Turkish labor market. We observe a similar pattern detailed in the previous section that for all groups, real wages increases though with different magnitudes, while the relative composition of supply shows a different pattern and change between periods.

The share of females decreases 10 points between 2002 and 2004 while it approximately goes back to its initial level between 2004 and 2010. This decline in two years period can be attributed to the increasing female participation rates due to crisis period. Female workers might have served as buffer labor supply, known as added worker effect, during the recession periods. For males, there is a reversing movement between two periods. Their share first increases 3 points before returning back to the initial level. The lines 3-7 of the Table are about the evolution of the relative wages/shares by by education levels. The relative share of less educated female workers (below primary) decreases between 2002 and 2010 while the share of all other levels increase, except HSG whose share is almost constant. For males the picture is very similar: the share of less educated workers decreases substantially while the share of HSG decreases slightly. The share of other education groups significantly increases, though their real wage gains differs in extent. The most of the compositional change in terms of education can be attributed to the generational difference, particularly the incoming of the new cohorts who are relatively more educated compared to elder cohorts. It is reasonable to think that considerable educational difference between generations might have produced some kind of rejuvenation effect during the decade which favors the recruitement of younger workers and can lead to partial exclusion of elder workers. The rest of the table compares the evolution of the relative wages/shares of age groups 20-24 and 50-54 for HSG, below-HSG and CLG. Quite against our intuition, the share of younger HSG decreases while that of elder ones increases throughout the period. Between 2002 and 2010, the relative share of middle young workers is positively correlated with education level, while the opposite is valid for relatively old workers. A striking fact is that despite the opposite movements in relative share of young (20-24) and old (50-54) workers with high-school diploma or below (-32.47% vs. 75.92%), their wage increase is almost equal (33.97% vs. 30.66%). Another interesting case is that the increasing share of both young and old college-graduates coincides with relatively increasing real wages which suggests a SBTC framework.

Figure (6) pictures the evolution of real log wages by education level and gender. Here, before analyzing *relative* wages, we focus on *real* wages to see big trends in the labor market. To facilitate comparison, each series is normalized to zero in 2002, the following years show the cumulative log change of real wages in comparison with 2002 level. There are some interesting points to be highlighted. Firstly, real wages are increasing for all education groups, both for males and females. Secondly, there seems to be a negative correlation between real wage growth and education level for both genders. Thirdly, for males, vocational high school graduates have smaller growth rates in comparison with high school graduates. For females the picture is just the opposite. When we look at relative supplies -measured in efficiency units- we see that the share of below-PSG workers is decreasing over time for both males and females. HSG have an almost constant share in female labor force while their share is slightly decreasing for male workers after 2004. This decrease is less pronounced than below-PSG ones however. All other education levels are increasing for both gender.

Figure (7) plots the composition-adjusted log hourly wage differences for CLG/Below-

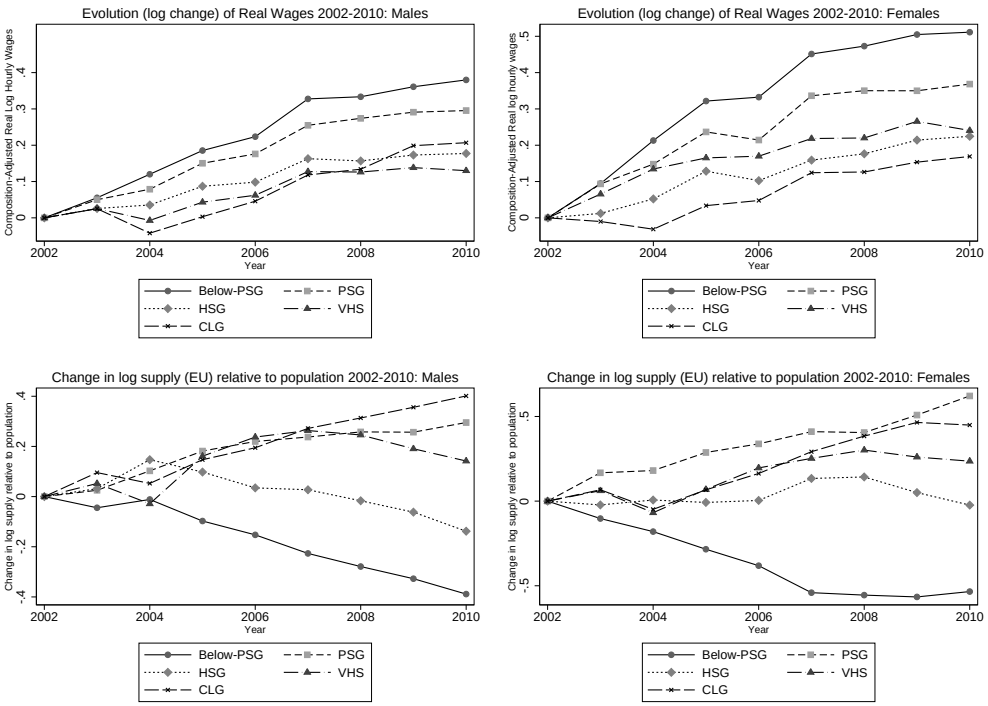

Figure 6: Evolution of real wages and labor shares (in efficiency units): males and females separately. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

CLG, CLG/HSG, CLG/Below-HSG, HSG/Below-HSG and in Turkey from 2002 to 2010. The adjustment consists in keeping constant the relative employment shares of demographic groups (defined by gender, education, experience and year). Thanks to this adjustment we are sure 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.

When aggregate groups are compared we observe several patterns throughout the period. Firstly, the log wage gap between HSG (high-school graduates) and Below-HSG is decreasing almost steadily. The log wage gap between CLG (college graduates) and HSG two asymmetric trends. First, it decreases between 2002 and 2005 and then increases after 2005. Both CLG/Below-HSG and CLG/Below-CLG wage ratios have a similar trend: between 2002 and 2005 these ratios are decreasing and after 2005 they are almost constant.

Figure (7) tells how relative price of education groups has evolved with time. In order to see whether these changes in relative prices can be explained by changes in relative supplies one needs to look at the relative supply of education group measured in efficiency units (see Figure (8)). The use of efficiency units as aggregated allows to take into account the changes

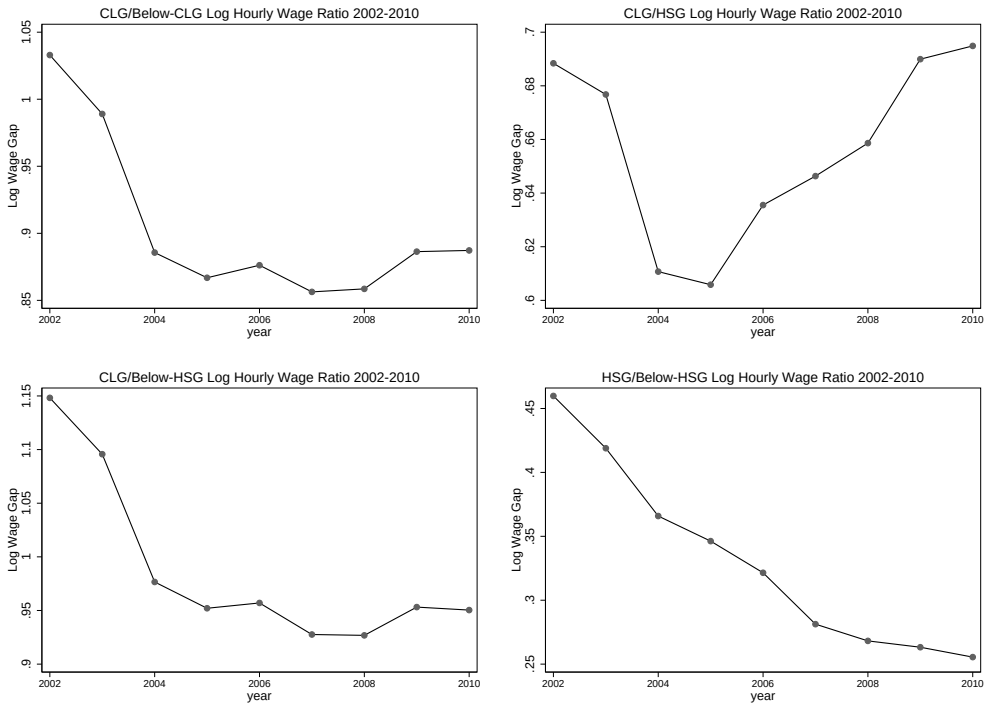

Figure 7: Mean real hourly wages are computed for 100 sex-education-experience demographic groups: 2 sexes, 5 education groups (below primary school, primary school, high school, vocational high school and college-and-plus) and 10 age groups (15-19, 20-24, ... , 60-64). Total (weighted sum of) wage income 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 sex-education-experience demographic groups. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

in the labor 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 (8)). The HSG/Below-HSG log relative supply index increases between 2002-2004 and stays approximately constant after 2004.

At the aggregate level, the evolution of relative supplies provides an interesting feature of the Turkish labor market. Excluding three years(2002-2004), the relative share of all 3 groups, i.e. CLG/Below-HSG, CLG/HSG and HSG/Below-HSG, is increasing possibly due to structural and demographic changes in Turkey. The share of the less educated workers (illiterate, literates without a diploma and junior primary school graduates) keeps decreasing while the average education level (and years of schooling) is gradually increasing. We will make three observations with regards to Figures (7) and (8) : i) Between 2002 and 2004, log relative supply index has a very similar shape for CLG/Below-CLG, CLG/HSG and HSG/Below-HSG. Namely, the 2004 value is very close to 2002 value for each of these 3 comparison groups, so there is no significant change in relative supplies. However, in each case, the relative wages are

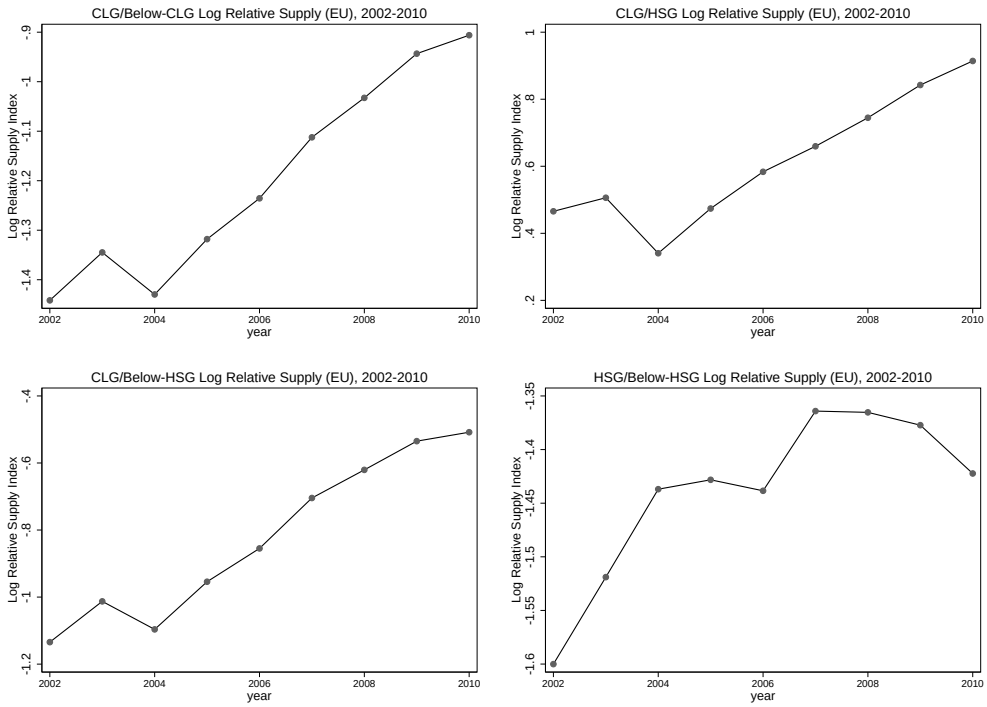

Figure 8: Labor supply is computed using all workers aged 15-64 who worked between 35 and 84 hours as wage earner, self-employed or unpaid family worker. For each year, 100 gender-education-experience cells are created: 2 sexes, 5 education groups (below primary school, primary school, high school, vocational high school and college-and-plus) and 10 age groups (15-19, 20-24, ... , 60-64). 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 total hours in the cell by the average relative wage (fixed wage) of the cell. The efficient labor supply of each cell is then deflated by the sum of total efficient labor supply over all cells so that we get the share of efficient labor supply for each cell. The labor supply (in efficiency units) of each aggregate group (such as college graduates) is computed as the sum of labor shares forming this aggregate group (all gender-experience cells that are college graduate). Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

increasing for lower education levels when compared to college graduates. This observation suggests that factors other than relative supply might be affecting the wage schedule of these education groups. ii) Again, between 2004 and 2010, log relative supply index has a very similar and increasing trend for CLG/Below-CLG, CLG/HSG and HSG/Below-HSG. Nevertheless, the CLG/Below-CLG and HSG/Below-HSG log relative wage indexes are almost constant while CLG/HSG log relative wage index is increasing. Once more, simple supply-demand framework can not explain these asymmetric behaviors if we assume stable demand schedules. iii) A simple supply-demand framework with a stable demand can partially explain the evolution of relative wages by changes in relative supplies in the case of HSG vs. Below-HSG workers. Even this is incomplete because the period after 2007 is not consistent with this simple framework.

To summarize our view that stems from the evaluation of changes in relative supplies and changes in relative wages, we claim that the decrease in wage gap between more educated workers and less-educated workers is due to the sharp increase in real minimum wage in

2004. The co-movement of relative supplies and relative wages during 2004-2010 in the case of CLG/HSG and the almost-constant trend for relative wages despite an increasing trend for relative supplies in the case of CLG/Below-CLG and HSG/Below-HSG during 2004-2010 requires a shift in the relative demand of more-skilled in the same period. However we should note that neither of these explanations 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 in the same period. A possible explanation is that a pooling equilibrium has made the sorting (by ability) less likely due to compulsory schooling (8 years) which increased schooling.

	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

Table 3: Inner product of changes in relative wages with changes in relative supply for 100 ($= 2 \times 5 \times 10$) demographic groups

Table (3) is computed as an inner product of changes in relative wages and changes in relative shares (measured in efficiency units) of our demographic groups. When we consider 2002-2008 period (the first 6 rows of Table (3)), almost all entries are negative, which is compatible with a stable demand curve hypothesis. The only positive entry is the one relating 2003 and 2004. If there is no measurement error specific to this entry, then one can claim that changes in relative supplies can explain changes in relative wages except the entry for 2004. A second important finding is about the most recent two years, i.e. 2009 and 2010. The last two rows corresponding these years have all entries positive beginning from 2004. This picture complements our earlier finding which suggests that there may a shift in demand schedule after 2008 and institutional factors (high minimum wage increase) explain the decrease in wage inequality from 2002 to 2004.

Figure (9) yields also a partial support for the above claims. Figure (9) presents how changes in log relative supplies are related with changes in log relative wages for education-by-age-by-gender demographic groups for 2002-2004 and 2004-2010 sub-periods. When we consider both males and females there is no clear trend between relative supply and relative wage changes (not showed in the paper). If we consider only males, then the slope is positive in each sub-period, but especially 2004-2010 sub-period is characterized by a steeper slope, which implies not the demand curve may not be stable in this sub-period. In the case of male workers we can say that workers whose relative labor share increased the most, had also knew largest increases in relative wages.

Remember that the expected slope is negative in Figure (9) as explained in Katz and Murphy

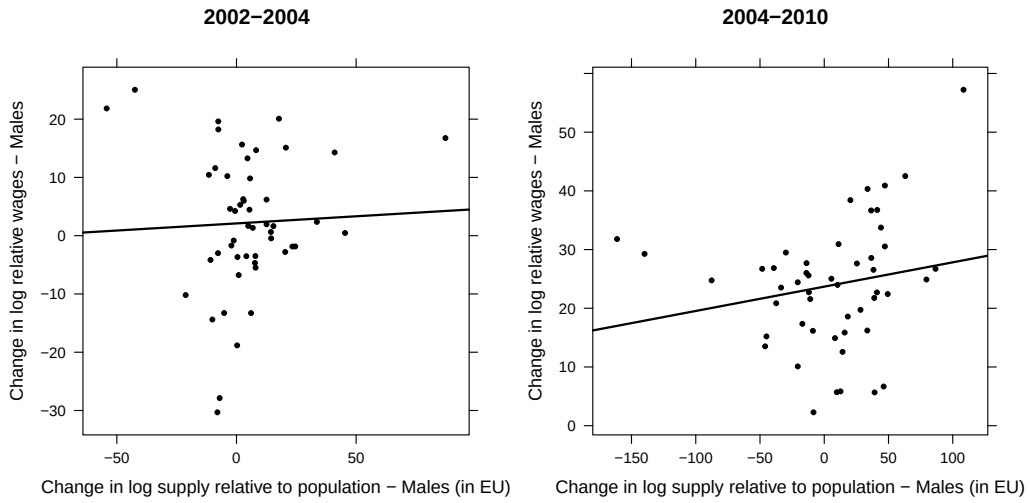

Figure 9: Changes in relative supply in efficiency units vs. changes in relative wages (Men only).

(1992) once we consider different demographic groups as distinct and imperfect substitutes in production process. The analysis so far confirms that the simple supply-semand framework with a stable demand schedule can not fully explain the evolution of wage structure during 2002-2010 period. Considering Figures (7), (8) and (9) alltogether we suspect that the demand schedule may not be stable during 2002-2010 period. As we already have discussed, between 2002 and 2004 the log relative supply index is almost constant for for CLG/Below-CLG, CLG/HSG and HSG/Below-HSG comparisons while the relative wages are increasing for lower education levels. Between 2004 and 2010, log relative supply index has a similar and increasing trend for CLG/Below-CLG, CLG/HSG and HSG/Below-HSG. But we see that CLG/Below-CLG and HSG/Below-HSG log relative wage indexes are approximately constant while the CLG/HSG log relative wage index is increasing. These findings call for a detailed analysis of changes in relative demands for different skill groups.

4.3 Changes in relative demand for labor

We can decompose changes in relative demand as "within industry shifts" (changes in relative demand occurring within each industry) and "between industry shifts" (changes in relative demand due to reallocation of labor across industries). For a given vector of wages, we may observe a shift in labor demand of more educated workers due to adopting a new technology more complementary to highly educated workers. A typical example may be the SBTC due to the rise of computer related tools in production processes. Then, we will observe an increase in labor demand of college graduates within each sector in a somehow parallel way. Other candidates for within industry demand shifts are price changes in non-labor inputs (e.g. computers) and off-shoring.

Another reason for changes in relative labor demand is between industry shifts. For given relative wages, we may observe a change in relative labor demand (say, an increase in the share of college educated workers) if industries are heterogeneous with respect to skill composition and if shifts in industrial employment distributions occur over time. This would be the case, for instance, if consumers' preference about different commodities change over time. Another example would be changes in production structure as a result of international competition.

There are 9 one-digit industries as reported by TurkStat in the Turkish HLFS data. TurkStat uses the International Standard of Economic Activities in the European Union (NACE) classification for economic activities.[10] The occupation classification is defined according to the *International Standard Classification of Occupations* (ISCO-88) one-digit level in Turkish HLFS data. We regrouped these 9 occupations into the following 4 broad categories based on skill levels used in the European Working Conditions Surveys.[11]

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

Table 4: Average employment shares of education groups across industries and occupations, 2002-2010. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

Table (4) shows the average employment in different industries and occupations for 2002-10 period. This gives an idea about how important can be between industry demand shifts. Given that there are substantial differences between average employment shares of education groups across industries and/or occupations, naturally one expects that the reallocation of labor from one sector to another might have an important impact on wage inequality. For instance an

[10] See footnote 5 for details.

[11] The European Working Conditions Surveys distinguish between "high skilled white collar" workers (ISCO codes 1,2 and 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). However, we should note that the use of 4 broad categories as occupation groups may not be sufficient to capture the full effect of within industry demand shifts. See `http://www.eurofound.europa.eu/surveys/ewcs/2005/classification.htm` accessed on 17.10.2012.

increase in the share of agriculture would favor low-educated workers (40 % of below-PSG work in agriculture) while an increase in the share of service will boost the demand for high educated workers where half of college graduates are employed.

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

Table 5: Overall industry and occupation employment distributions, 2002-2010

Table (5) presents the evolution of industrial and occupational shares between 2002-2010. This is a direct measure of between industry shift of labor demand. Agriculture's share in employment decreases sharply from 33% to 22%. Construction, trade and manufacturing have gained, each, almost 2%. Service's share increased 5%. The rapid conclusion emerging from Tables (4) and (5) seems to be the following: there is a labor shift from resource based, low-technology industry (agriculture) toward relatively medium-technology industries. The evolution of occupations yields a similar picture. The share of relatively low-skill occupations (production workers) decrease 10 percentage points while all others see slight increases in their labor share.

To compute between and within industry demand shifts, KM provides a theoretical framework which results in an equation very similar to the widely-used "fixed-coefficient manpower requirements index". The idea of this index is to compute the percentage change in the labor demand of a given demographic group via changes in the employment distribution occurring within industries.[12] The fixed-coefficient manpower requirements index was proposed by Freeman (1980b) quantify shifts in relative demand of different demographic groups due to changes in the employment distribution across industries at fixed relative wages.

The traditional index for relative demand shifts is based on raw labor units while KM provides a formal justification for the case where labor inputs being measured in efficiency units.[13] KM use

$$\frac{E_{kt} - E_{ks}}{E_{ks}} = \sum_j \frac{\gamma_{kj} \Delta E_{jt}}{E_{ks}}$$

[12] We can show that the fixed-coefficient input requirement index is the "between" component in a standard shift-share analysis. See Appendix (B) for details.

[13] See section 5 in Katz and Murphy (1992) for details of the derivation.

to compute between- and within-industry effects for any year s and t. 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). They fix γ_{kj} to the average value of E_{kjt}/E_{jt} over the period. This is compatible with both fixed-coefficient input requirement index and shift-share analysis. However, KM do not use year and occupation specific values for E_{ks}, but use its average over the entire period analyzed (1967-1987), E_k. Another non-standard choice made by KM is to define demand shifts between occupation-by-industry cells as total (overall) demand shifts. This is important because this means that relative demand shifts occurring within an occupation are neglected. If, for instance, there is a demand shift toward college graduates within any occupation cell this shift does not appear in overall employment change in this approach. Thus, in KM paper, the within-industry component measures only shifts in employment among occupations within industries. Between-industry demand shifts are defined in a standard way. In the above formula j indexes all industry-occupation cells (150) when they compute overall demand shift for any k, but for between effects j refers only to industries (50). This choices may affect the magnitudes of within and between components which are seen important in SBTC discussion. This is why we do a standard shift-share analysis as well.

		Between industry			Within industry			Overall (indust. and occup.)		
	Educ.	d0402	d1004	d1002	d0402	d1004	d1002	d0402	d1004	d1002
F	Below-PSG	-4.02	-31.44	-36.99	1.49	2.08	4.22	-2.53	-29.36	-32.77
	PSG	-0.85	-7.49	-8.41	0.22	4.13	4.40	-0.63	-3.36	-4.02
	HSG	2.00	5.01	6.92	-2.19	6.20	4.12	-0.19	11.21	11.04
	VHS	0.89	9.05	9.86	-2.03	3.14	1.32	-1.15	12.19	11.18
	CLG	0.10	16.85	16.93	-1.19	0.04	-0.97	-1.09	16.88	15.96
M	Below-PSG	-0.14	-6.01	-6.16	0.61	-1.79	-1.13	0.48	-7.81	-7.29
	PSG	1.00	1.81	2.79	0.51	-0.59	-0.08	1.50	1.22	2.71
	HSG	1.56	5.42	6.90	-0.50	1.63	1.14	1.06	7.06	8.05
	VHS	0.89	6.88	7.72	-0.49	0.13	-0.32	0.41	7.02	7.40
	CLG	0.21	14.77	14.95	-1.37	0.42	-0.75	-1.16	15.19	14.20

Table 6: Industry and occupation based demand shift measures following Katz-Murphy (1992) approach, 2002-2004-2010, as changes in log relative demand multiplied by 100, i.e. $100 \times \log(1 + \Delta E_k)$ where E_k denotes the share employment of cell k in total employment. Employment is measured in efficiency units. d0402 is used to denote the difference between 2004 and 2002. The same logic applies to d1004 and d1002 as well. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

Table (6) presents the evolution of demand shifts for different education-by-gender groups for different sub-periods. For each period and demographic group we report the overall demand shift and decompose this into "between industry" and "within industry" components. Our results for the entire period, 2002-2010, show that the overall and between demand shifts are increasing with education level. College graduate males have seen their demand increase approximately 21 % between 2002-2010 compared to workers with a below primary school level. For females with comparative education groups the difference is even stronger: approximately 48 % between 2002-2010. For both male and female less-educated workers between-industry demand shifts are negative and more pronounced for females. Also, another interesting finding is that between 2002-2010 the within industry shift is women-biased, i.e. demand for women

increased within each industry while for men we have no clear trend in this period.

Table (7) shows the results of a standard shift-share analysis for the same time period and demographic groups. As in Table (6), the main finding is that the relative demand shifts are increasing in education level, between 2002-2010. Between-industry demand shifts are stronger than within-industry ones. Within-industry effects are significantly positive only for CLG males and females in 2004-2010 period. Male HSG and both male and female with a BPS education have seen their relative demand decreasing.

To the extent that between effects does not favor a SBTC argument, we can claim that Tables (6) and (7) show a shift in product demand (rather than SBTC) which precipitates a reallocation of labor across industries. Note that since we use only 9 industries it is possible that our within industry shifts contain some between industry effects as well. For a deeper analysis which distinguishes within and between effects more cleanly one should use a more disaggregated data such as firm- or plant-level data.

		Between industry			Within industry			Overall effect		
	Educ.	d0402	d1004	d1002	d0402	d1004	d1002	d0402	d1004	d1002
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

Table 7: Between and within industry decomposition of changes in employment shares of demographic groups (multiplied by 100) using a standard shift-share approach, 2002-2004-2010. Employment is measured in efficiency units. d0402 is used to denote the difference between 2004 and 2002. The same logic applies to d1004 and d1002 as well. Below-PSG, PSG, HSG, VHS anc CLG denote, respecteviley, below primary school, primary school, high school, vocational high school and college graduates.

5 Decomposing Wage Inequality

5.1 Methodology

In this section, we will try to decompose the wage inequality in order to analyze how changes in individual attributes affect the wage distribution. Among varius decomposition strategies, we have chosen to use the techniques proposed by DFL and JMP. Like all other applications, both of these decomposition techniques are generalizations of Oaxaca decomposition with the difference that instead of mean, they estimate the entire wage distributions. To give a brief account, JMP proposes an imputation approach where the wage from a given period t is replaced by a counterfactual wage of the $t + 1$ where both the returns to observables and unobservables are set to be as in the period of $t + 1$. The implementation of this procedure follows in two steps. First, unobservables (residuals) are replaced by counterfactual unobservables and then

counterfactual returns to observables are imputed[14]. For the case of DFL, the counterfactual distribution in a particular year is obtained by assuming that the conditional distribution of workers attributes change over the period. Let us assume that we have information about wages w and individual attributes x, given[15] at time t. The density of wages at one point in time $g(w|t)$ could 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 $dF(x|t)$:

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

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, $g(w|t_{w|x} = 10, t_x = 02)$ would represent the density of wages that would have prevailed holding the 2010 wage structure same but assuming that the composition of attributes remains 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, reweighting 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 to estimate the weighting factor using a parametric approach. Holding that the choice of the estimation procedure might affect results, generally a probit model is preferred to estimate. We follow the same procedure and use the individual controls described above.

[14]The details of JMP decomposition will be skipped and the study will concentrate on the DFL decomposition for two reasons; first it is widely used in the literature, second the results from JMP procedure are displayed just to have a comparison with the DFL decomposition. See more detailed in "Decomposition Methods in Economics", Fortin et al. (2001).

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

We can rewrite the differences in wage densities as a decomposition of the two effects namely the composition and price (or wage structure).

$$
\begin{aligned}
&g(w|t_{w|x}=10,t_x=10)-g(w|t_{w|x}=02,t_x=02)= \\
&\underbrace{\Big(g(w|t_{w|x}=10,t_x=10)-g(w|x,t_{w|x}=10)\theta(x)dF(x|t_x=10)\Big)}_{composition\ effect} \\
&+\underbrace{\Big(g(w|x,t_{w|x}=10)\theta(x)dF(x|t_x=10)-g(w|t_{w|x}=02,t_x=02)\Big)}_{price\ effect}
\end{aligned}
\tag{5}
$$

The first of term of the equation (5) is the composition effect where wage schedule in 2010 kept same but the distribution of attributes have re-weighted according to the distribution prevailing in 2002. The second term is the price effect where the distribution of attributes are similar as in 2002 but the wage schedules are different. The benefit of DFL decomposition is that the wage effect can be interpreted as a kind of treatment effect in which the contribution of unobservables factors are in play. Before proceeding, we have to underline several shortcomings of the counterfactual analysis. The simplifying assumption of the DFL decomposition, like all others is that it ignores the possible general equilibrium effects on prices when the composition of quantities change. This might be crucial when the change in wage schedule or composition is cumbersome. Secondly, beside being a intuitive, the DFL technique does not give an implication of casual inference. In the proceeding section, we will discuss the size of both effects on the wage in equality in Turkey.

5.2 Findings

	Years 2002-2010				Years 2002-2004				Years 2004-2010			
	Total	Quantities	Price	Unobserv.	Total	Quantities	Price	Unobserv.	Total	Quantities	Price	Unobserv.
	Men											
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
sd	-0.126	-0.012	-0.064	-0.050	-0.105	-0.014	-0.059	-0.033	-0.021	0.004	-0.005	-0.020
d9010	-0.328	-0.032	-0.175	-0.122	-0.294	-0.051	-0.155	-0.089	-0.035	0.014	-0.009	-0.039
d9050	-0.095	0.047	-0.102	-0.040	-0.163	-0.005	-0.125	-0.033	0.068	0.048	0.028	-0.009
d5010	-0.233	-0.078	-0.072	-0.082	-0.131	-0.045	-0.029	-0.056	-0.102	-0.034	-0.038	-0.031
d7525	-0.252	-0.078	-0.108	-0.066	-0.184	-0.044	-0.094	-0.046	-0.068	-0.017	-0.028	-0.023
	Women											
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
sd	-0.132	-0.019	-0.072	-0.042	-0.109	-0.021	-0.068	-0.020	-0.023	0.004	-0.003	-0.024
d9010	-0.346	-0.067	-0.176	-0.104	-0.260	-0.031	-0.177	-0.052	-0.087	-0.024	-0.009	-0.054
d9050	-0.043	0.044	-0.083	-0.004	-0.164	-0.033	-0.143	0.011	0.121	0.071	0.066	-0.016
d5010	-0.303	-0.111	-0.092	-0.100	-0.095	0.002	-0.034	-0.063	-0.208	-0.095	-0.075	-0.037
d7525	-0.205	-0.076	-0.096	-0.034	-0.199	-0.068	-0.109	-0.021	-0.006	0.008	-0.004	-0.010

Table 8: JMP Wage Gap between Percentiles

Firstly the results of the JMP decomposition for three different periods will be presented and then a similar exercise will be carried out using the DFL procedure. The sub-periodisation is helpful in two ways in this context, first it provides to understand particularly in which

episode, the effect of economic recovery has been reflected in the reduction of the wage inequality. Secondly, it helps to capture which particular institutional change has contributed the reduction of inequality for specific groups at different segments of the wage distribution. It is complementary to our previous discussion which underlines the changing structure of price (or wage) schedule. For both JMP and DFL decomposition, same set of individual covariates described above are used in order to avoid any confusion in comparing both techniques. The JMP decomposition describes the components of wage density changes that could be attributed to measured prices and quantities and residuals which are referred to as unmeasured prices and quantities.

In case of male wage inequality, the JMP decomposition clearly shows (Table 8) that mainly the differences in observable prices has contributed the reduction in inequality between 90/10 percentiles between 2002-2010. The total contribution of differences in quantities and residuals have been lower than those of prices. The same result also holds for the case of female wage inequality for the 90/10 percentiles. For the reduction in inequality between 50/10 percentiles, the contribution of quantities is almost equal to those of prices and residuals (or unobservables)[16]. The change in 90/50 wage gap for both sex is not minor compared to the wage gap between other percentiles, at least for the period between 2002-2010.

	Years 2010-2002			Years 2004-2002			Years 2010-2004		
	total	composition	price	total	composition	price	total	composition	price
	Men								
p90/p10	-0.3285	-0.0587	-0.2698	-0.2939	-0.0492	-0.2447	-0.0329	-0.0053	-0.0276
p50/p10	-0.2332	-0.0443	-0.1889	-0.1309	-0.0423	-0.088	-0.1023	-0.0284	-0.0739
p90/p50	-0.0953	-0.0144	-0.0809	-0.1630	-0.0069	-0.1561	0.0694	0.0231	0.0464
p75/p25	-0.2518	-0.1292	-0.1226	-0.1845	-0.0404	-0.144	-0.0677	-0.0207	-0.047
Variance	-0.1733	-0.0437	-0.1296	-0.1471	-0.0185	-0.1286	-0.0264	-0.0188	-0.0076
Std. Dev	-0.1263	-0.0342	-0.0922	-0.1056	-0.0142	-0.0914	-0.0209	-0.0149	-0.0059
	Women								
p90/p10	-0.3505	-0.1409	-0.2096	-0.2639	-0.0447	-0.2191	-0.0829	-0.0688	-0.0141
p50/p10	-0.3032	-0.1007	-0.2025	-0.0954	-0.0264	-0.0690	-0.2041	-0.0584	-0.1458
p90/p50	-0.0473	-0.0402	-0.0070	-0.1685	-0.0183	-0.1501	0.1212	-0.0105	0.1316
p75/p25	-0.2052	-0.1272	-0.0780	-0.1996	-0.0538	-0.1458	-0.0063	-0.0645	0.0583
Variance	-0.1993	-0.0624	-0.1368	-0.1688	-0.0288	-0.1400	-0.0320	-0.0275	-0.0045
Std. Dev	-0.1326	-0.0441	-0.0884	-0.1105	-0.0200	-0.0905	-0.0230	-0.0198	-0.0032

Table 9: DFL Wage Gap between Percentiles

The results of DFL decomposition largely backs those of the JMP technique. Table 9 shows that the price effect dominates the composition effect throughout the period particularly for the declining wage gap between 90/10 percentiles. Regarding our earlier discussion, it would be more informative to look at the evolution of wage inequality by separating the period between 2002-2010 into 2002-2004 and 2004-2010. The sub-period 2002-2004 coincides with the episode where the real minimum wage hike has taken place. Keeping in mind that during the sub-period 2004-2010, minimum wages are set above the inflation(5), the impact on wage schedule turns out to be real rather than nominal. Evidently, the reduction in the wage gap

[16]The one shortcoming of JMP procedure is that the total contribution of components needs not to add up to one, so the contribution of each factor is not given as the percentage of the total change.

between 90/10 has taken place between the years 2002 and 2004. Similar observation can be made for the male wage gap between 50/10 but with the difference that the contribution of price remains less modest compared to the 90/10 wage gap. This result is quite intuitive since the real minimum wage increases might have also affected the wages of those workers around the median of the distribution. Hence, we could expect that the contribution of prices would become less important and the difference of quantities have more effect on the reduction.

Following the same reasoning, we could see another proof of the real minimum wage driven wage inequality reduction by looking at the change in the wage gap 90/50. In fact, the real wages at the median, 50^{th} percentile has also increased by the change in minimum wage legislation which took place in the first semi-annual term of 2004. The wage gap 90/50 has decreased between 2002-2004, nevertheless, for the rest of the period 2004-2010, a combination of positive changes differences in observable price and quantities has 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 has been the result of price effect mainly due to the minimum wage increase. The DFL composition backs the argument more robustly in the sense that the composition effect remains relatively small compared to wage effect which is likely to reflect the change in pay schedule.

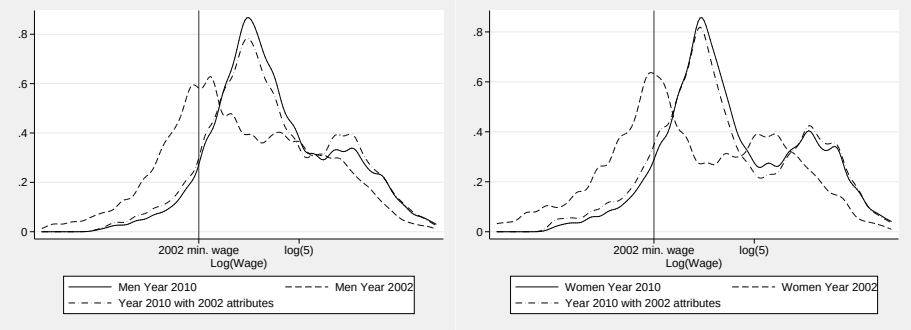

Figure 10: 2010-2002 Wage Distribution

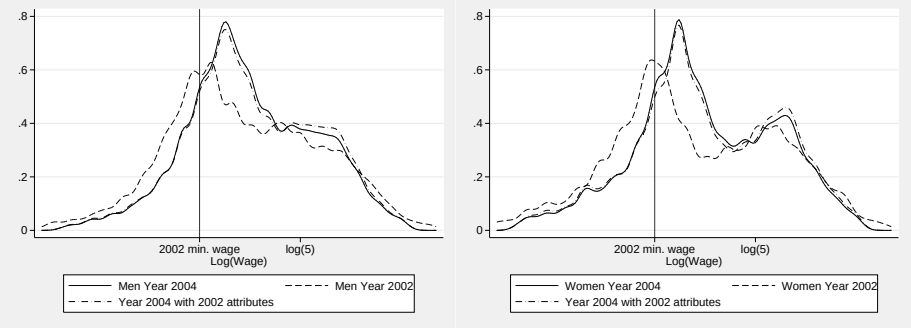

Figure 11: 2004-2002 Wage Distribution

For wage inequality among female wage earners, the same pattern can be traced from the JPM and DFL decompositions, with the exception that firstly the inequality reduction is much

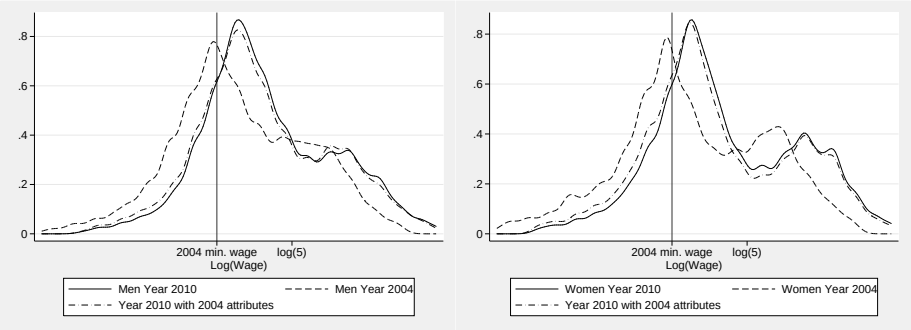

Figure 12: 2010-2004 Wage Distribution

more sharper, secondly, the 50/10 wage gap continued to decrease between years 2004-2010, again largely due to price effect. The 90/50 has significantly widened between the 2004-2010 period where the main contributor is the differences in prices, contrary to the male case. A general remark would be made for the female case. The price effect clearly dominates that of the composition throughout the period between 2004-2010. We can argue that the sharp decline in wage inequality, particularly between the 10^{th} percentile and upper percentiles might have contributed to the convergence between male and female wages(table 1). In the Turkish labor market, it is very typical characteristics of female labor force that the participation rates increases with the 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 those of male wage earners. We will not further investigate any gender wage convergence, since it needs a different elaboration in regard to labor force participation.

When the results of decomposition combined with the raw wage inequality in the table 1 and the view from 4, we have to underline that one other reason why the wage inequality has decreased can be interpreted in favor of the reference wage argument of the minimum wage. Clearly, thanks to the regulation of minimum wages, the decrease in real wage of upper percentiles (starting from 60^th) in the period 2002-2004 has not affected the lower percentiles. The dramatic improvement in real wages of mostly lower skilled workers during that period has produced welfare increasing affect in terms of wage earnings.

The graphical representation shows the wage distribution of each year and the counterfactual distribution re-weighted with the individual attributes held in their previous year composition. The counterfactual exercise displays the wage distribution if workers attributes are held in their previous year level but the pay schedule prevails still as in the actual year (figures10, 11 and 12). Between 2002-2004, the counterfactual distribution reflecting the composition effect nearly matches with the actual distribution, implying that the shift in wage distribution and the change in lower percentiles are the result of wage effect (fig.11). It is note worthy that when compared with the rest of the distribution, the shift in the upper percentiles from 2002 to 2004 is less clear. As it is discussed above through the results of decomposition, comparing both years, the shift in the lower percentiles is more visible, moving from year 2002 and 2004 for female wage distribution. This visual representation confirms our discussion that the most important

wage effect has occurred around the median, but mainly at lower percentiles. The position of the minimum wage in the entire distribution is 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 could produce dispersed impact on the wage distribution. For the period 2004-2010, it seems that the distribution shift has been more proportional with the except that the composition effect is clear for women, particularly for lower percentiles (fig.12). The composition effect dominates the inequality increasing contribution of price change and the overall effect is the reduction of inequality for the wage gap 90/10 for women. The figure 13 clearly shows that for lower percentiles the compositon effect is very limited whereas it turns out to produce a counteracting effect for upper percentiles between 2004-2010.

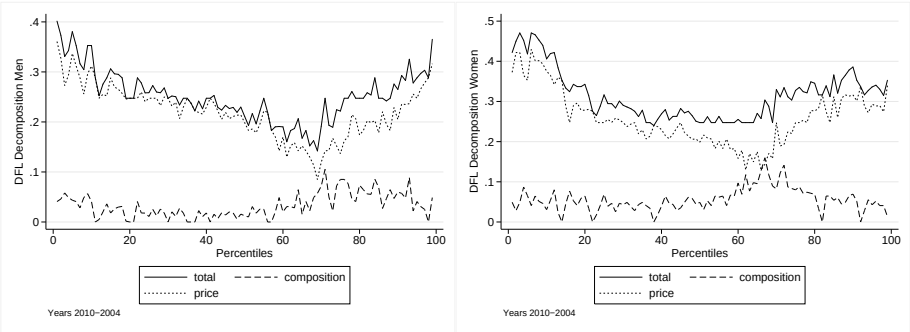

Figure 13: Decomposition of Effects by Percentiles, 2010-2004

Among limited developing country studies, Bosch and Manacorda (2010) finds for Mexico that real minimum wage erosion has contributed to the growth in inequality at the bottom end. For female wage inequality, the effect of the institutional change is stronger, consistent with the finding of the DFL (1996) paper which concludes that the decrease in real minimum wage decrease affected female wage inequality for more than that of male. A welfare improving asymmetric gender effect of minimum wage is can be found in Ganguli and Terrell (2006) which concludes a similar positive effect of the minimum wage, particularly for female wage earners in Ukraine. It is worth noting that the real minimum wage indexation has helped to maintain the wage gap stable over the period 2004-2010 after the real minimum wage hike. Another important finding is that the composition effect is relatively small compared to the dominant price effect particularly between the years 2002-2004. Xing and Li (2011) conclude in a similar fashion, arguing that although the educational attainment has increased in China, the composition effect has remained relatively smaller compared to price effect.

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

Table 10: Share of Formal Contracts 2002-2010

For a concluding remark, the role of informal contracts which Ganguli and Terrell (2006) also raises as an issue in implementing the policy on compliance and enforcement of minimum

wage should be discussed as well. In an economy like Turkey where the informal contracts are sizable, it is likely that real minimum wage increase might produce a reallocation of unskilled workers towards the informal sector. The size of this swing could be considerable. Unlike in the case of a decrease in real minimum wage, the raise in real minimum wage must be coupled with strict enforcement. For the Turkish case, we observe that enforcement policy has been quite efficient so that the share of the formal sector has increased over the period 2002-2010 (table 10) with the exceptional decline in year 2004. However, the decrease in the share of formal contracts is limited and proved temporary, gradually increasing over the period. One last point should be underlined as well. The stable growth period has contributed the welfare improving outcome of the structural changes in the labor market. It would be hard to argue in favor institutional change in an environment of loose enforcement policy and recessionary pressure.

Conclusion and Discussion

The literature emphasizing the role of institutional factor suggest 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 USA (Card and DiNardo, 2002 and Lemieux, 2006) based on the works of DiNardo, Fortin and Lemieux (1996) and Lee (1999) supporting the institutional view. The real minimum wage increase in 2004 explains the significant decrease in the wage gap between 90/10 and 50/10 observed among male and female wage earners in Turkey between 2002 and 2010. The Turkish case is a positive example demonstrating that a sharp increase in real minimum wage is likely contribute to the narrowing of wage gap with upper percentiles. It rests for a further study to integrate whether disemployment and informality played a role during the institutional change. It would be informative to look at whether any polarization effect is in pay during the period, since it is possible that the rise in both poles of the distribution might disfavor the employment share of middle occupations groups as well as their real wages. Household Budget Surveys could be used for the generalization of the results of obtained from Household Labor Force Surveys.

A Log hourly wages

Year	No. Obs.	Min	Max	Std. Dev.	Variance	p5	p10	p25	p50	p75	p90	p95
2002	43622	-1.803	2.223	0.764	0.584	-0.956	-0.668	-0.262	0.143	0.836	1.319	1.529
2003	42764	-1.587	2.086	0.705	0.497	-0.776	-0.531	-0.200	0.205	0.842	1.287	1.476
2004	65183	-1.551	1.945	0.657	0.432	-0.725	-0.453	-0.086	0.277	0.847	1.258	1.444
2005	69615	-1.496	2.059	0.653	0.427	-0.649	-0.377	-0.007	0.336	0.904	1.335	1.548
2006	71886	-1.365	2.092	0.644	0.415	-0.518	-0.299	0.021	0.358	0.917	1.363	1.562
2007	72030	-1.161	2.110	0.626	0.392	-0.419	-0.237	0.092	0.410	0.967	1.394	1.596
2008	73359	-1.212	2.189	0.626	0.392	-0.413	-0.190	0.110	0.456	0.985	1.439	1.621
2009	73341	-1.185	2.234	0.638	0.408	-0.366	-0.155	0.155	0.471	1.030	1.500	1.723
2010	81015	-1.249	2.229	0.638	0.407	-0.374	-0.151	0.137	0.437	1.035	1.501	1.690

Table 11: Log Hourly Wages 2002-2010 (using sample weights)

B Fixed-coefficient input requirement index and standard shift-share analysis

The fixed-coefficient manpower requirements index relies on a constant ratio a_{kj} between workers in education group k in industry j and total employment in industry j. For any period t, if the ratio of workers in occupation (or education level) k in industry j (L_{kjt}) to total employment of industry j (L_{jt}) is constant, then we have: $a_{kj} = L_{kjt}/L_{jt}, \forall t$. Using this information, the demand for education group k workers is formulated as

$$L_{kt} = \sum_j L_{kjt} = \sum_j a_{kj} L_{jt}$$

Hence, the change in education level k employment between period s and period t is related to shifts in industrial employment by the following formula

$$L_{kt} - L_{ks} = \Delta L_{kt} = \sum_j a_{kj} \Delta L_{jt}$$

Without assuming such a constant ratio we would write

$$L_{kt} = \sum_j \gamma_{kjt} L_{jt}$$

where $\gamma_{kjt} = L_{kjt}/L_{jt}$ the proportion of workers in industry j employed in occupation k in year t. Using a standard shift-share analysis we may write the shift in employment of demographic group k, $\Delta L_{kt} = L_{kt} - L_{ks}$, as the sum of a within-industry effect, a between-industry effect and optionally a covariance effect. It is well-known that the choice of the base year/group affects the magnitudes of the between and within terms. Depending on the base choice (initial period values vs. average values) we have

$$L_{kt} - L_{ks} = \Delta L_{kt} = \underbrace{\sum_j \gamma_{kjs} \Delta L_{jt}}_{\text{between effect}} + \underbrace{\sum_j L_{js} \Delta \gamma_{kjt}}_{\text{within effect}} + \underbrace{\sum_j \Delta L_{jt} \Delta \gamma_{kjt}}_{\text{covariance term}} \tag{6}$$

$$= \underbrace{\sum_j \gamma_{kj} \Delta L_{jt}}_{\text{between effect}} + \underbrace{\sum_j L_j \Delta \gamma_{kjt}}_{\text{within effect}} \tag{7}$$

where γ_{kj} and L_j denote, respectively, average group k share of employment in industry j and average employment of industry j over during analyzed period (between two periods). Equation (6) uses initial employment shares and levels as weights while (7) uses average values. The between effect computed from the standard shift-share analysis is the same as the one from the fixed-coefficient input requirement index, if we use period s as base group in both methods, i.e. $a_{kj} = \gamma_{kjs}$.

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