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Heterogeneous effects of minimum wage on labor market outcomes: A case study from Turkey

Abstract

We assess the effects of a sharp minimum wage increase on wages, informality, and employment in Turkey, a large developing economy with one of the highest minimum wage-to-average wage ratios among OECD countries and widespread discrepancies between labor market outcomes of women and of men. We look at the quasi-experimental 2016 minimum wage increase and pay attention to identifying information coming from demographic groups. We find that the increase in the minimum wage had an economically substantial and statistically significant positive impact on wages. Despite the positive wage effects of the increase, we find no negative employment effects. However, we show that the minimum wage increase may have caused an increase in the share of informal employment among workers with less than tertiary education, especially for such workers working for small firms.

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1 Introduction

The literature on the effects of minimum wage on employment finds its roots in the standard labor market model, which posits a negative relationship between the demand for labor and the wage level and suggests that a minimum wage imposed above the labor market clearing wage level will lead to unemployment. Several empirical studies test the impact of minimum wage on employment, but no clear consensus emerges from these studies. While some argue that minimum wage increases have adverse impacts on less-skilled workers' employment (Brown et al., 1982; Neumark and Wascher, 2007); others find no employment effects (Card, 1992a; Card, 1992b; Katz and Krueger, 1992; Card and Krueger, 1994), even though the overwhelming majority of these studies find some evidence for the positive effects of minimum wage on average wages. A controversy about methodology also exists, and these different findings may be partly due to the use of different empirical approaches. As the drawbacks of the use of time series are well established (Card and Krueger, 1995), there is an ongoing debate about the use of panel data of case-study approaches and of alternative approaches such as the “bunching” estimator (Dube et al., 2010; Allegretto et al., 2011; Allegretto et al., 2017; Neumark et al., 2014; Neumark and Wascher, 2017; Neumark, 2017; Cengiz et al., 2019).

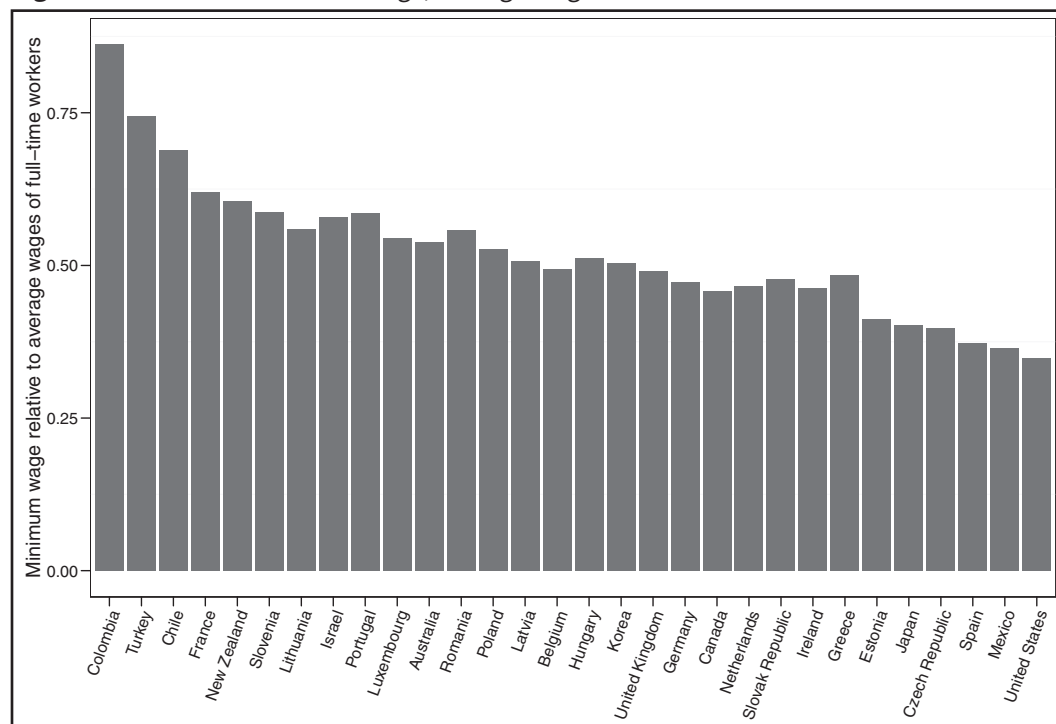
While most of this literature focuses on advanced economies, several additional issues emerge when it comes to analyzing the effects of minimum wages in developing economies. First, weak compliance with the minimum wage law in these countries (Rani et al., 2013) may negate the employment effects of the minimum wage. It is possible that overall employment is not affected by minimum wage increases as employers are able to pay lower than the minimum wage by employing workers informally. For example, del Carpio et al. (2019) found that increases in the minimum wage raise the share of informal workers in the labor market in Thailand. Similar results are presented for Honduras (Ham, 2018), Brazil (Jales, 2018; Broecke and Vandeweyer, 2016), and Chile (Wedenoja, 2013). On the other hand, a negative impact on formal employment is reported for Indonesia (Comola and De Mello, 2011), Russia (Muravyev and Oshchepkov, 2016), and South Africa (Millea et al., 2017). Second, the relationship between minimum wage and average wages may be quite different in developing economies due to the existence of large informal sectors.¹ If an increase in minimum wage level causes a labor flow from the formal sectors to the informal sectors, or new entrants become informal workers rather than formal workers due to minimum wage increase, average wage effects of the increase will depend on the effects on informal wages. Khamis (2013) found that minimum wage increases have considerable positive impacts on both informal and formal workers' wages in Argentina. Lemos (2009) argued that an increase in the minimum wage is associated with a compression in the wage distribution of informal workers in Brazil. While Millea et al. (2017) found a positive relationship between minimum wages and informal workers' wages in South Africa, Ham (2018) found a negative relationship in Honduras.

Building on this literature, we investigate the labor market outcomes of the quasi-experimental sharp increase in the minimum wage level in Turkey in 2016. Turkey presents an interesting and important case considering that its minimum-wage-to-average-wage ratio is

¹ In some developed countries where sector-specific collective agreements are prevalent, informal works, such as service provision, are margins of adjustment to wage increases arising from collective agreements because it is possible to pay informal service providers below the minimum wage rate (Martins, 2020).

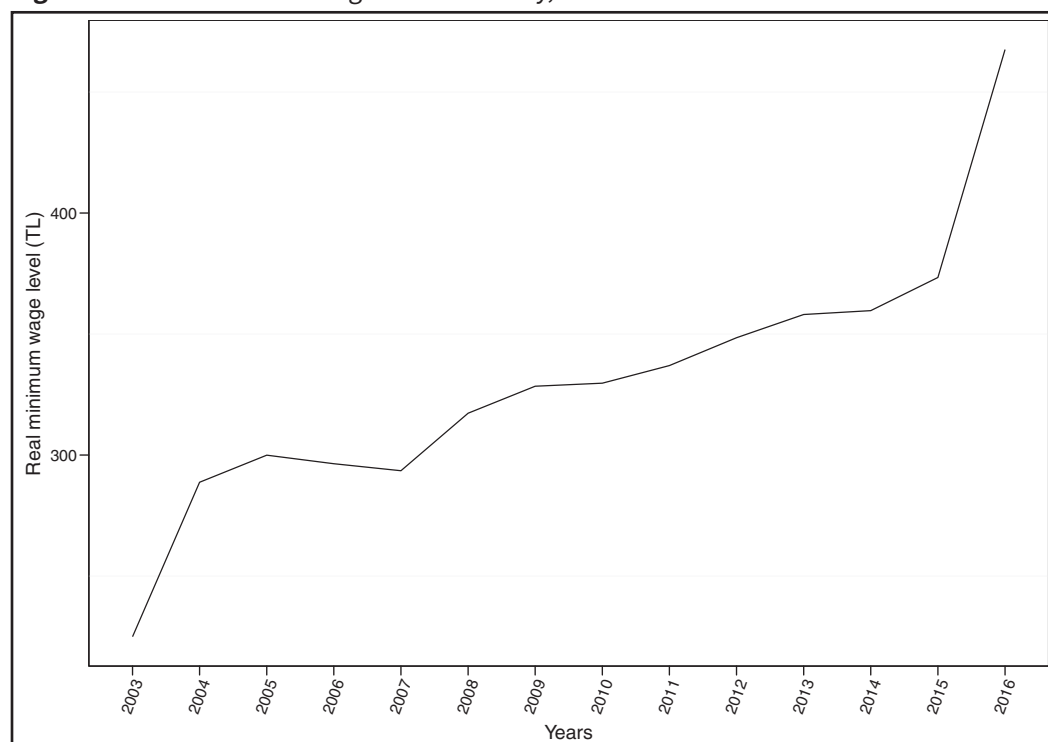
one of the highest among OECD countries (Figure 1) and has experienced significant increases in the real minimum wage level since 2003 (Figure 2), with two dramatic increases: 28% in 2004 and 25% in 2016. Furthermore, although the share of informal employment has been declining in the last two decades, informal employment still accounts for about one-third

Figure 1 National minimum wage/average wage ratio.



Notes: OECD countries in 2016, based on OECD data.

Figure 2 Real minimum wage level in Turkey, 2003–2016.



Notes: Based on Turkstat's CPI and Labor and Social Security Ministry's minimum wage data.

of total employment. The labor market is characterized by regional inequalities, widespread discrepancies between female and male employment and wages, and wage discrepancies across employment by small and large firms.

In addition to its potential role in such disparities, the minimum wage may also be considered as a “surrogate social policy” used to support low-income groups. The labor market produces dynamics that lift individuals out of poverty (Şeker and Dayıoğlu, 2015), and minimum wage may thus play an active role in the income and labor market outcomes of the poor. However, there are few and limited studies examining the Turkish case. Acar et al. (2019) argued that the increase in minimum wage in 2016 led to an increase in firms’ exit rates from formal sectors, and Gürsel et al. (2018) found a positive relationship between the minimum wage increase and the share of informal workers. Of the few earlier studies, Güven et al. (2011), using a time-series approach, found no employment effects. Pelek (2015), using a fixed-effect model and regional variation in Kaitz index, shows that minimum wage has a positive impact on informality among young workers. Papps (2012), using the variation in individual-level labor costs to detect employment effects of the social security taxes and minimum wage, found that minimum wage has a negative effect on employment outcomes. Yüncüler and Yüncüler (2016) utilized the variation in the share of minimum wage workers affected by the minimum wage increase in 2004 within various industry and occupation interactions and found that the minimum wage increase affected wages, working hours, and informality positively.

In this article, we follow the methodology used in Caliendo et al. (2018), Dolton et al. (2015), and Card (1992b) and exploit the regional variation in the share of workers affected by minimum wage increases. This allows us to control for the Russian economic sanctions and the coup attempt—two confounders in 2016 who coincided with the minimum wage increase. We also show that ignoring the gender discrepancy in labor markets may result in biased results when analyzing the effects of minimum wages. Our findings also demonstrate the importance of addressing the heterogeneous effects of the minimum wage increase across firms with different sizes. We find that the increase in the minimum wage in 2016 has been shown to have had economically substantial and statistically significant positive wage effects on most demographic groups. When it comes to least educated groups, these positive effects are mainly seen in the wages of men. We also find positive, statistically significant and economically important effects on informal wages, supporting the “lighthouse effect” of the quasi-experimental minimum wage increase. We find no negative impact on employment from the minimum wage increase. However, we also find that the increase induced an economically considerable positive effect on the share of less-educated workers working without social security. These positive informality effects rise when we focus on firms that employ less than ten employees.

The remainder of the article is organized as follows. In Section 2, we provide a brief overview of the labor market characteristics, the institutional setting, and the political background of the sharp minimum wage increase in 2016 to show that this increase was exogenous to labor market conditions. We present the data in Section 3. We identify the minimum wage workers, discuss whether the minimum wages are binding, and present our empirical model and identification strategy in Section 4. Results and their robustness are discussed in Section 5 before we conclude with Section 6.

2 Institutional details and political background

2.1 The minimum wage policy and labor markets

Minimum wage regulations in Turkey began with region-varying levels in 1951, was replaced by a sector-specific minimum wage statute in 1974, and became national in 1989 (Korkmaz, 2004). The minimum wage legislation states that a tripartite committee representing workers, employers, and the government must set a monthly minimum wage at least every two years. Most of the time, the committee announces different minimum wage levels for the first and second half of the following year in December of the current year, taking into account the inflation expectations, and the updated wage floors go into effect on January 1 and July 1 of the following year. In some years, like 2016, when the minimum wage increase is relatively high, the committee sets one minimum wage level for the entire year.

The share of wage employment in total employment and the share of minimum wage workers within the wage employment has been on the rise since the early 2000s; however, on the other hand, the rate of unemployment has been persistently high even in periods of high economic growth (Orhangazi, 2019). Increasing wage employment, higher share of minimum wage workers, and the persistent high unemployment render labor market regulations, relevant in the debates on unemployment, such as employment protections and minimum wage, and non-wage costs to employers (Ayhan, 2013). Moreover, it is possible to place the minimum wage regulations within the context of social policy in Turkey, since crucial social policy indicators such as the poverty threshold are determined according to the current minimum wage level (Tekgüç, 2018). Given the active role of the labor market in income and poverty dynamics in Turkey (Şeker and Dayıoğlu, 2015), the minimum wage policy, through its effects in the labor market, may also be considered of as one of “surrogate social policies” used by the government to lift individuals out of poverty and to provide a modest amount of social assistance.

Three characteristics of the labor markets in Turkey should be taken into account when analyzing the impacts of minimum wages on labor market outcomes. First, even though the minimum wage is legally binding, some employers, especially small firms, in practice avoid paying the minimum wage (and other employment regulations) by employing workers informally, that is, without registering them with the social security system. Although the share of informal employment has declined during the 2000s, it is still estimated that around one-third of overall employment and nearly 20% of full-time wage employment in the private sector are informal (Orhangazi, 2019). Therefore, small firms/higher informality-larger firms/lower informality segmentation in the labor market may also be debated.

Second, an important segmentation in the Turkish labor market is observed along the widespread discrepancies between labor force participation rates, unemployment rates, and the wages of women and men. The participation rate of women in Turkey in the labour force (34% in 2018) was much lower than that of men (72% in 2018). Compared to most other developing countries, it is also much lower (e.g. 48% in South Africa and Argentina, 55% in the Russian Federation, 52% in Brazil in 2018). Moreover, the rate of unemployment is higher for women and there is a persistent gender wage gap. For example, less educated women earn 24% less than less-educated men, while women with tertiary education earn 9% less than men with tertiary education (Tekgüç et al., 2017).

Third, regional inequalities also characterize the labor market. Unemployment is concentrated in large migrant-receiving provinces such as Istanbul, Izmir, Adana, Mersin, and Van, while the Northeastern region displays low unemployment and relatively high labor force participation due to the higher share of agricultural employment.

Share of manufacturing employment in the formal sector is the highest in Tekirdağ, Bilecik, and Düzce regions and the lowest in Iğdır, Hakkari, and Ardahan regions in Southeastern Turkey, which is also economically the most underdeveloped with an ongoing armed conflict (Ministry of Development, 2011).

In the empirical analysis below, we pay specific attention to the heterogeneities presented by these characteristics and show that the effects of the minimum wage increase may be different for women and men, formal and informal sectors, small and large firms, different education groups, different age groups, and across regions.

2.2 The 2016 minimum wage increase

The real minimum wage level was gradually increased through the 2000s and 2010s. The sharpest minimum wage increase came in 2016 with a 33% nominal, 25% real increase. The main driving force behind this sharp increase was the electoral competition in 2015. In the days leading to the June 7 general elections, the most popular election promise by the competing parties became the promise to increase the minimum wage, when the main opposition party, the Republican People's Party's (CHP), pledged to raise the monthly minimum wage from 949 Turkish liras to 1500 Turkish liras. The other opposition parties quickly jumped in and the Nationalist Movement Party (MHP) promised an increase to 1400 Turkish liras and the People's Democratic Party (HDP) to 1800 Turkish liras. The ruling Justice and Development Party (AKP) refrained from joining this competition and kept the position that these promises were economically unrealistic. However, AKP lost its parliamentary majority in the June 7 elections, and, unwilling to form a coalition government, pushed for renewed elections. Between the June 7 and the renewed elections on November 1, AKP also entered the minimum wage pledge competition and promised a 1300 Turkish lira minimum wage, which, after AKP's election victory in November, went into effect on January 1, 2016. Hence, the increase in the minimum wage can be seen as exogenous to the internal dynamics of the economy as it originated mainly from the exogenous political competition rather than the dynamics of the economy itself.

As Figure 2 shows, this is one of the highest minimum wage increases in Turkey during the 2000s. Although a similar increase took place in 2004, the increase in the minimum wage cost to the employer, which is the sum of unemployment premium, social security tax, and net minimum wage, was smaller in 2004. As such, the 2016 increase received widespread complaints from the employers,² which led the government to temporarily reduce the social

² Just to cite a few examples, an employer in textile sector was making the following complaint: "I rented a new facility. I was planning to increase my production by hiring 500 workers. In response to announcement [of the minimum wage increase], however, I dropped the idea" (Hürriyet, 2015). A CEO in textile manufacturing business argued that "the labor-intensive sector is not able to cope with a 30% increase in minimum wage. Some factories will be liquated." (ibid.). But complaints were not limited to the textile sector. Before the enactment of the increase, the vice chairman of the Independent Industrialists' and Businessmen's Association (MÜSIAD) maintained that "business world is very sensitive to such costs" (İHA, 2015).

security premiums paid by the employers for the already employed for 2016. In other words, the nominal increase in the total labor cost to the employers was less than the 33% increase in the minimum wage but still significant at 26%. Moreover, this temporary reduction was only valid for the number of employees who were employed full-time in 2015 and did not cover new hires.

The year 2016 also witnessed two political events that had significant economic consequences. First, following a military rift in Syria toward the end of 2015, Russia began imposing economic sanctions on Turkey. These sanctions included stopping agricultural imports from Turkey, rescinding the work permits of Turkish construction companies in Russia, and preventing Russian tour operators from organizing tours to Turkey. These sanctions hit regions that either produced agricultural products for the Russian markets or were dependent on tourists from Russia. As the sanctions and the minimum wage increase occurred around the same time, a minimum wage study based on a sectoral identification strategy would not be able to distinguish their effects. Therefore, in the analysis below, we rely on an identification strategy based on the regional variation in the potential minimum wage workers. The second political event in 2016 was the coup attempt of July 15. This attempt and the ensuing state of emergency led to a contraction of the economy in the third quarter of 2016. It is thus possible to falsely attribute the effects of this turmoil to the minimum wage's effects. Therefore, in the analysis below, we capture such year-specific effects and address the possibility that the turmoil's and the sanctions' effects vary across regions.

3 Data

We use the 2009–2016 annual Household Labor Force Survey (HLFS), which presents individual-level cross-sectional data gathered by Turkstat to produce official labor market indicators and provides information about demographic characteristics, employment status, income, and past work experience of household members. Even though some consider the quarterly HLFS to be more informative than the annual HLFS, especially when there are two different minimum wage levels in a year (Gürsel et al., 2018), the quarterly HLFS lacks regional information, which is essential for the empirical strategy of this article. Therefore, we opt for the annual HLFS.

The annual HLFS is representative at the national and the NUTS-2 region level. Our main sample is non-institutional working-age (15–64) population. The main outcome variables we use are income, employment, and informality status; and the main demographic variables such as age, education, and gender. We focus on the full-time wage employment in the private sector rather than the overall employment, since the public sector employees are already paid more than the minimum wage. Therefore, we start our analysis from 2009, the first wave that introduces public-private sector distinction in the data set. Finally, we analyze employment outcomes rather than unemployment outcomes, since minimum wage may affect households' labor force participation decisions, leading to spurious increases in unemployment figures. Our analysis is thus not affected by the change in unemployment and labor force participation definitions that took place in the data in 2014.

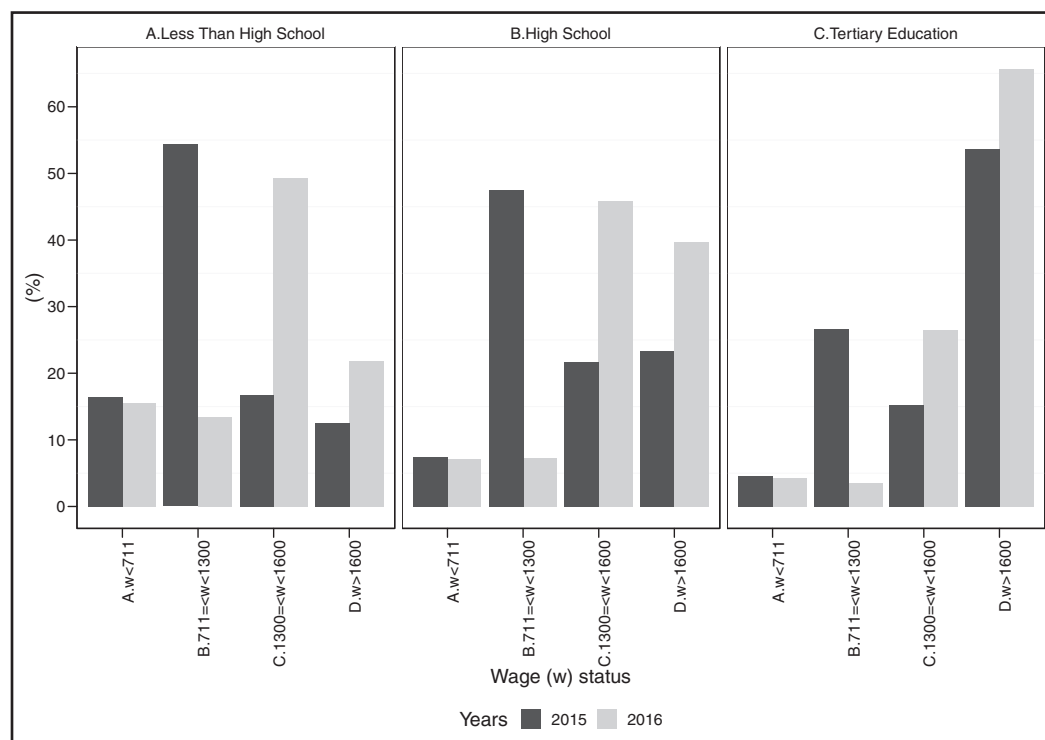
4 Empirical approach

4.1 Distribution of affected workers by demographic groups

Heterogeneous workers models predict that minimum wage's effects on the labor market outcomes of the demographic groups with a higher share of the minimum wage workers will be stronger (Brown et al., 1982). As a result, most studied groups in the minimum wage literature are teenagers (13–19 years), young adults (20–24 years), retail trade workers, and workers in restaurants. Studies seeking to discern the effects of the minimum wage in Turkey generally focus on the youth (e.g. Bakış et al., 2015; Pelek, 2015), conduct an industry-occupation based analysis (e.g. Yüncüler and Yüncüler, 2016), or examine the manufacturing sector (e.g. Güven et al., 2011). We identify workers potentially affected by the minimum wage increase in year t using the fraction of workers whose wages fall below the new minimum wage level in year t , but equal or surpass the 75% of the minimum wage level in year $t-1$ within nearly all education and age groups.³

Figure 3 shows the share of full-time private sector workers earning lower than 711 Turkish liras, workers earning lower than 1300 Turkish liras but higher than 711 Turkish liras, workers

Figure 3 Wage groups potentially affected by the minimum wage increase in 2016, by education.



Notes: Own calculations based on the 2015 and 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector by education groups (471,271 individuals). Tertiary educated workers are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. 711TL cutoff is 75% of the lowest minimum wage level in 2015; 1300TL is the minimum wage level in 2016. To read the A panel, for example, around 55% of workers with no high school degree earned less than 1300TL but higher than 711TL in 2015.

³ Data shows that the share of wage workers with wages less than 95% of minimum wage fluctuates from year to year (see Figure A1 and A2 in appendix), suggesting that even some of these workers below minimum wage is impacted by it. The share of workers with wages below 75% of minimum wage is stable over the years.

earning between 1300 Turkish liras and 1600 Turkish liras, and workers earning higher than 1600 Turkish liras in 2015 and 2016 within three education groups. 711 Turkish liras is 75% of the minimum wage level in the first half of 2015, and 1300 Turkish liras is the minimum wage level in 2016. It is reasonable to expect that workers earning around the current minimum wage level (between 711 Turkish liras and 1300 Turkish liras) in 2015 and demographic groups with a higher share of such workers in 2015 could be more affected by the minimum wage increase in 2016.

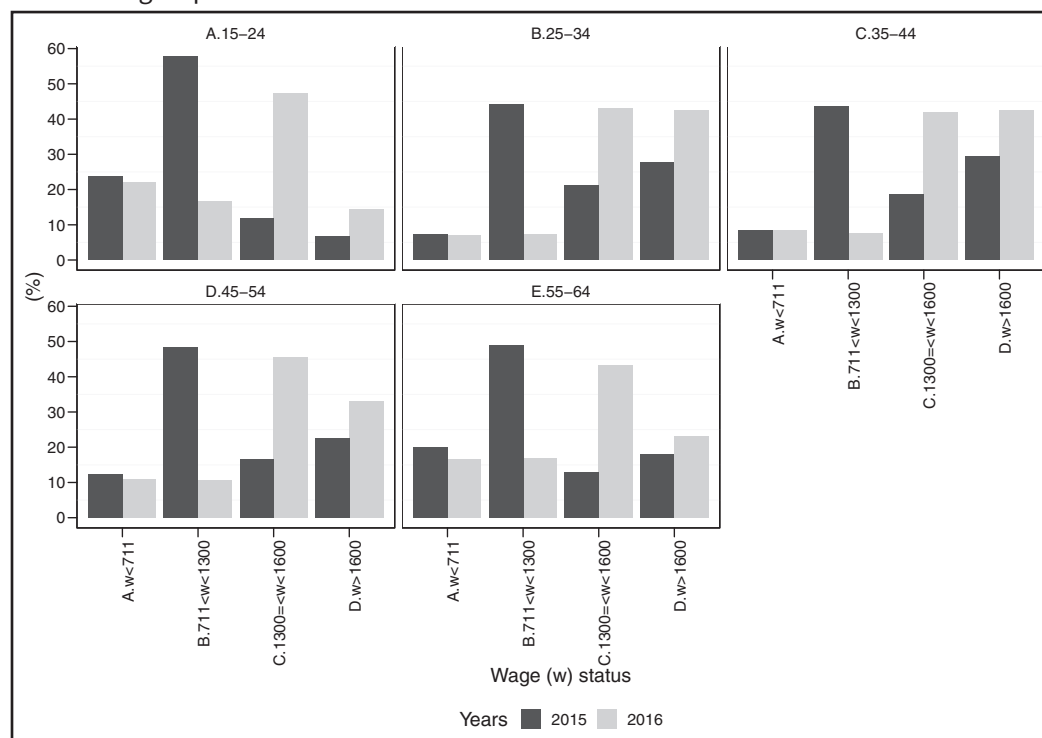
With this in mind, the figure indicates that more than 50% of workers with no high school degree earned around the minimum wage in 2015. Following the minimum wage increase in 2016, the share of workers earning around the minimum wage level in 2016 increased noticeably within this group, while the share of workers earning between 711 Turkish liras and 1300 Turkish liras declined. The same transition from one minimum wage level to another minimum wage level also took place among workers with a high school degree, though to a lesser extent. On the other hand, informal workers with a wage lower than minimum wage are detectable in both years within both skill groups. In 2016, for example, around 25% of workers with no high school degree earned less than 1300 Turkish liras. The main reason is likely to be firms' ability to surpass the minimum wage statute by employing informal workers working without social security. Below we pay specific attention to this issue.

Meanwhile, workers with a tertiary education seem to be the least affected group, as the share of those earning higher than the minimum wage was higher than 50% in both years. The share of workers with a lower than minimum wage was very low among higher educated workers in both years. All in all, Figure 3 suggests that the minimum wage increase in 2016 had an enforcement power on wages and that less-educated workers appear to be the most affected group.⁴

Teenagers and young adults are also among the prime suspects who are most likely to be affected by an increase in the minimum wage. Neumark and Wascher (2007) present an extensive review of the literature, which shows that the vast majority of the minimum wage literature considers the effects of minimum wage on teenagers and young adults. We thus look at the share of workers earning around the minimum wage in 2015 and 2016 by age cohorts in Figure 4. The figure shows that the only group in which more than 50% of workers earned around minimum wage in 2015 was the 15–24 age cohort. There was a considerable increase in the share of workers with a wage around the new minimum wage level (between 1300 Turkish liras and 1600 Turkish liras) in 2016 among the youth. But nearly 35% of the youth was not able to climb up the wage ladder after the increase, most likely due to informality. It is also important to note that the share of workers earning between 711 Turkish liras and 1300 Turkish liras in 2015 was approximately 40% within all other age cohorts, showing that the share of workers

⁴ In Figure A1, we adopt a more conservative approach to identify minimum wage workers by taking the minimum wage level in the first half of the year as the minimum wage threshold, and the minimum wage level in the second half of the year as the maximum threshold, and allowing 5% error margin to observe time trends in the share of minimum wage workers in both formal and informal sectors. The figure shows that the share of minimum wage workers has been highest among formal workers with no high school degree and lowest among formal workers with college education. Considering only formal workers, for example, around 33% of the workers with less than high school education earned a minimum wage in 2015, while the same figure was nearly 25% for the high school group, and around 13% for workers with college education. Also, the share of minimum wage workers has increased considerably over time among all formal workers and there was a noticeable increase in the share of workers working at the minimum wage level among workers with no high school degree and high school degree in 2016. When we look at the same figures by age groups in Figure A2, we observe that in the formal sector, the share of minimum wage workers within the 15–24 age group was approximately 38% in 2015. By contrast, 22% of workers aged 25–34, for example, earned the minimum wage in 2015.

Figure 4 Wage groups potentially affected by the minimum wage increase in 2016, by age groups.

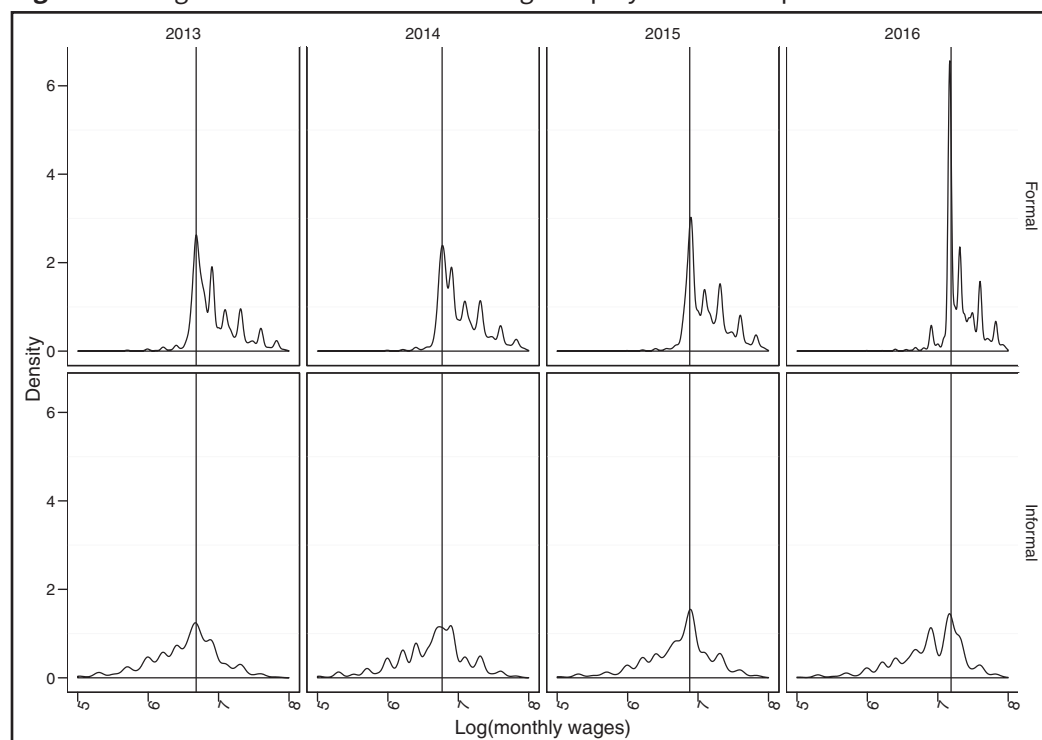


Notes: Own calculations based on the 2015 and 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector by age groups (471,271 individuals). 711TL cutoff is 75% of the lowest minimum wage level in 2015; 1300TL is the minimum wage level in 2016. To read the A panel, for example, around 60% of workers aged 15–24 earned less than 1300TL but higher than 711TL in 2015.

whose wages could be directly affected by the minimum wage increase in 2016 (i.e. those earned between 711 Turkish liras and 1300 Turkish liras) were also high among young adult and adult workers expected to be more experienced and hence less affected by the increase.

In short, the evidence presented in Figures 3 and 4 indicates that the minimum wage has more impact on the less-educated and the younger workers (ages 15 to 24). But the figures show also the importance of addressing the identifying information coming from remaining demographic groups. For this reason, differing from the previous studies focusing on specific groups such as youth, restaurant workers, or manufacturing workers, we analyze the effects of minimum wage on all age and education groups in our sample. Since the figures illustrate also that it is crucial to take into account the labor market segmentation (formal vs. informal) to capture the effects of the minimum wage policy on workers working without social security, we present the wage distribution of workers working full time in the formal and informal sectors starting from 2013 in Figure 5 to quantify the enforcement power of the minimum wage policy more carefully.

The top panel shows the wage distribution in the formal sector and the bottom panel shows the wage distribution in the informal sector. Vertical lines indicate the minimum wage level in that year. First, we observe that there are hikes at the minimum wage level in both formal and informal wage distributions. Second, the humps at the minimum wage level become larger over years in the formal sector. Third, the sharpest increase in the density at the minimum wage level occurred from 2015 to 2016 when the minimum wage level increased by 33%. Fourth, informal wage distribution becomes a left-skewed distribution from 2013 to 2016.

Figure 5 Wage distribution in full-time wage employment in the private sector.

Notes: Own calculations based on the 2013 to 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector by informality status. The vertical line shows the minimum wage level in the first half of that year.

Fifth, informal wage distribution becomes a double-humped distribution in 2016. The presence of a “lighthouse effect” showing the minimum wage’s positive impact on the informal wages is thus detectable in the labor market.⁵ Relying on this evidence, it is possible to argue that the minimum wage policy has enforcement power and is binding, even in the informal sector to a certain extent.

4.2 Identification strategy

We showed that minimum wage has enforcement power in Turkey and workers with no high school degree and younger workers (ages 15 to 24) in the formal sector seem to be more likely to be affected by an increase in the minimum wage. Many minimum wage studies examine the minimum wages’ effects on demographic groups by exploiting the state-level variation in the minimum wage statute and labor market outcomes. While an identification strategy based on the variation in state-specific minimum wage regulation is inapplicable in countries with a national minimum wage level, a regional identification strategy can still be valuable since the effects of a national minimum wage level can differ across regions. Card (1992b), for example, captures the effects of the federal minimum wage increases in 1990 and 1991 in the U.S. by utilizing the state-level variation in the fraction of workers affected by the increases. Dolton et al. (2015) and Caliendo et al. (2018) use a similar methodology to examine the effects

⁵ Figure A3 supports this evidence from a different perspective. It shows that some informal workers were able to earn the new minimum wage following the minimum wage increase in 2016. To support these descriptive evidences, we construct below a causal relationship between the minimum wage increase and informal employment wages.

of the national minimum wage introductions in the U.K. in 1999 and in Germany in 2015, respectively.

We follow a similar methodology and exploit the regional variation in the fraction of affected workers whose wages fall below the new minimum wage level in year t , but equal or surpass the 75% of the minimum wage level in year $t-1$ in region j in demographic group s . For example, if an increase in the minimum wage from year $t-1$ to t affects the labor market outcomes of the workers with no high school degree, then the regions with a higher fraction of affected workers within this demographic group in year $t-1$ should experience a relatively larger change in less-than-high-school-educated workers' labor market outcomes in year t .

Our data provides spatial information at NUTS-1 and NUTS-2 levels. The provinces are classified into 12 (NUTS-1) and 26 (NUTS-2) regions according to their geographical, demographic, economic, and socio-cultural proximity. We use NUTS-2 level classification to utilize a higher variation and define the *fraction of affected workers* in each NUTS-2 region in year $t-1$ as the following,

$$\frac{n_{sjt-1}}{E_{sjt-1}}$$

where n_{sjt-1} is the number of affected workers whose wages are equal to or higher than the 75% of the minimum wage level in year $t-1$ but lower than the minimum wage level in year t , in demographic group s in NUTS-2 region j in year $t-1$; E_{sjt-1} is the employment rate of salaried, waged, or casual workers working in private sector in demographic group s in region j in year $t-1$.⁶ We have three education groups, and five age groups.

For example, the upper panel of Figure 6 shows that the ratio of salaried, waged, or casual young workers working in the private sector whose wages equal or exceed 711 Turkish liras (75% of the minimum wage level in the first half of 2015) but are below 1300 Turkish liras (minimum wage level in 2016) in TR33 region (Manisa, Afyonkarahisar, Kütahya, and Uşak) to a number of all salaried, waged, or casual young workers in the private sector in the same region was around 0.7 in 2015. If the minimum wage increase in 2016 caused a noticeable change in the labor market outcomes of young workers in that region, then we should observe a considerable *relative* change in their labor market outcomes in the TR33 region in 2016.

4.3 Model

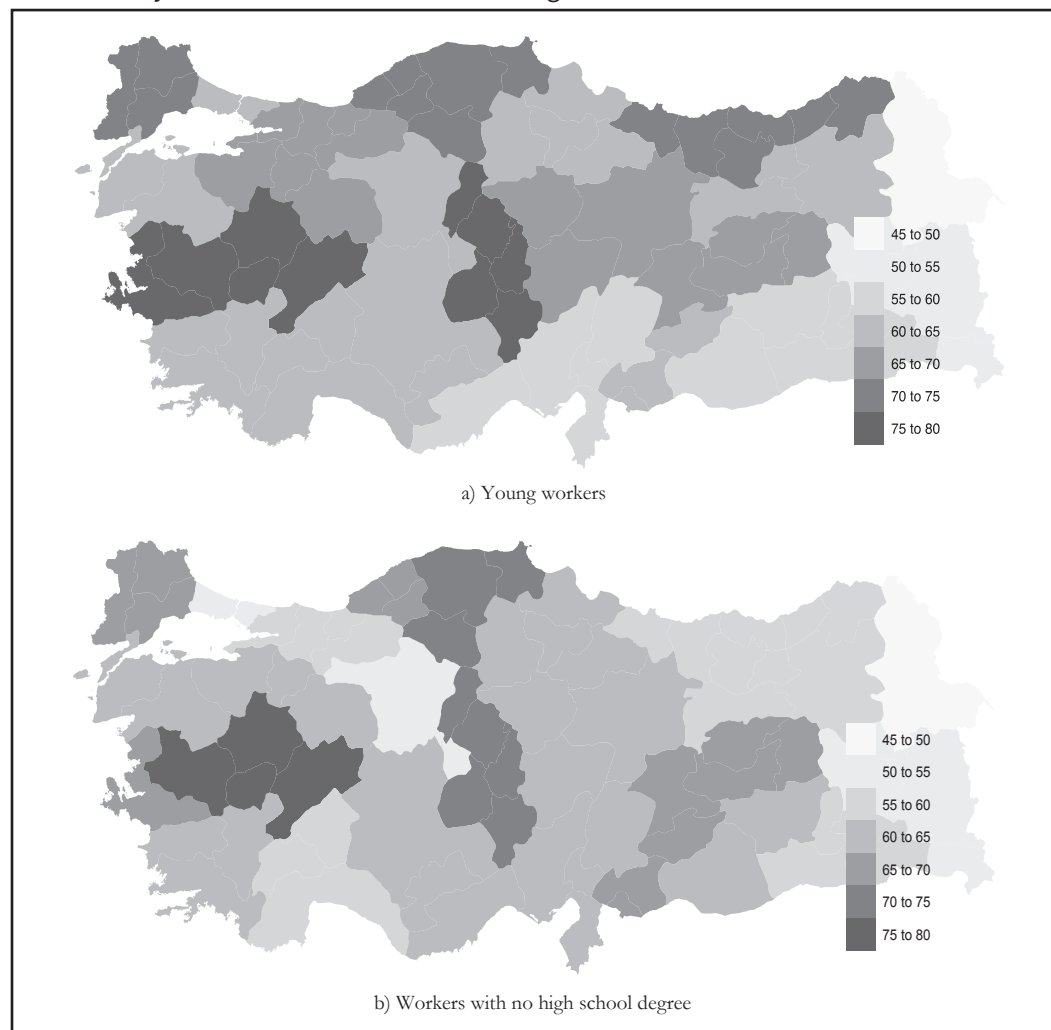
To capture the relationship between the fraction of workers affected by minimum wage increases and the changes in labor market outcomes for demographic groups, we use Dolton et al.'s (2015) "incremental" difference-in-differences model:

$$Y_{isjt} = \gamma_0 + J_j + \gamma_t \sum_{k=2010}^t T_{k(t)} + \theta_0 F_{sjt-1} + \theta_t^{DID} \sum_{k=2010}^t T_{k(t)} F_{sjt-1} + \sum_{k=2010}^t T_{k(t)} FR_r + X_{isjt} + \varepsilon_{jt}$$

where Y_{isjt} is labor market outcomes, i.e. wages, employment, and informality status of worker i with demographic characteristic s in region j in year t . J_j is a dummy variable for region j ,

6 To check the robustness of this key variable of interest, we take into account informality issue and use a different numerator including only formal workers. We also exploit more conservative variable of interest, "fraction at the minimum wage", by taking the minimum wage level in the first half of the year as the minimum threshold and the minimum wage level in the second half of the year as the maximum threshold, and allowing a 5% error margin to capture minimum wage workers. See the notes in Figure A2 and Section 5 for a more detailed discussion of alternative exposure variables.

Figure 6 Fraction of young or less than high school educated workers potentially affected by the increase in the minimum wage in 2016.



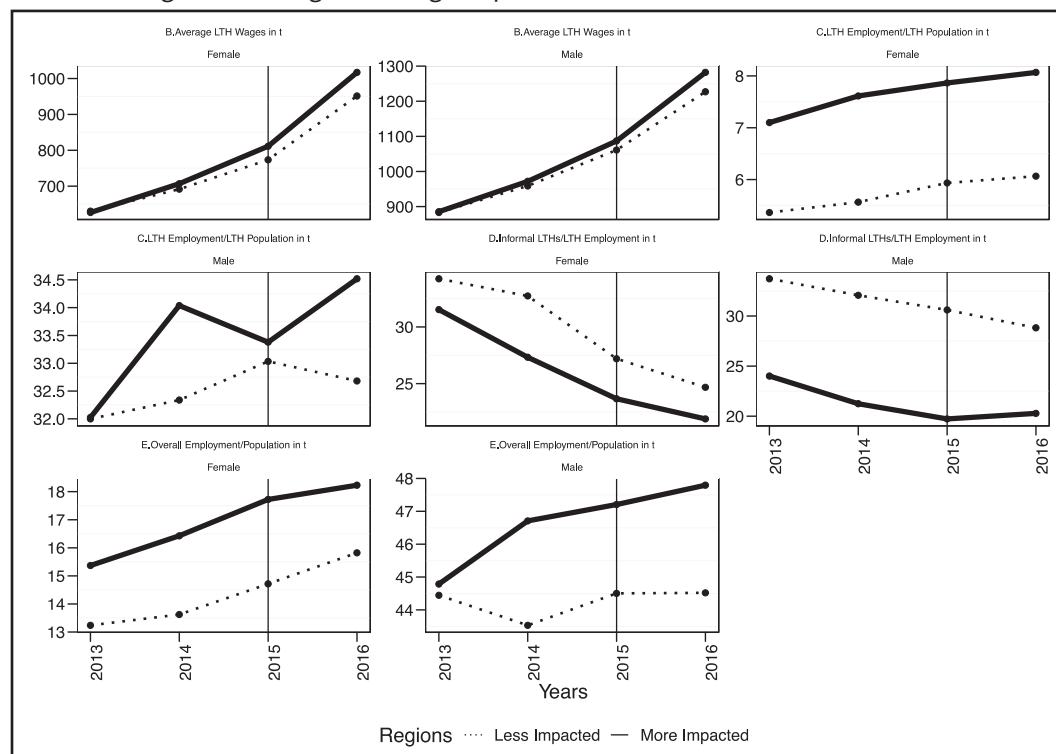
Notes: Own calculations based on the 2015 wave of the Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector. The figures show the regional distribution of young or less than high school educated workers earning higher than 711TL but lower than 1300TL in 2015.

capturing the effects of the time-invariant characteristics of the region on dependent variables. $T_{k(t)}$ is the set of year dummy variables for the years 2010 to the year t that takes 1 if t equals k and otherwise 0. F_{sjt-1} is the fraction of affected workers with demographic characteristic s in region j in year $t-1$. $T_{k(t)}F_{sjt-1}$ is the interaction of year fixed effect and the fraction of affected workers. $T_{k(t)}FR_r$ is the interaction of year dummy variables and 5 aggregated regions (West, Central, South, North, and East), which captures the time-variant regional shocks. X_{isjt} is a set of individual controls (see notes for regression tables for each case), θ_t^{IDID} , the coefficient of interest, shows the effect of the minimum wage change from $t-1$ to t , what is left from the year-specific effects capturing the potential effects of the coup attempt or of the Russian sanctions, the effects of time-invariant regional characteristics captured by region dummies, and the effects of time-variant regional economic activity, i.e. region varying effects of year specific shocks discussed above. The coefficient thus quantifies how regions with a higher fraction of affected workers within a demographic group s in $t-1$ experience a relative change in average outcomes of the group s in year t .

We assume that labor market outcomes in regions with a higher fraction of workers affected by minimum wage increases and in regions with a lower fraction of workers affected by minimum wage increase would have followed a similar trend in the absence of a minimum wage shock. If the assumption is satisfied, then a difference between labor market outcomes of more impacted regions and that of less impacted regions in 2016 can be attributed to the effects of the minimum wage increase. The violation of the assumption is likely, however, because the regions with a lower fraction of affected workers were in the Northeast and Mediterranean regions (see Figure 6). The eastern region of the country has been subject to region-specific shocks such as armed conflicts or a region-specific state of emergency. Since the fraction of affected workers was relatively low in these regions, a negative shock coinciding with the minimum wage increase in these regions can create negative employment outcomes independently of the minimum wage increase, causing the spurious positive relationship between employment outcomes and the fraction. Given that 2015–2016 was a period in which two events that were likely to affect labor market outcomes took place (see section 2.2), it is possible that we falsely attribute the effects of such time-variant unobservable heterogeneities across regions to interaction term $T_{k(t)} F_{sjt-1}$.

To investigate such heterogeneities, we define the regions in which the fraction of affected workers with no high school education in 2015 was higher than the median fraction as more impacted regions. Figure 7 shows that although the increase in average female wages in more

Figure 7 Testing parallel trend assumption: Labor market outcomes of workers with no high school degree during the period of 2013–2016.

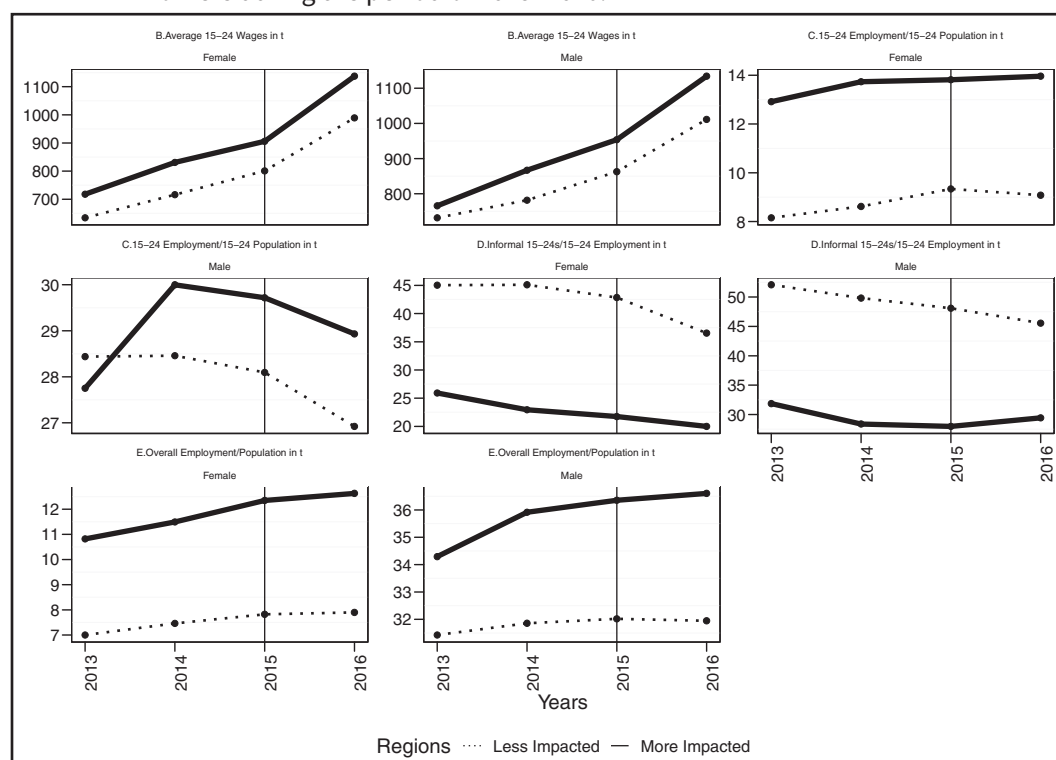


Notes: Own calculations based on the 2013 to 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector. *More Impacted* regions are ones in which the fraction of workers affected by the increase (workers earning less than 1300TL but higher than 711TL in 2015) in the minimum wage in 2016 is higher than the median fraction. There are 13 NUTS-2 *More Impacted* and 13 NUTS-2 *Less Impacted* regions.

impacted regions exceeded the increase in average female wages in less impacted regions in 2016, the divergence started in 2015. Likewise, the assumption that less-than-high-school-educated male and female workers' employment would have followed a similar trend in the absence of the minimum wage increase does not hold. The parallel trend assumption is satisfied for only informal employment of male workers with no high school education. We change the definition and define the regions in which the fraction of affected young workers in 2015 was higher than the median fraction of more impacted regions. Figure 8 indicates that there was no considerable divergence in the average wages of both female and male young workers until 2016. For employment and informality outcomes of young workers, however, the parallel trend assumption is violated.

In short, both Figures 7 and 8 indicate the importance of addressing the time-varying heterogeneities across regions when exploring the effects of the minimum wage increases. To capture the potential time-varying heterogeneities across regions, we follow Aksu et al. (2018) who examine the effects of mass immigration in Turkey on labor market outcomes by exploiting the regional variation in immigrant/native ratio. They handle the violation of parallel trend assumption by including *year $\times$ 5 aggregated regions* interaction terms. This estimation strategy is also useful in our case, because, for example, if the Eastern region of the country experienced an armed conflict in 2016, *eastern $\times$ d_2016* dummy can capture the conflict's effects on labor

Figure 8 Testing parallel trend assumption: Labor market outcomes of young (15–24) workers during the period of 2015–2016.



Notes: Own calculations based on the 2013 to 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in the private sector. *More Impacted* regions are ones in which the fraction of workers affected by the increase (workers earning less than 1300TL but higher than 711TL in 2015) in the minimum wage in 2016 is higher than the median fraction. There are 13 NUTS-2 *More Impacted* and 13 NUTS-2 *Less Impacted* regions.

market outcomes. Similarly, if the effects of the Russian sanctions or the coup attempt vary across regions, we are able to control for such heterogeneity across regions.

5 Results and discussion

We present descriptive statistics in Table 1 and the baseline results in Tables 2–4. Each cell presented in Tables 2–4 shows the estimates for the interaction term between the 2016 dummy and the regional fraction of affected workers earned less than 1300 Turkish liras but higher than 711 Turkish liras in 2015. Each row shows the estimates for the selected demographic groups. All models include region (NUTS-2) and year fixed effects as well as *5 regions $\times$ year* interaction terms. The analysis starts in 2010 ($k=2010$), the first wave in the HLFs where the key variable of interest (F_{ijt-1}) is available.⁷ All coefficients are thus relative to the interaction term between the 2010 dummy and the fraction of affected workers in 2009. Standard errors are clustered at the region (NUTS-2) level. When we focus on education groups, we control for age using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. We control for education when we focus on age groups using dummies for less than high school, high school, and tertiary-educated groups.

Before jumping to the interpretation of the baseline estimations, Table 1 provides some useful information to make sense of the results. It divides the regions into more impacted regions in which the fraction of workers earned lower than 1300 Turkish liras but higher than 711 Turkish liras in 2015 is higher than the median fraction and less impacted regions in which the fraction is lower than the median fraction. Some time-invariant differences stand out. First, less impacted regions are more populous. Second, the employment-to-population ratio among both men and women is higher in less impacted regions. Third, average wages are lower in more impacted regions, while informality is considerably higher, especially for women. Finally, the raw gender wage gap seems to be higher in regions expected to be more impacted by the minimum wage increase. We try to capture such time-invariant heterogeneities across regions by using the NUTS-2 level region fixed effects.

Some time-varying differences are also worth noting. For example, average male wages increased from 2014 to 2015 nearly 10% in less impacted regions, and 9.3% in more impacted regions. From 2015 to 2016, however, the increase in average male wages is larger in more impacted regions. This is true also for average female wages. The change in informal male and informal female wages from 2015 to 2016 is larger in less impacted regions, though the growth in the change in informal wages is relatively large in more impacted regions, especially for men. A decrease in male and female employment from 2015 to 2016 is not detectable in both more impacted and less impacted regions. And there was no rise in male and female informality in both groups. However, both more and less impacted regions experienced a decrease in male employment growth, and in the rate of speed in the ongoing decline in informality. Some of the time-varying differences may be attributed to the effects of the minimum wage increase. We try to discern the effects of unobservable time-varying heterogeneities across regions using 5 aggregated region fixed effects $\times$ year fixed effects.

⁷ The estimates for the increase in remaining years are presented in Figure A4 to A6.

Table 1 Descriptive statistics

	Less impacted regions						More impacted regions					
	2014		2015		2016		2014		2015		2016	
	M	F	M	F	M	F	M	F	M	F	M	F
Overall labor force statistics												
Working-age population (000)	15760	15567	15861	15735	16111	15935	9774	9877	9981	10004	10098	10106
Full-time wage employment (FTWE) (000)	7453	2889	7647	3057	7708	3211	3841	1093	3999	1248	4000	1311
Full time wage employment ratio	0.47	0.19	0.48	0.19	0.48	0.20	0.39	0.11	0.40	0.12	0.40	0.13
Informal (FTWE) (000)	806	348	761	336	736	337	793	308	791	316	747	311
Informality (FTWE)	0.11	0.12	0.10	0.11	0.10	0.10	0.21	0.28	0.20	0.25	0.19	0.24
Average wages (FTWE) (TL)	1697	1575	1867	1709	2163	2035	1424	1273	1557	1394	1832	1693
Change in average wages			10.02%	8.58%	15.80%	19.02%			9.27%	9.43%	17.74%	21.46%
Average informal wages (FTWE) (TL)	1002	772	1134	856	1306	1011	841	665	913	720	1072	837
Change in average informal wages			13.24%	10.90%	15.12%	18.15%			8.50%	8.24%	17.48%	16.30%
Labor force statistics by selected demographic groups												
Less than high school emp. (FTWE)	0.40	0.10	0.40	0.10	0.40	0.11	0.32	0.06	0.33	0.07	0.32	0.07
Tertiary educated emp. (FTWE)	0.67	0.54	0.68	0.53	0.67	0.53	0.66	0.47	0.67	0.49	0.65	0.48
15–24 employment (FTWE)	0.32	0.16	0.32	0.17	0.30	0.17	0.26	0.09	0.27	0.10	0.25	0.10
35–44 employment (FTWE)	0.62	0.23	0.63	0.26	0.62	0.27	0.53	0.15	0.55	0.17	0.54	0.18
Less than high school informality (FTWE)	0.18	0.28	0.16	0.26	0.16	0.26	0.31	0.53	0.31	0.49	0.29	0.48
Tertiary educated informality (FTWE)	0.02	0.02	0.02	0.02	0.02	0.01	0.03	0.03	0.03	0.03	0.03	0.02
15–24 informality (FTWE)	0.24	0.16	0.23	0.16	0.20	0.14	0.44	0.38	0.44	0.35	0.42	0.30
35–44 informality (FTWE)	0.06	0.12	0.06	0.10	0.06	0.09	0.14	0.26	0.13	0.24	0.11	0.22
Less than high school average wage (FTWE) (TL)	1228	909	1353	1007	1588	1246	1057	771	1160	850	1398	1060
Tertiary educated average wage (FTWE) (TL)	2819	2290	3010	2468	3362	2798	2468	2057	2603	2154	2895	2518
15–24 average wage (FTWE) (TL)	1078	1062	1195	1159	1467	1449	916	907	1015	1004	1215	1256
35–44 average wage (FTWE) (TL)	1892	1728	2086	1844	2389	2208	1607	1408	1729	1482	2029	1777

Notes: Own calculations based on the 2014 to 2016 waves of Turkish Household Labor Force Survey. *More Impacted* regions are ones in which the fraction of workers affected by the increase (workers earning less than 1300TL but higher than 711TL in 2015) in the minimum wage in 2016 is higher than the median fraction. There are 13 NUTS-2 *More Impacted* and 13 NUTS-2 *Less Impacted* regions.

5.1 Wages

Table 2 presents the wage effects of the minimum wage increase in 2016. It shows the baseline wage estimates for the key variable of interest, i.e. regional fraction of workers earned lower than 1300 Turkish liras but higher than 711 Turkish liras in 2015. Since the minimum wage committee sets a monthly wage floor, employers may offset the effects of the minimum wage increases by raising working hours. We thus calculate hourly wages using weekly working hour's information in the HLFS and look at the effects on both monthly and hourly wages. We repeat the main specifications for women and men to capture the gender segmentation in the labor market.

Table 2 Wage effects, baseline estimation using the baseline *fraction affected* exposure variable

	Monthly wages			Hourly wages		
	Overall (1)	Male (2)	Female (3)	Overall (4)	Male (5)	Female (6)
By education						
No high school degree	0.321*** (0.091)	0.475*** (0.074)	−0.140 (0.206)	0.327*** (0.085)	0.616*** (0.111)	−0.205 (0.250)
High school degree	0.353*** (0.054)	0.316*** (0.051)	0.443*** (0.087)	0.338*** (0.060)	0.362*** (0.070)	0.504*** (0.117)
Higher degree	0.471*** (0.151)	1.013*** (0.186)	0.468*** (0.095)	0.512*** (0.137)	1.170*** (0.187)	0.551*** (0.101)
By age						
15–24	0.110 (0.155)	0.364* (0.194)	−0.055 (0.251)	0.215 (0.202)	0.668** (0.271)	0.035 (0.297)
25–34	0.410*** (0.069)	0.299*** (0.052)	0.535*** (0.073)	0.403*** (0.059)	0.345*** (0.050)	0.527*** (0.081)
35–44	0.372*** (0.109)	0.287*** (0.064)	0.617*** (0.109)	0.304*** (0.088)	0.337*** (0.065)	0.559*** (0.113)
45–54	0.508*** (0.165)	0.589*** (0.081)	0.576 (0.465)	0.448*** (0.147)	0.658*** (0.076)	0.596 (0.510)
55–64	0.640** (0.276)	0.829** (0.327)	−0.141 (0.336)	0.674*** (0.241)	0.880** (0.332)	−0.052 (0.327)
Individual level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The wage sample is full-time wage employment in the private sector in the Turkish Household Labor Force Survey 2010–2016. It includes 471,271 individuals (362,845 males; 108,426 females). Dependent variables are natural logarithm of monthly wages and of hourly wages. Hourly wages are calculated using the weekly working hour information. The key variable of interest is the fraction of affected workers (the ratio of workers earning higher than 75% of the minimum wage level in year $t-1$ but lower than the new minimum wage level in year t). Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in the 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicate a statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

The first row in column (1) shows that a 1% increase in the regional fraction of workers with no high school degree who earned less than 1300 Turkish liras but more than 711 Turkish liras in 2015 increased the average monthly wages of workers with no high school degree in 2016 by 0.32%. Columns (2) and (3) show that this overall monthly wage effect is mainly due to positive and substantial wage effects on less-educated men. When we look at hourly wages in columns (4)–(6), we observe that the hourly wage effects on less-educated men are larger than the monthly wage effects. When it comes to the wage effects on workers with a high school degree, we observe larger overall wage effects despite smaller wage effects on men, hence the positive and noticeable wage effects on women with a high school degree. Among workers with tertiary education, wage coefficients are considerably larger, especially for men.

Given that the proportion of affected workers is lower within this education group, the result may seem unexpected. Several explanations may be proposed. First, the minimum wage is still a reference wage for tertiary-educated but informal workers. Second, *the positive* wage estimations for this group partly reflect a phenomenon of the Turkish labor market. Figure 3 shows that a noticeable share of the tertiary educated group earns around the minimum wage level. Third, although we control for age and time-varying heterogeneities, the largest wage effect estimated for this group is likely to be spurious. To avoid an *ad-hoc* selection of sample period, we preferred to start the analysis from 2010, as 2009 is the first year where we can identify public sector employees in the data set.⁸ When we start the analysis from 2012, instead of 2010, as shown in Figure B1 in Appendix, wage coefficients for men with tertiary education (panel A) decline and are no more than other education groups. Figure B1 in Appendix also shows that the use of a different sample does not lead to a significant change in the wage coefficients estimated for no high school (panel B) and high school sub-groups (panel C). In other words, our sample period choice results in a potential bias in wage effects estimated for the tertiary-educated group, while this is not the case for workers with no high school degree or high school-educated workers. We further elaborate on this issue in Figures B2, B3, and Accompanying Discussion in Appendix.

We examine the wage effects by age groups in the lower panel. Columns (1) and (2) highlight positive wage effects on young (15–24) workers. The positive wage effects are due to young men's wages, and the coefficients are somewhat smaller. Hourly wage effects are larger than monthly wage effects. Small wage effects on young workers stem from relatively large informality effects on these groups. Below, we provide suggestive evidence to that end. Meanwhile, overall wage effects are larger within other age cohorts and increase generally as age increases. The two age groups in which the wage effects are larger for women than that for men are 25–34 and 35–44 cohorts. Hourly wage effects on men are larger than monthly wage effects on men in all cases. But for women, this is generally true for elder women.

To sum up, we find economically large and statistically significant wage effects on most groups. Our findings suggest no increase in the wages of women with no high school degree, young (15–24) women, and elder women (45–64), but noticeable increases in the wages of other demographic groups. Hourly wage effects are generally larger, implying that employers may not be able to surpass the monthly minimum wage statute by inducing higher working

⁸ We use the fraction of affected workers in year $t-1$ as the key independent variable, hence the first round in our sample with the key variable of interest is in the 2010 wave.

hours. Supplementary evidence presented in Figure A4 in Appendix shows that, in most cases, there were no such considerable increases in the wages following the minimum wage increases that took place before 2016, hence the 33% increase in the minimum wage in 2016 may be seen as a positive wage shock. Table A4 in Appendix suggests that the shock had positive and relatively large wage effects on also informal men, supporting the “lighthouse effect” of the minimum wage increase. Overall, it is possible to suggest that a 1% increase in the fraction of workers supposed to be affected by the shock allows, on average, around a 0.4% increase in average wages.

5.2 Employment

Table 3 shows the effects on full-time wage employment in the private sector. We replicate the same structure as in Table 1 and find no indication of statistically and economically significant negative employment effects of the minimum wage increase in 2016. Column (3) in the upper panel suggests positive and statistically significant employment effects on women with no high school degree. Although we find negative employment effects on workers with high school degree or tertiary education, the coefficient estimates are small, and the standard errors are large. When we investigate the effects by age cohorts in the lower panel, we observe the positive overall employment coefficients except for 35–44, 45–54 age groups. But because of very large standard errors, negative and positive employment coefficients are not conclusive.

5.3 Informality

We examine informality outcomes in Table 4. The dependent variable is a dummy variable taking 1 if salaried, casual, or waged individual is working full-time in the private sector without social security, 0 otherwise. We replicate the main specification for small firms with less than 10 employees, since it may be easier for smaller firms to avoid regulations while larger firms are expected to be subject to closer scrutiny by the government. Hence, we want to investigate whether small firms have a higher ability to avoid the minimum wage regulations by employing workers without social security in case of an increase in the minimum wage and to quantify the labor market discrepancies between small and large firms.

Column (1) in the upper panel shows that the regions with a higher fraction of less-than-high-school-educated workers earning less than 1300 Turkish liras but higher than 711 Turkish liras in 2015 experience a *relative* increase in informality of workers with no high school degree following the minimum wage increase in 2016. Columns (2) and (3) suggest that this relative increase in informality of workers with no high school degree is not attributable to a particular gender. When we focus on only small firms, we observe an increase in the positive informality effects on workers with no high school degree. More importantly, this relative increase is mainly in the informal employment of women with no high school degree. The informality effect is smaller when it comes to workers with a high school degree. In all cases, the minimum wage effect on informality is statistically insignificant. However, statistical insignificance is driven by large standard errors and not because of small coefficient estimates. As a result, we do not want to disregard the potential effect on informality based solely on statistical significance.

Table 3 Employment effects, baseline estimation using the baseline *fraction affected* exposure variable

By education	Employment		
	Overall (1)	Male (2)	Female (3)
No high school degree	0.041 (0.128)	−0.040 (0.040)	0.055** (0.024)
High school degree	−0.033 (0.079)	0.046 (0.058)	−0.008 (0.023)
Higher degree	−0.015 (0.077)	0.150 (0.092)	0.021 (0.043)
<i>By age</i>			
15–24	0.153 (0.209)	−0.036 (0.074)	−0.008 (0.040)
25–34	0.072 (0.169)	0.043 (0.050)	−0.020 (0.019)
35–44	−0.215 (0.235)	−0.029 (0.048)	−0.017 (0.027)
45–54	−0.166 (0.142)	−0.021 (0.034)	−0.024 (0.029)
55–64	0.023 (0.039)	−0.031 (0.070)	0.000 (0.006)
Individual-level control	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES
Year and region fixed effects	YES	YES	YES
5 regions x year effects	YES	YES	YES

Notes: The employment sample is the working-age population in the Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working full-time in the private sector. The key variable of interest is the fraction of affected workers (the ratio of workers earning higher than 75% of the minimum wage level in year $t-1$ but lower than the new minimum wage level in year t). Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in the 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicate a statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

The lower panel shows that the informality coefficients are considerably larger for young workers aged 15 to 24 and become even larger following the exclusion of firms employing more than 10 workers. Moreover, in this sample young women's informality increases disproportionately. These are economically large effects, though the standard errors are relatively large. Within other age cohorts, we find neither statistically nor

Table 4 Informality effects, baseline estimation using the baseline *fraction affected* exposure variable

	Informality					
	All firms			Firms with less than 10 employees		
	Overall (1)	Male (2)	Female (3)	Overall (4)	Male (5)	Female (6)
By education						
No high school degree	0.093** (0.041)	0.018 (0.038)	0.004 (0.016)	0.172** (0.066)	0.088 (0.068)	0.112 (0.122)
High school degree	0.037** (0.015)	0.011 (0.033)	−0.003 (0.016)	−0.003 (0.043)	0.103 (0.074)	−0.087 (0.093)
Higher degree	0.010 (0.014)	0.001 (0.029)	−0.002 (0.012)	−0.000 (0.055)	0.054 (0.107)	−0.076 (0.064)
By age						
15–24	0.172 (0.125)	0.052 (0.063)	0.021 (0.024)	0.444 (0.264)	0.147 (0.205)	0.337 (0.224)
25–34	0.038 (0.038)	−0.022 (0.046)	−0.003 (0.009)	0.063 (0.085)	−0.011 (0.070)	0.074 (0.058)
35–44	0.036 (0.043)	−0.035 (0.029)	−0.006 (0.014)	0.094 (0.073)	0.041 (0.046)	0.062 (0.062)
45–54	0.022 (0.038)	0.010 (0.034)	−0.000 (0.016)	0.078* (0.043)	0.128** (0.055)	0.049 (0.043)
55–64	0.020 (0.021)	−0.032 (0.034)	−0.002 (0.003)	0.023 (0.029)	0.009 (0.037)	−0.007 (0.019)
Individual-level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The informality sample is the working-age population in the Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working without registered in the Social Security Institution in full-time in the private sector. The key variable of interest is the fraction of affected workers (the ratio of workers earning higher than 75% of the minimum wage level in year $t-1$ but lower than the new minimum wage level in year t). Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in the 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicate a statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

economically significant informality effects. Following the exclusion of large firms with more than 10 employees, however, the increase in informality effect on workers aged 45 to 54 becomes worth noting.

In short, our evidence suggests positive and relatively large informality effects on workers with no high school degree. The effect becomes economically more important when we focus on only small firms, especially for women with no high school degree. We find also positive but smaller informality effects on workers with a high school degree.

5.4 Robustness

Our main exposure variable, the fraction of workers earning lower than the new minimum wage level in year t but higher than 75% of the minimum wage level in year $t-1$, include informally employed. Figure A7 in Appendix shows that regions such as TRA2, TRB2, TRC2, and TRC3 had a very large share of informal workers and a higher share of workers earning lower than 711 Turkish liras in 2015 in full-time wage employment. Hence, it is reasonable to expect that the variation in the fraction of workers may be affected by the cross-region differences in the share of the informal sector, leading to biased estimates. To handle this issue, first, in the first two columns of Tables A1–A3 in Appendix, we define an alternative exposure variable “fraction of formal affected workers” by excluding informal workers from the numerator of the exposure variable. Second, in columns (3)–(5), we adopt a more conservative exposure variable, “fraction at minimum wage”, i.e. the proportion of employees working at the minimum wage in year $t-1$. For example, in this case, workers earned between 902TL and 1050TL, not between 711TL and 1300TL, in 2015 are expected to be affected by the minimum wage increase in 2016. In doing so, we eliminate the possibility that the variation in the proportion of workers who earn lower than minimum wage level in year $t-1$ is affected by the variation in the proportion of informal workers. Finally, in the models presented in the last two columns in Tables A1–A3 in Appendix, we exclude outlier regions TRA2, TRB2, TRC2, and TRC3 in which the share of informality is noticeably higher.⁹

Comparison of the baseline results presented in Tables 2–4 and the results presented in Tables A1–A3 in Appendix reveals that monthly wage coefficients are still statistically different from zero and become larger in most cases where we exclude informally employed from the numerator of exposure variable. When it comes to employment outcomes, in two of three alternative definitions of fractions, we observe negative coefficients for men with less than high school education (−0.068 (column 5 in Table A2 of the Appendix) and −0.078 (column 8 in Table A2 of the Appendix)). Only the latter is statistically significant. These negative employment effects for men with no high school degree are accompanied by positive coefficients for men with high school or higher degrees (albeit none of the coefficient estimates for these later groups are statistically significant). At first, these findings suggest that less-skilled men are substituted by more skilled men after the minimum wage increase. However, we do not observe a similar pattern for women. On the contrary, coefficient estimates for women are almost always positive for every education level (albeit mostly insignificant) and coefficient sizes are largest for women with less than high school education. Taking these findings together does not support a skill-biased substitution explanation. If men with less than a high school education are more likely than other groups (more educated men and women in general) to work in tradable goods sectors, a minimum wage increase can explain their relative employment losses. However, such an investigation is beyond the scope of this paper.

The alternative exposure variable excluding informal workers from the numerator results in a small decrease in the positive informality effect on workers with no high school degree, an increase in the informality of workers with a high school degree, and of workers aged 25 to 34. And the exclusion of outlier regions leads to larger positive informality on workers aged 15 to 24.

⁹ We also check whether an outlier NUTS-1 region drives our main finding. We leave each NUTS-1 regions out of analysis re-run wage, employment and informality regressions and find no significant effect on outcomes. The results are available upon request.

In conclusion, large positive wage effects seem to be robust to alternative estimations. We find also that positive informality effects on less-experienced or less-educated groups are not sensitive to alternative estimations in most cases. For employment outcomes, only one of the alternative models contrasts with no employment findings on demographic groups supposed to be more affected by an increase in the minimum wage. Considering negative employment elasticities reported by the studies suggesting large and negative employment effects of minimum wage policy, however, statistically significant negative employment elasticities reported in our alternative specifications seem to be economically insignificant.

6 Concluding remarks

Using an identification strategy based on regional variation in the fraction of workers affected by minimum wage increases, we investigated labor market outcomes of the quasi-experimental minimum wage increase of 2016 in Turkey. Turkey presents an interesting case as its economy displayed a low employment generation capacity in recent decades; a large number of workers are employed at the minimum wage; and the national minimum-wage-to-average-wage ratio is one of the highest among OECD countries. Moreover, employment without social security is still widespread, the gender wage gap is persistent, there are noticeable regional inequalities in labor market outcomes, and the labor market plays an active role in income and poverty dynamics.

We showed that an important share of young workers (ages between 15 and 24) and workers with no high school degree in the formal sector work around the minimum wage level, but also that there are many demographic groups in which a considerable share of workers worked around the minimum wage level and expected to be affected by an increase in the minimum wage. Armed with this information, we find that the 2016 minimum wage increase had economically substantial and statistically significant positive effects on wages of most demographic groups. This is true also for informal workers, supporting the “lighthouse effect” of the minimum wage increase. Our wage specifications show also that hourly wage coefficients are larger in most cases, especially for men, hence suggest that employers may not be able to surpass the monthly minimum wage statute by imposing longer working hours. We find substantial wage effects particularly on men aged 45–64 and on men with tertiary education, that is on demographic groups expected to be less affected by the minimum wage increase. Although such large wage coefficients are partly spurious because of our sample period choice, the analysis presented in this study reveals that a considerable share of higher-skilled groups works around minimum wage, hence that the positive wage effects on demographic groups expected to be less affected by an increase in the minimum wage are likely to reflect a phenomenon of the Turkish labor market. This probable lack of skill premium deserves further investigation however it is beyond the scope of this paper.

Our findings indicate that the minimum wage increase did not have a negative impact on employment outcomes. However, the increase induced an economically considerable positive effect on the share of workers working without social security among workers with a higher school degree and no high school degree, potentially indicating that the minimum wage increase led to an increase in informal employment. This informality effect is stronger when we focus on small firms, employing less than ten employees.

These findings appear to be robust to alternative estimations that take into account the potential biases stemming from our key variable of interest. Yet, some limitations should be emphasized. First, we focus on the short-run effects of the minimum wage increase, though it is recognized that the short-run effects may differ from the effects in the long-run. Second, since the data we use do not allow us to estimate the effects on consumption and income dynamics, our findings on the large and positive wage effects of the minimum wage increase provide only indirect information about the effect of the minimum wage policy on income. Given the studies that emphasized the important role played by the labor market in income and poverty dynamics in Turkey (e.g. Şeker and Dayıoğlu, 2015), however, the importance of this finding in addressing the role of active labor market policies in income and poverty trends should not be underestimated. More importantly, our study has important implications for the minimum wage debate in the developing country context, since we discover noticeable heterogeneities in the effects of the minimum wage increase and find that ignoring gender discrepancy in a developing country labor market when analyzing the effects of the minimum wage may lead to biased results; that the effects of the minimum wage policy may be closely related to cross-firm differences in productivity and labor market regulations; and that previously ignored demographic groups may provide invaluable identifying information.

Declarations

Availability of data and material

We use the annual Household Labor Force Survey (HLFS) for 2009–2016, a cross-sectional restricted-use-micro-data gathered by Turkstat to produce official labor market indicators and to provide information about demographic characteristics, employment status, income, and past work experience of household members. Since our estimations and calculations are based on this restricted-use-micro-data, we are not able to provide full access to the data. Access to our replication package is available upon request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Not applicable.

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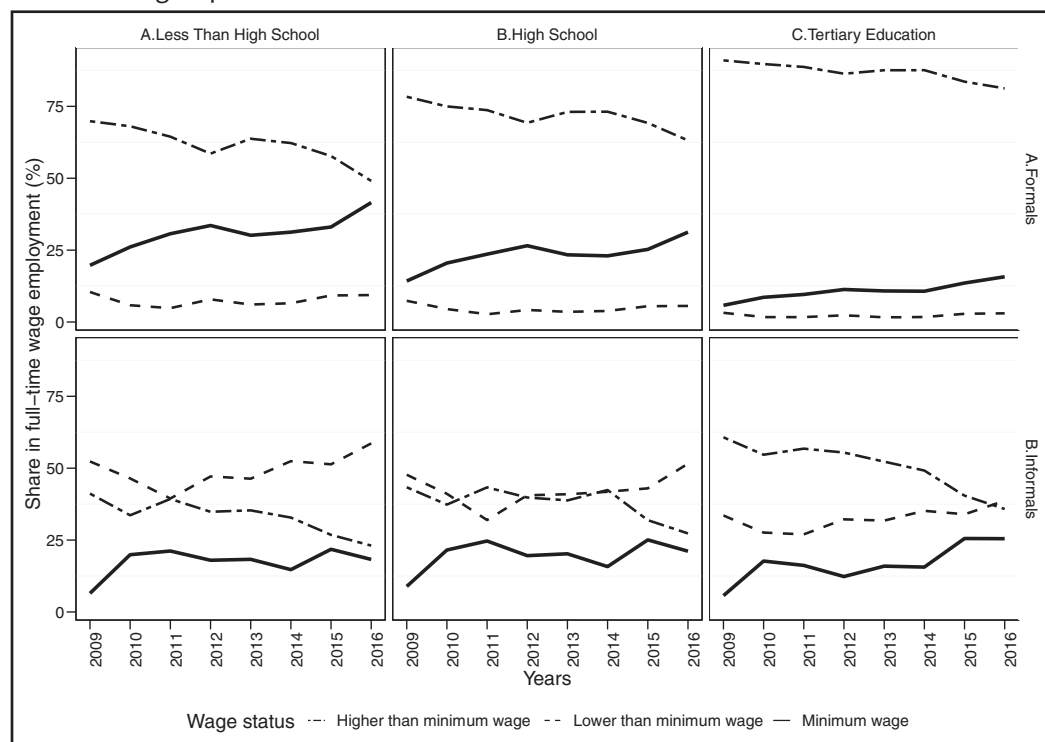
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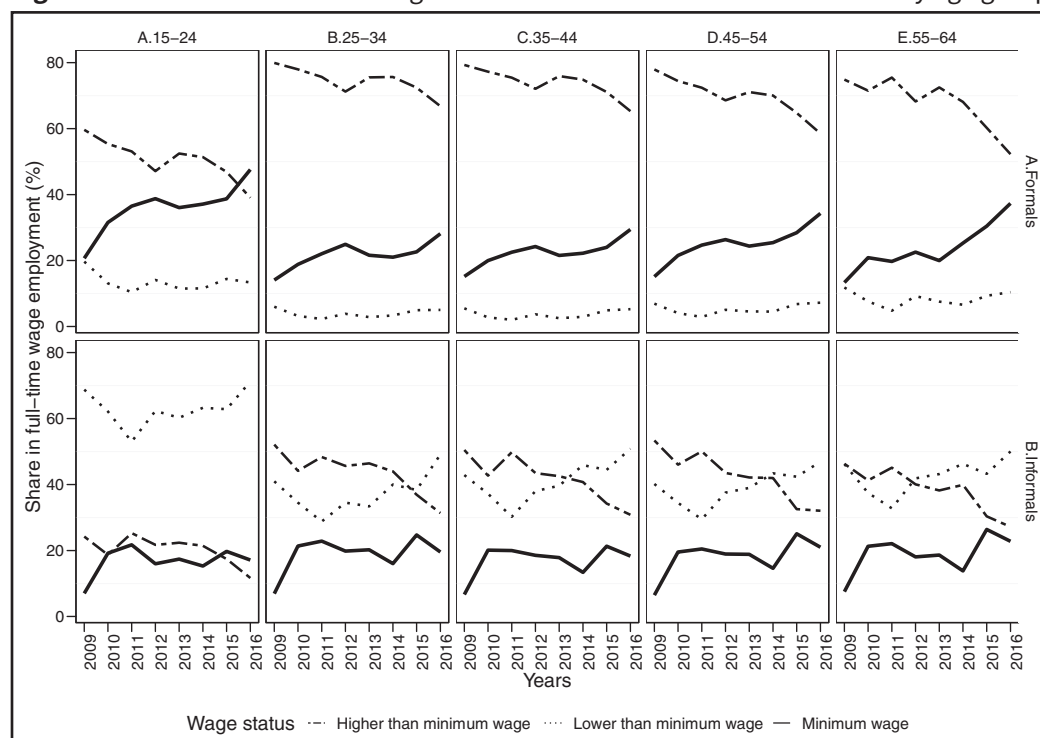
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Appendix A

Figure A1 Share of minimum wage workers in formal and informal sectors by education groups.

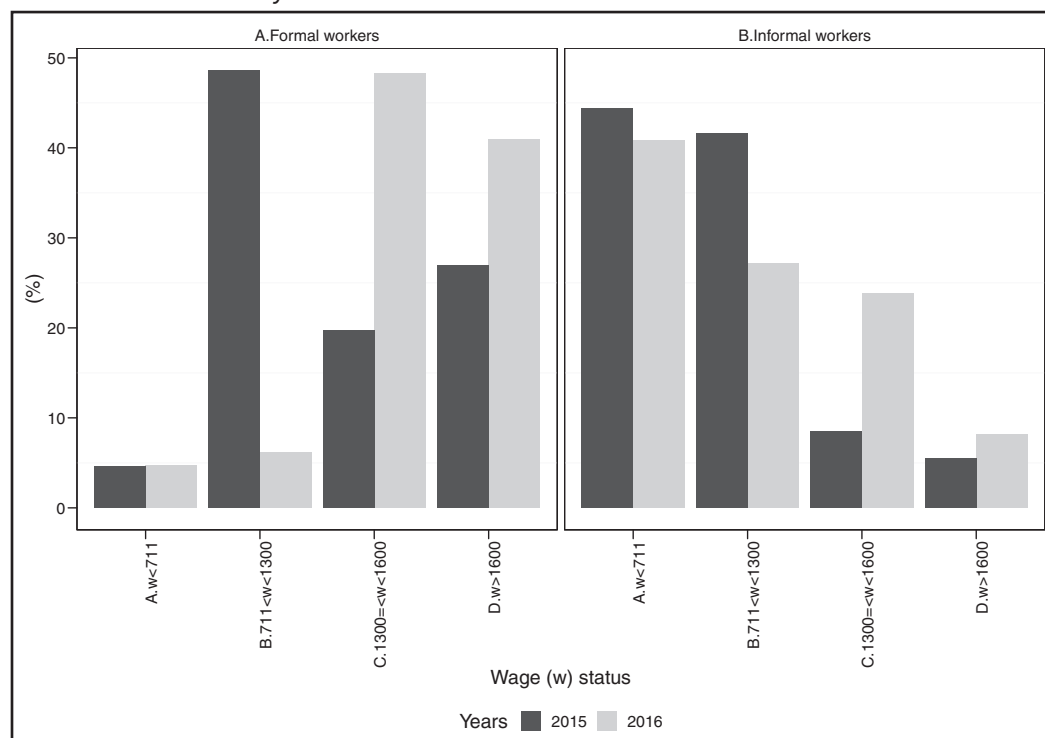


Notes: Own calculations based on the 2009 to 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in private sector by education groups (of 527,149 individuals 410,463 individuals are working formally, while 116,686 are working informally during the sample period). Informal workers are wage earners working full-time without registering in the Social Security Institution. Taking the minimum wage level in the first half of the year as the minimum threshold and the minimum wage level in the second half of the year as the maximum threshold, and allowing a 5% error margin, we discern minimum wage workers. Generalization of the approach yields the following wage condition for minimum wage workers: $MW_{1t} - (MW_{1t} * 0.05) < Y_{it} < MW_{2t} + (MW_{2t} * 0.05)$, where MW_{1t} is the minimum wage level of the first half of the year t , MW_{2t} is the minimum wage level of second half of the year t , Y_{it} is the wage of the worker i in year t . There are some legitimate reasons for workers in the formal sector to earn less than the minimum wage during the survey month. The question relating to earnings asks respondents their earnings in the previous month and some full-time workers might have worked less than whole month because i) they started a new job in the middle of the previous month, ii) they got an unpaid leave to deal with family emergencies; or iii) the workplace was temporarily closed. Moreover, if the respondent was interviewed in January, she is reporting her wages from December of previous year, which is probably less than the 95% of new minimum wage. As can be seen from the figure, the share of formal sector workers with less than minimum wage is stable over the years for all education groups suggesting that these are idiosyncratic issues independent from macroeconomic trends. We thank İnsan Tunalı for pointing out these data issues.

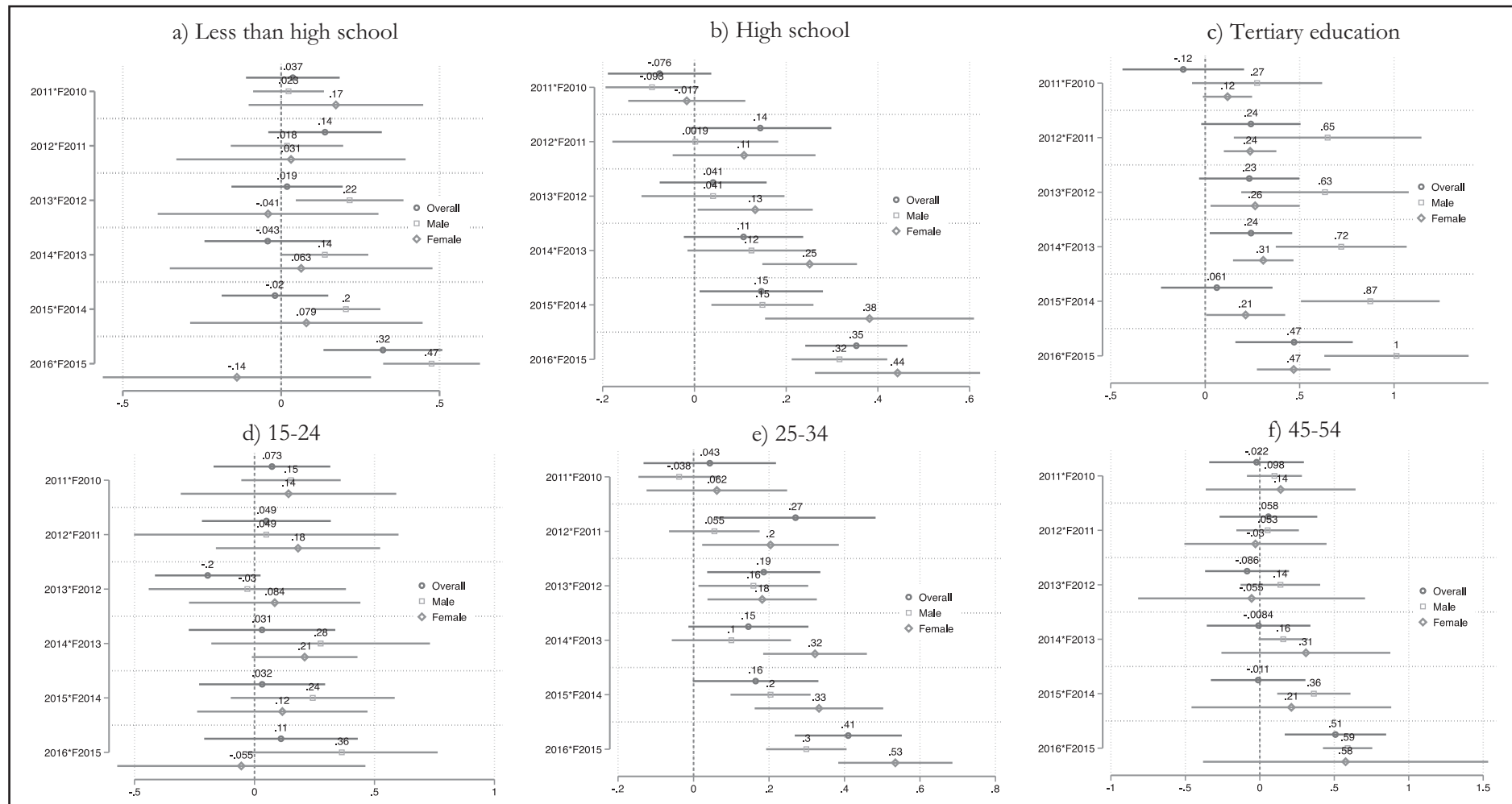
Figure A2 Share of minimum wage workers in formal and informal sectors by age groups.

Notes: Own calculations based on the 2009 to 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in private sector by age groups (of 527,149 individuals 410,463 individuals are working formally, while 116,686 are working informally during the sample period). Informal workers are wage earners working full-time without registering in the Social Security Institution. Taking the minimum wage level in the first half of the year as the minimum threshold and the minimum wage level in the second half of the year as the maximum threshold, and allowing a 5% error margin, we discern possible minimum wage workers. Generalization of the approach yields the following wage condition for minimum wage workers: $MW_{1t} - (MW_{1t} * 0.05) < Y_{it} < MW_{2t} + (MW_{2t} * 0.05)$, where MW_{1t} is the minimum wage level of the first half of the year t , MW_{2t} is the minimum wage level of second half of the year t , Y_{it} is the wage of the worker i in year t . There are some legitimate reasons for workers in the formal sector to earn less than the minimum wage during the survey month. The question relating to earnings asks respondents their earnings in the previous month and some full-time workers might have worked less than whole month because i) they started a new job in the middle of the previous month, ii) they got an unpaid leave to deal with family emergencies; or iii) the workplace was temporarily closed. Moreover, if the respondent was interviewed in January, she is reporting her wages from December of previous year, which is probably less than the 95% of new minimum wage. As can be seen from the figure, the share of formal sector workers with less than minimum wage is stable over the years for all education groups suggesting that these are idiosyncratic issues independent from macroeconomic trends. We thank İnsan Tunalı for pointing out these data issues.

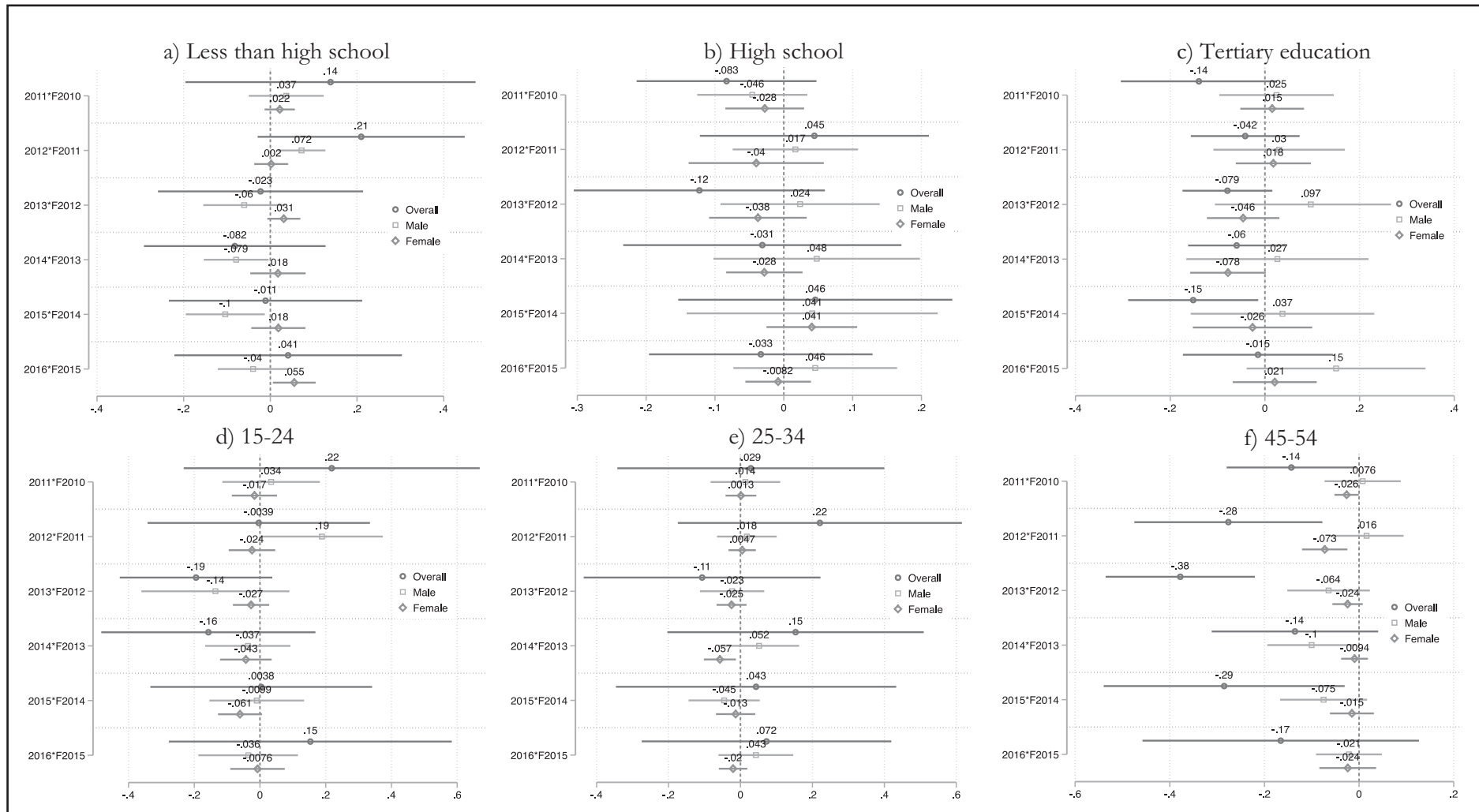
Figure A3 Wage groups potentially affected by the minimum wage increase in 2016, by informality status.



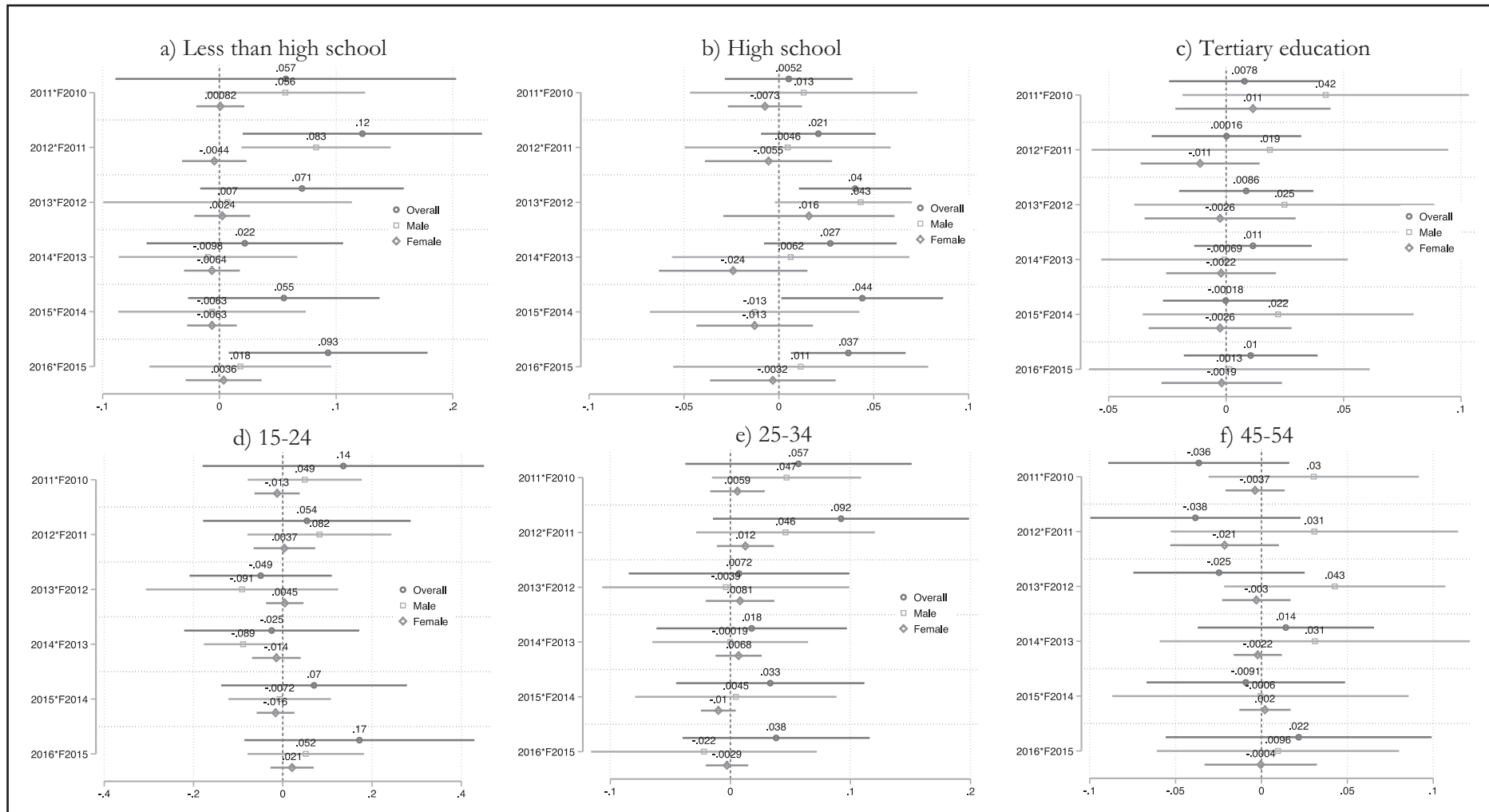
Notes: Own calculations based on the 2015 and 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in private sector by education groups (471,271 individuals). Informal workers are wage earners working full-time without registering in the Social Security Institution. 711TL cutoff is 75% of the lowest minimum wage level in 2015, 1300TL is the minimum wage level in 2016. To read the A panel for example, around 50% of workers registered in the Social Security Institution earned lower than 1300TL but higher than 711TL in 2015.

Figure A4 All monthly wage coefficients for the key variables of interest in the baseline wage estimation.

Notes: The wage sample is full time wage employment in private sector in Turkish Household Labor Force Survey 2010–2016. It includes 471,271 individuals (362,845 males; 108,426 females). Dependent variables are natural logarithm of monthly wages. The key variable of interest is the ratio of workers earning higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t . Each row shows the estimates for the interaction of the year t dummy and the fraction of affected workers in year $t-1$. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations.

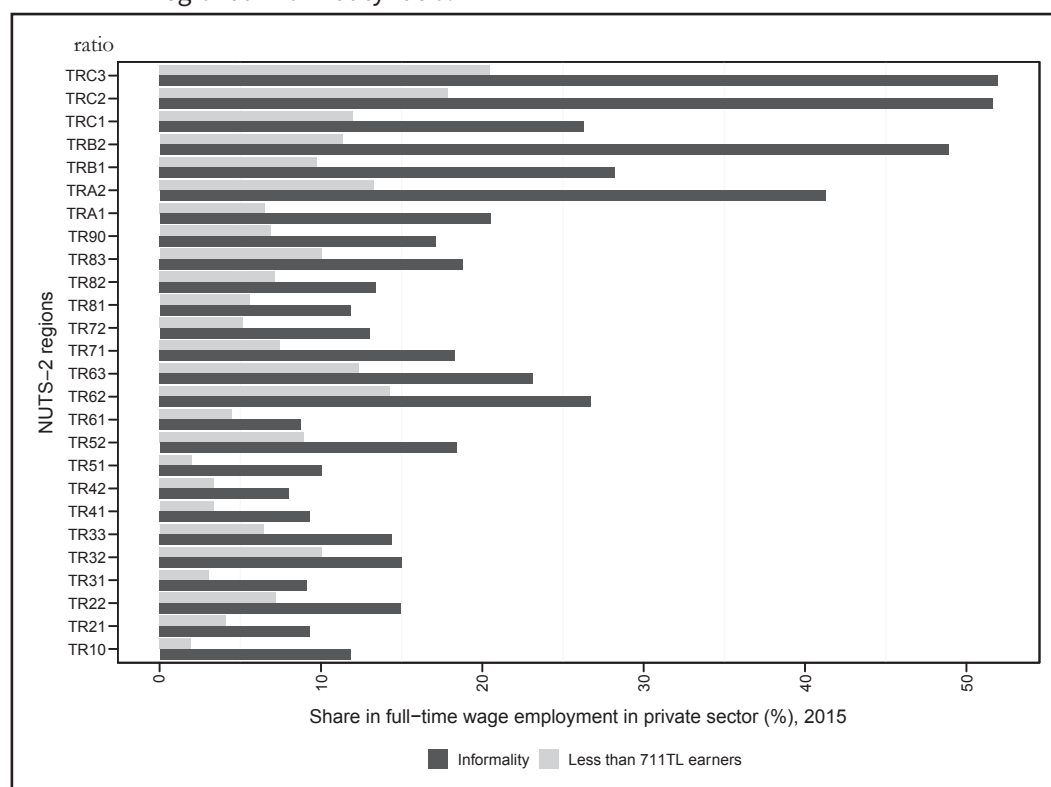
Figure A5 All employment coefficients for the key variables of interest in the baseline employment estimation.

Notes: The employment sample is working age population in Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working full-time in private sector. The key variable of interest is the ratio of workers earning higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t . Each row shows the estimates for the interaction of the year t dummy and the fraction of affected workers in year $t-1$. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations.

Figure A6 All informality coefficients for the key variables of interest in the baseline informality estimation.

Notes: The informality sample is working age population in Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working without registered in the Social Security Institution in full-time in private sector. The key variable of interest is the fraction of affected workers (the ratio of workers earning higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t). Each row shows the estimates for the interaction of the year t dummy and the fraction of affected workers in year $t-1$. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations

Figure A7 The regional fraction of workers earned less than 711 Turkish liras and the regional informality ratio.



Notes: Own calculations based on the 2015 wave of Turkish Household Labor Force Survey. The sample includes full-time wage employment in private sector (68,649 individuals). 711TL cutoff is 75% of the lowest minimum wage level in 2015. To read the figure for example, around 70% of workers earned less than 711TL and approximately 20% of workers worked without social security in TRC3 region in 2015.

Table A1 Wage effects, alternative estimation using the alternative exposure variables or excluding outlier regions

	Fraction of formal affected		Fraction at minimum		Excluding outlier regions	
	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)
By education						
No high school degree	0.482*** (0.114)	0.184 (0.218)	0.566*** (0.096)	0.103 (0.283)	0.535*** (0.068)	-0.249 (0.200)
High school degree	0.392*** (0.071)	0.540*** (0.096)	0.328*** (0.079)	0.587*** (0.100)	0.318*** (0.050)	0.467*** (0.089)
Higher degree	1.283*** (0.240)	0.549*** (0.112)	1.286*** (0.239)	0.504*** (0.130)	1.069*** (0.195)	0.469*** (0.092)
<i>By age</i>						
15–24	0.336* (0.196)	0.246 (0.196)	0.426** (0.196)	0.144 (0.274)	0.522** (0.206)	-0.201 (0.258)
25–34	0.321*** (0.068)	0.522*** (0.087)	0.311*** (0.069)	0.578*** (0.113)	0.296*** (0.052)	0.521*** (0.075)
35–44	0.277*** (0.081)	0.463** (0.197)	0.347*** (0.081)	0.603*** (0.161)	0.279*** (0.065)	0.582*** (0.126)
45–54	0.852*** (0.174)	0.321 (0.428)	0.733*** (0.117)	0.318 (0.437)	0.631*** (0.076)	0.594 (0.488)
55–64	1.927*** (0.195)	-0.467 (0.564)	0.933** (0.391)	-0.219 (0.342)	1.005*** (0.328)	-0.154 (0.342)
Individual level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The wage sample is full time wage employment in private sector in Turkish Household Labor Force Survey 2010–2016. Full sample includes 471,271 individuals (362,845 males; 108,426 females). Dependent variables are natural logarithm of monthly wages. *Formal numerator* is the ratio of **formal** workers earned higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t in full time wage employment in private sector. *Fraction at* is the ratio of minimum wage workers in $t-1$ whose wages are lower than 110% of the minimum wage but higher than 90% of the minimum wage. The last three columns show the models where TRA2, TRB2, TRC2, and TRC3 NUTS-2 regions are excluded. Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicates statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

Table A2 Employment effects, alternative estimation using the alternative exposure variables or excluding outlier regions

	Fraction of formal affected		Fraction at minimum		Excluding outlier regions	
	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)
By education						
No high school degree	-0.001 (0.046)	0.033 (0.022)	-0.068 (0.050)	0.042 (0.027)	-0.078** (0.035)	0.073*** (0.025)
High school degree	0.088 (0.068)	0.009 (0.028)	0.060 (0.066)	0.022 (0.035)	0.058 (0.056)	-0.007 (0.024)
Higher degree	0.156 (0.106)	0.021 (0.046)	0.211 (0.125)	0.044 (0.044)	0.119 (0.104)	0.024 (0.044)
<i>By age</i>						
15–24	-0.070 (0.062)	-0.046 (0.029)	0.028 (0.075)	0.003 (0.047)	0.032 (0.094)	-0.002 (0.046)
25–34	0.058 (0.049)	-0.031 (0.022)	0.060 (0.063)	-0.000 (0.023)	0.051 (0.051)	-0.016 (0.021)
35–44	0.047 (0.067)	-0.015 (0.036)	-0.055 (0.055)	-0.031 (0.037)	-0.035 (0.043)	-0.039 (0.043)
45–54	0.065 (0.062)	-0.001 (0.029)	-0.010 (0.041)	0.002 (0.021)	-0.061* (0.032)	-0.031 (0.042)
55–64	-0.229*** (0.049)	-0.011 (0.010)	-0.033 (0.068)	0.018** (0.007)	-0.052 (0.080)	0.003 (0.007)
Individual level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The employment sample is working age population in Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working full-time in private sector. *Formal numerator* is the ratio of **formal** workers earned higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t in full time wage employment in private sector. *Fraction at* is the ratio of minimum wage workers in $t-1$ whose wages are lower than 110% of the minimum wage but higher than 90% of the minimum wage. The last three columns show the models where TRA2, TRB2, TRC2, and TRC3 NUTS-2 regions are excluded. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicates statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

Table A3 Informality effects, alternative estimation using the alternative exposure variables or excluding outlier regions

	Fraction of formal affected		Fraction at minimum		Excluding outlier regions	
	Male (1)	Female (2)	Male (3)	Female (4)	Male (5)	Female (6)
By education						
No high school degree	−0.002 (0.053)	−0.006 (0.014)	0.012 (0.045)	−0.005 (0.020)	0.007 (0.038)	0.012 (0.014)
High school degree	0.018 (0.036)	−0.012 (0.016)	0.006 (0.038)	−0.010 (0.016)	0.015 (0.033)	−0.002 (0.018)
Higher degree	−0.019 (0.032)	−0.002 (0.015)	0.015 (0.035)	−0.001 (0.016)	−0.012 (0.031)	−0.003 (0.013)
<i>By age</i>						
15–24	0.007 (0.060)	−0.012 (0.032)	0.054 (0.063)	0.040 (0.029)	0.089 (0.087)	0.034 (0.023)
25–34	−0.049 (0.053)	0.001 (0.009)	−0.031 (0.054)	0.001 (0.011)	−0.019 (0.047)	−0.001 (0.009)
35–44	−0.006 (0.036)	−0.022 (0.016)	−0.030 (0.035)	−0.015 (0.020)	−0.032 (0.029)	−0.016 (0.020)
45–54	0.016 (0.052)	−0.002 (0.013)	0.010 (0.044)	0.001 (0.012)	0.007 (0.034)	0.001 (0.023)
55–64	−0.063 (0.047)	0.000 (0.005)	−0.008 (0.038)	0.004 (0.004)	−0.045 (0.036)	−0.001 (0.003)
Individual level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The informality sample is working age population in Turkish Household Labor Force Survey 2010–2016. It includes 2,361,071 individuals (1,152,475 males; 1,208,596 females). Dependent variable is a dummy variable taking 1 if an individual is a wage earner and working without registered in the Social Security Institution in full-time in private sector. *Formal numerator* is the ratio of **formal** workers earned higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t in full time wage employment in private sector. *Fraction at* is the ratio of minimum wage workers in $t-1$ whose wages are lower than 110% of the minimum wage but higher than 90% of the minimum wage. The last three columns show the models where TRA2, TRB2, TRC2, and TRC3 NUTS-2 regions are excluded. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years) or doctorate. Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education or faculty, or 4 years higher education, or master's degree (5- or 6-years faculty included) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicates statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

Table A4 Lighthouse effects, effects of the minimum wage increase on informal wages, the baseline *fraction affected* exposure variable

	Monthly informal wage			Hourly informal wage		
	Overall (1)	Male (2)	Female (3)	Overall (4)	Male (5)	Female (6)
By education						
No high school degree	0.232 (0.195)	0.539** (0.196)	-0.128 (0.295)	0.205 (0.203)	0.670*** (0.230)	-0.187 (0.370)
High school degree	0.331 (0.221)	0.445** (0.203)	-0.031 (0.461)	0.312 (0.195)	0.517** (0.199)	0.193 (0.488)
Higher degree	0.527 (0.339)	1.990*** (0.551)	0.909* (0.473)	0.841** (0.357)	2.336*** (0.484)	1.472** (0.591)
<i>By age</i>						
15–24	-0.018 (0.345)	0.185 (0.352)	-0.465 (0.546)	0.289 (0.441)	0.607 (0.489)	-0.051 (0.627)
25–34	0.582*** (0.205)	0.430*** (0.148)	0.622** (0.256)	0.568** (0.207)	0.508*** (0.164)	0.620* (0.306)
35–44	0.303 (0.308)	0.539*** (0.139)	0.606* (0.296)	0.268 (0.245)	0.645*** (0.144)	0.295 (0.355)
45–54	0.506 (0.304)	0.492** (0.210)	0.593* (0.294)	0.347 (0.287)	0.536*** (0.168)	0.488 (0.334)
55–64	0.700** (0.297)	0.779* (0.396)	-0.308 (0.463)	0.672** (0.264)	0.779* (0.387)	-0.150 (0.414)
Individual level control	YES	YES	YES	YES	YES	YES
Standard errors clustered at NUT2-level	YES	YES	YES	YES	YES	YES
Year and region fixed effects	YES	YES	YES	YES	YES	YES
5 regions x year effects	YES	YES	YES	YES	YES	YES

Notes: The lighthouse effect sample is full time **informal** wage employment in private sector in Turkish Household Labor Force Survey 2010–2016. It includes 100,157 individuals (77,387 males; 22,770 females). Dependent variables are natural logarithm of monthly wages and of hourly wages. Hourly wages are calculated using the weekly working hour information. The key variable of interest is the fraction of affected workers (the ratio of workers earned higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t). Each cell shows the estimates for the interaction of the 2016 dummy and the fraction of affected workers in 2015. Workers with *Higher degree* are those with 2- or 3-years higher education, or 4 years higher education, or master's degree (5- or 6-years) or doctorate. There are 26 NUTS-2 regions. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. In “by education” estimations, age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts. Education is controlled using dummies for less than high school, high school, and tertiary education groups in “by age” estimations. ***, **, and * indicates statistical significance level at the 0.01, 0.05, and 0.1 level, respectively.

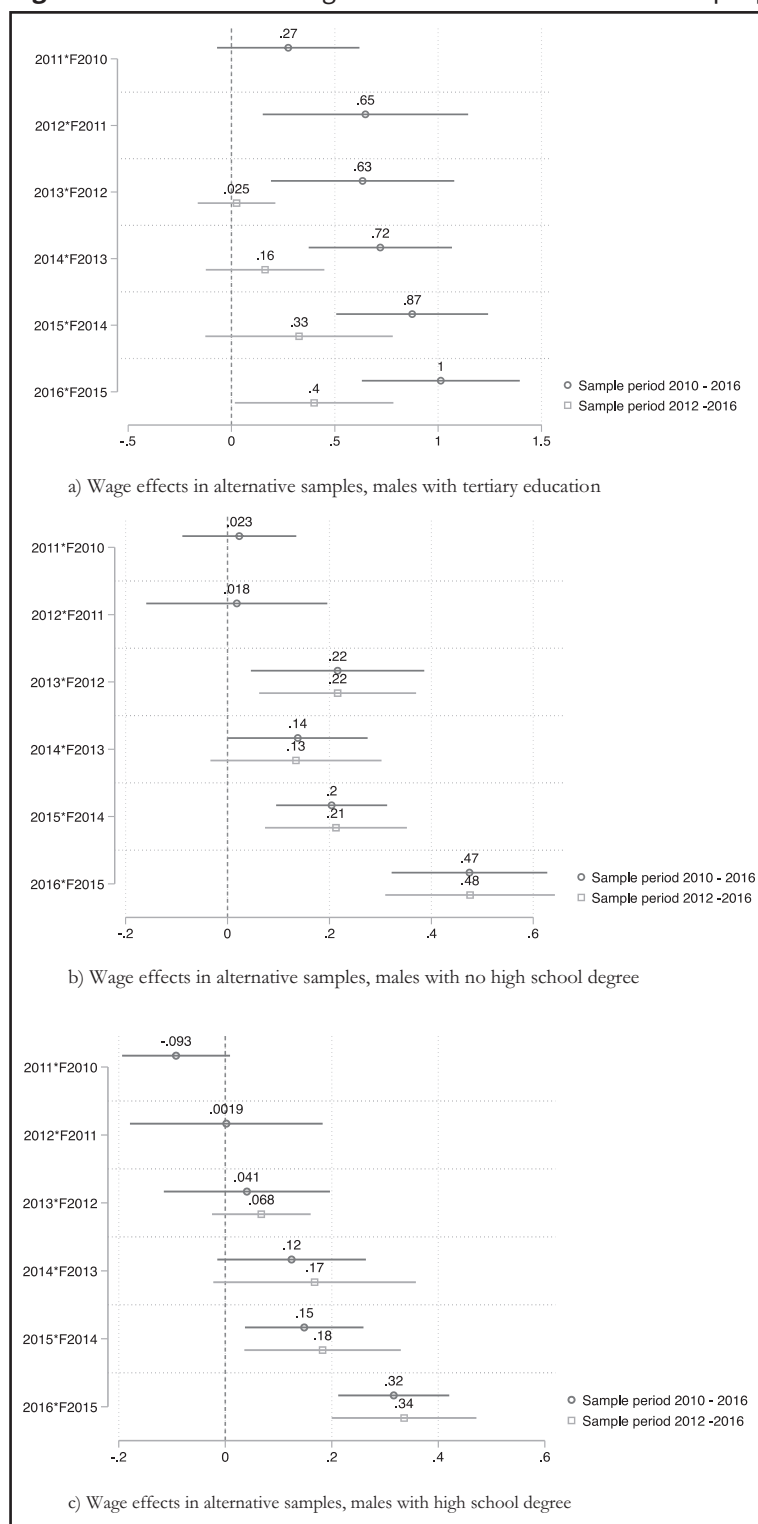
Appendix B

Complementary evidence on the largest wage effects estimated for men with tertiary education

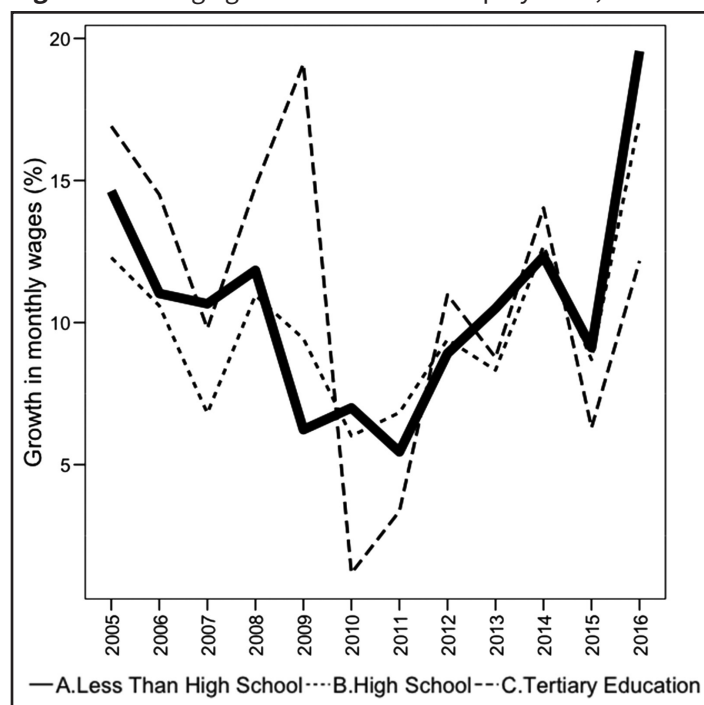
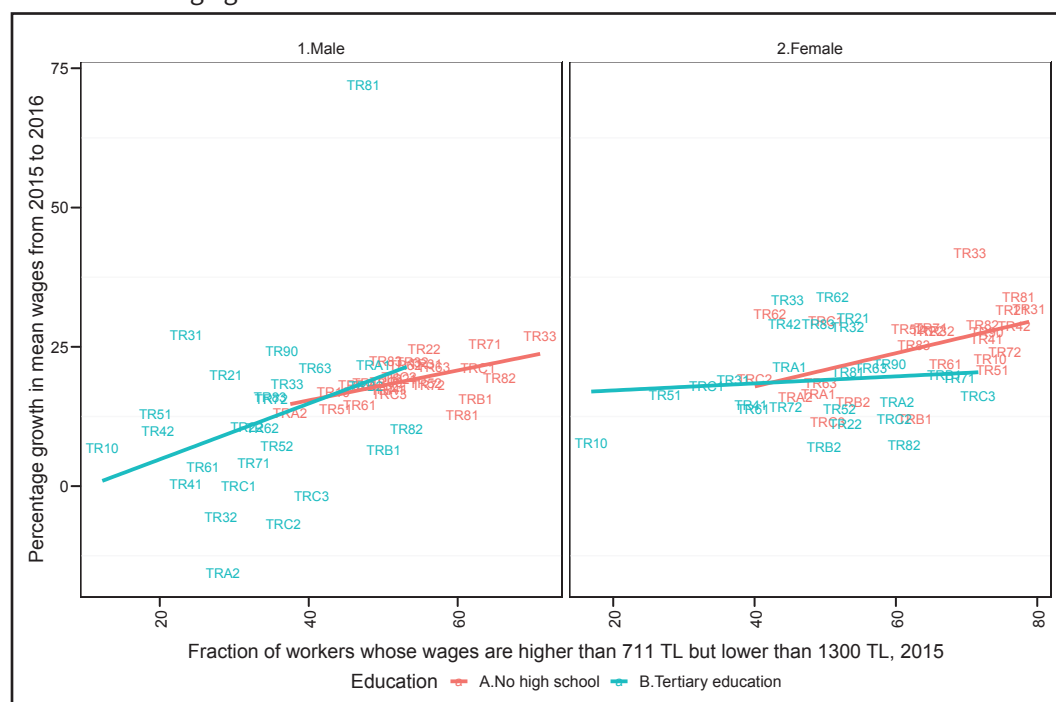
The results presented in Table 2 show that the largest wage effects are estimated for men with tertiary education. Since the share of minimum wage workers is lower within this education group, this result raises the concern that the estimates presented in this study might be vulnerable to the choice of the sample period. In this section, we provide further evidence suggesting that *the largest* wage effect estimated for men with tertiary education results from our base year choice, that the other estimates are not vulnerable to the sample period choice, and also that *the large* wage effect we estimate for this group is a characteristic of the labor market in Turkey.

The base year 2010 in our baseline specification was a bust-and-boom year in Turkey. The fluctuation in growth in wages of tertiary educated was much more pronounced (see Figure B2) during this period possibly due to a “composition effect”. Employment went down substantially in 2009 when the 2008 financial crisis was felt most severely and recovered significantly in 2010. Within tertiary educated sub-group, employees with a lower tenure were more likely to become unemployed in 2009, leading to a compositional increase in growth in wages of tertiary educated. In 2010, by contrast, re-employment of employees with tertiary education who had unemployed in 2009 seems to result in a compositional decrease in wage growth of tertiary educated sub-group (Figure B2 in Appendix). Taking inflation into account, real wages of tertiary educated workers declined in 2010. Hence, the first available year in our sample period (we use the fraction of affected workers in year $t-1$ as the key independent variable, thus the first round in our sample with the key variable of interest is in the 2010 wave) leads to an important upward bias in estimates for wage coefficients of tertiary educated group.

While the wage effects estimated for men with tertiary education when we use a different sample period (Panel A in Figure B1 of the Appendix) are not larger than the estimates for wage coefficients of men with no high school degree or high school degree, they are still large for a group supposed to be less affected by an increase in minimum wage. They thus deserve a further explanation. With this aim, in Figure B3 in Appendix we present the unconditional relationship between regional fraction of workers with wages between 711 Turkish liras and 1300 Turkish liras in 2015 and subsequent growth in 2016 in regional averages of wages at NUTS 2 level. We observe that estimated slope is roughly the same for men with tertiary education and for men with no high school degree. In other words, positive and large coefficient estimates for higher skilled men are not only a result of our preferred specification but also visible in the raw data. Therefore, they partly reflect a characteristic of the labor market in Turkey.

Figure B1 Alternative wage estimations with different sample period choice.

Notes: The wage sample is full time wage employment in private sector in Turkish Household Labor Force Survey 2010–2016. It includes 471,271 individuals (362,845 males; 108,426 females). Dependent variables are natural logarithm of monthly wages. The key variable of interest is the ratio of workers earning higher than 75% of minimum wage level in year $t-1$ but lower than new minimum wage level in year t . Each row shows the estimates for the interaction of the year t dummy and the fraction of affected workers in year $t-1$. All coefficients are relative to the interaction of the 2010 dummy and the fraction of affected workers in 2009 variable. Age is controlled using dummies for 15–24, 25–34, 35–44, 45–54, and 55–64 age cohorts.

Figure B2 Wage growth in full time employment, 2005–2016.**Figure B3** The unconditional relationship between the key variable of interest in 2015 and wage growth in 2016.

Notes: Own calculations based on the 2015 and 2016 waves of Turkish Household Labor Force Survey. The sample includes full-time wage employment in private sector. 711TL cut-off is 75% of the lowest minimum wage level in 2015. To read the figure for example, around 60% of men with no high school degree earned higher than 711TL but lower than 1300TL in 2015 and wage growth from 2015 to 2016 for this group was around 25%.