Policy Research Working Paper 8749

Do Firms Exit the Formal Economy after a Minimum Wage Hike?

Quasi-Experimental Evidence from Turkey

Aysenur Acar
Laurent Bossavie
Mattia Makovec

WORLD BANK GROUP
Social Protection and Jobs Global Practice
February 2019

Policy Research Working Paper 8749

Abstract

This paper explores the effects of a large increase in the national minimum wage in Turkey on firms' exit rates from the formal economy. The analysis exploits a unique, linked employer-employee panel data set of the universe of registered firms in all sectors of the economy. The causal impact of the minimum wage hike is estimated by using pre-policy information on the full distribution of wages in registered firms as a measure of exposure to treatment, and by implementing a difference-in-difference estimation strategy. The minimum wage hike is found to increase firms' exit rates from the formal economy by 12 percent. This suggests that firm exits attributable to the minimum wage hike could account for up to one-third of the total formal employment destruction that occurred between 2015 and 2016. The minimum wage effect on exit rates is found to be larger among firms with low productivity levels before the policy change, and in sectors where profit margins are low. A range of placebo tests and robustness checks indicate that these findings are not driven by trends in unobservable characteristics correlated with exposure to the minimum wage hike.

This paper is a product of the Social Protection and Jobs Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/research. The authors may be contacted at lbossavie@worldbank.org; mmakovec@eorldbank.org; or aacar@worldbank.org.

Do Firms Exit the Formal Economy after a Minimum Wage Hike? Quasi-Experimental Evidence from Turkey*

Aysenur Acar, World Bank†

Laurent Bossavie, World Bank‡

Mattia Makovec, World Bank§

Keywords: Minimum wage, firms' exits, productivity, informality.

JEL codes : J23, J31, J46.

* **Acknowledgement and disclaimer.** We would like to thank Ximena Del Carpio, Cem Mete and Sirma Demir Seker for helpful comments and suggestions throughout the preparation of this paper. We are deeply indebted to Elif Tuğçe Çınar and her team at the Ministry of Industry and Technology (MoIT) of the Republic of Turkey for making available the Enterprise Information System, and for continuous support in the use of the microdata at the Ministry's premises. The findings and the opinions reported in this paper should be considered sole responsibility of the authors: they do not necessarily represent the official view of the World Bank, and they cannot be attributed in any way to any agency of the Government of Turkey.

† aacar@worldbank.org
‡ lbossavie@worldbank.org
§ mmakovec@worldbank.org

1. Introduction

The minimum wage can play an important role in improving the welfare of workers and their households. Most developing country studies find that minimum wages boost labor income by increasing formal sector wages, but also in some cases in the informal sector, through a "lighthouse effect" (Lemos, 2009, Khamis, 2013, Gindling and Terrell, 2005, Maloney and Mendez, 2004). Given the positive impacts of the minimum wage on wage levels, an increase in mandatory labor costs has been shown to lower deprivation in many contexts (De Janvry and Sadoulet, 1995, Lustig and McLeod, 1997, Saget, 2001, Devereux, 2005, Bird and Manning, 2008, Gindling and Terrell, 2010, Alaniz et al., 2011).

However, as policy makers enforce labor regulations to improve the protection and welfare of workers, firms - especially micro and small firms which are still absorbing the larger share of total employment in developing countries - face increasing labor costs. Rising labor costs may hamper the capacity of firms to absorb more labor and create employment or could even induce them to shut down their business by squeezing profit margins (Draca et al, 2011). Alternatively, in the countries where the rule of law and government resources tend to be weaker (Loayza and Rigolini, 2006) and informality is widespread (Meghir et al. 2015), a minimum wage hike could also incentivize firms to operate informally to avoid rising labor costs. A rise in the minimum wage could therefore partly offset simultaneous efforts to reduce informality, a common priority for policy makers in developing economies.

An overwhelming majority of the literature focuses on the employment effects of the minimum wage, in the form of workers' layoffs by firms. Much less is known about other firms' responses to the minimum wage, although the literature has been growing in recent years, primarily in the context of advanced economies. The limited attention to firms' responses other than employment adjustments is partly driven by a lack of rich firm data, a constraint which is particularly salient in developing countries. In the context of advanced economies, the literature has recently been looking at the effect of the minimum wage on firm profitability (Draca et al., 2011), stock market value (Bell and Machin, 2018) or firm productivity (Rosazza-Bondibene, 2018). In the US, other studies have examined the impact of the minimum wage on firms' location (Rohlin, 2011), firms'

entries and exits (Aaronson et al., 2017) and consumer prices (Aaronson 2001, Aaronson and French 2007, Lemos 2008, Allegretto and Reich 2018). In the context of developing economies, evidence on the minimum wage impact on firms' adjustment mechanisms other than employment is even more sparse. A recent exception is Mayneris et al. (2018) which look at the impact of a minimum wage hike on value added, productivity and profits in China. Hau et al. (2016) also examined the substitution of labor for capital by Chinese firms in response to the minimum wage, as suggested by Stigler (1946). Borhat at al. (2013) looked at the effect on hours worked in South Africa.

This paper contributes to the literature on firms' margins of adjustments to the minimum wage by focusing on an under-explored response mechanism, namely the exit of firms from the formal economy. To the best of our knowledge, it is only the second paper in the vast minimum wage literature to look at impacts on firms' exits, after Aaronson et al. (2017), who focused on a very specific industry in the US.[5] It is also the first paper to examine this issue in the context of a developing economy where firms can often operate outside the formal sector.[6]

Our paper also contributes to the long-lasting debate on the employment effects of the minimum wage by exploring another channel through which the minimum wage can impact employment, namely through its effect on firm dynamics, particularly through firms' exits. While existing studies primarily focus on the employment adjustments made by continuing firms in response to the minimum wage, they are silent about the role played by firms' exits in response to the minimum wage in net job creation. Our paper therefore sheds light on this under-explored channel for employment effects.

Our contribution also adds to the limited evidence on the impact of the minimum wage on the size of the formal and informal economy in settings where informal economic activities remain widespread (Meghir at al., 2015). In this context, the minimum wage can affect the allocation of employment and economic activity between the formal and informal sectors (Del Carpio and

[5] The paper by Aaronson et al. (2017) focuses on the restaurant industry in the US, one of the main employers of low-paid workers in the US.
[6] Although this is not the focus of their paper, and the evidence they provide is descriptive, Mayneris et al. (2018) show a decline in survival rates of firms highly exposed to the minimum wage in China.

Pabon, 2017). This is important in a setting where policy makers devote simultaneous effort and resources to reducing informality, as it is the case in Turkey. While several studies looked at the effect of the minimum wage on formal and informal employment, they are silent about the underlying mechanisms of these compositional changes.[7] Our paper sheds light on one of these mechanisms by examining firms' exits from the formal sector as a response to the minimum wage hike.

Our paper is also one of the few contributions to examine firms' margins of adjustment to the minimum wage using data on the universe of registered firms.[8] To the best of our knowledge, it is also the first contribution that investigates the effects of the minimum wage on firm exits for firms of all sizes and all sectors of activity.[9] Observing smaller firms is important when estimating the effect of the minimum wage, as those typically pay lower wages and are therefore more exposed to increases in mandatory labor costs. This is especially important in the context of developing economies where small firms remain prevalent. Studies that observe only larger firms may therefore underestimate the effects of the minimum wage for firms in the economy at large. In addition, observing firms across different sectors of activity and sizes allows to look at the heterogenous effects of the minimum wage on firm adjustment responses

Turkey is a relevant country case to analyze for two main reasons. First, about 40% of the workers employed in registered firms were paid around the minimum wage prior to the minimum wage hike. As a result, any minimum wage increase could trigger adjustment responses by firms, particularly among smaller ones. Second, despite a strong decline in informal employment over the past decade, about a third of total employment in the Turkish economy is estimated to be informal (Figure 1).[10] Operating informally therefore remains a possible and viable option for many firms.

[7] See for example Lemos (2009) or Gindling and Terrell (2005) or Comola (2011) among others.
[8] The financial sector is the only industry excluded from the data, which represents a very small share of total employment and GDP in the economy. As of 2017, the share of the financial sector in total formal employment was only 1.4%, and the sector generated 4.3% of the total GDP in the country.
[9] The other study by Aaronson et al. (2017) which examines the impact of the minimum wage on firms' exits estimates those effects in a very specific industry in the US, namely the restaurant industry.
[10] Informal employment is defined as employment which is not registered with social security authorities.

To estimate the causal effects of the minimum wage, the paper takes advantage of a large increase in the statutory minimum wage in Turkey. In January 2016, the Turkish labor national nominal minimum wage was raised by 33%, an increase of about 25% in real terms. This large increase contrasts with raises implemented in previous years, which had roughly followed the inflation rate. It therefore constitutes an ideal quasi-experiment to study the impacts of the minimum wage given its magnitude and the fact that it was largely unanticipated.

Our data allow to construct a precise measure of exposure to the minimum wage hike, in a setting where the implementation was nationwide. As we observe the entire distribution of workers' wages prior to the policy change, we can measure exposure to the minimum wage as the "wage gap" prior to the hike, as suggested by Machin et al. (2003) and Draca et al. (2011). We construct this measure of exposure at the cell level, where a cell is defined as the set of firms operating in the same industry in a given district of Turkey. Exposure is therefore measured as the proportional increase in the wage bill needed to bring all workers in the cell at the new statutory minimum wage. We then implement a difference-in-difference estimation where the change in exit rates of high-exposure cells (treatment group) before and after the minimum wage hike is compared to that of low-exposure cells (control group).

The paper is organized as follows. Section 2 provides some background on the minimum wage setting in Turkey. Section 3 describes the Enterprise Information System (EIS) used in the paper and presents some descriptive statistics and evidence. Section 4 presents our methodology and identification strategy. Section 5 reports the main results of our difference-in-difference estimation, as well as placebo tests. Section 6 concludes.

2. The minimum wage in Turkey

2.1. Institutional setting

In 1989, Turkey abandoned regional and sector-specific minimum wages to introduce a single national minimum wage. A minimum wage for workers under 16, set at 85% of the national

minimum wage, was also put in place, before being abolished in 2014. The national minimum wage covers in principle all employees working under a labor contract, whether they are under the scope of labor law or not. The minimum wage regulation of 2004 (39 principle of the Labour Act 4857) defines the minimum wage as "the wage paid to workers for a normal working day, which satisfies the necessary needs of workers, such as food, housing, clothing, health, commuting, and cultural expenses at a minimum level". In practice, the Turkish Institute of Statistics (TurkStat) provides an estimate of the net cost of these needs for one worker.

The minimum wage setting is conducted by the Ministry of Family, Labor and Social Service (MFLSS) through the Minimum Wage Fixing Board. The Board is a tripartite process of collective bargaining, involving the government, the workers' largest unions, as well as the employers' largest unions. The Committee is composed of 15 members with an equal number of these three organizations, and a minimum quorum of 10 members. Decisions are taken under the majority of votes of its members, and in the event of a tie, the chairman of the Committee has a casting vote. The decision of the Board is final.

Minimum wage rates must be adjusted at least every two years and have been in practice adjusted every year over the past decade. Typically, since the Minimum wage regulation of 2004, the new monthly minimum wage level in each year is announced by the Minimum Wage Commission on the last Friday of December of the previous year, after a series of weekly consultation meetings that can last between one to two months.

Minimum wage practices, which aim at securing a certain state of welfare for workers, concern a considerable part of the labor market in Turkey. The Turkish labor force still exhibits relatively low levels of educational attainment compared to other economies in the OECD. While about one-third of workers in the OECD have completed some tertiary education, this share is only at 15% in Turkey. Turkey has one of the highest minimum wage to median wage ratios among the OECD countries. As of 2016, this ratio was around 0.8 in Turkey compared to an OECD average of 0.6. As result, as in many developing countries, a large share of workers formally employed in Turkey are paid around the minimum. As of 2015, more than 40% of registered workers in Turkey were paid at around the minimum wage. The minimum wage is particularly binding in firms with fewer

than 10 employees, where three-quarters of workers are paid at the minimum wage. This implies that any sizeable increase in the real minimum wage would have substantial impacts on firms' labor costs.

2.2. The quasi-experiment: The minimum wage hike of 2016

In January 2016, the nominal minimum wage was increased by about 32% compared to the previous months, from about US$ 265 to about US$ 350 in net terms. With an inflation rate of 8.8% in 2015 (Turkish Statistics Institute-TurkStat), the target for 2016 in the latest Medium Term Fiscal Plan (2016-2018) was 6.5%, this raise represented an increase of about 23% of the minimum wage in real terms. This contrasts with the minimum wage increases that occurred in previous years, which ranged from 5 to 8% increase in nominal terms and were aligned with annual consumer inflation expectations and realizations. Figure 2 displays the annual growth of the real and nominal wage compared to the CPI from 2010 to 2016 and shows a very large hike in the minimum wage in the first quarter of 2016. This sharp increase generated by the reform constitutes a suitable experiment to study the firms' responses. In the remainder of the paper, we also provide evidence suggesting that the increase has not been anticipated by firms and therefore constitutes a valid quasi-experiment to study the impact of the minimum wage on firm behaviors.

3. Data

3.1. The Enterprise Information System (EIS)

This paper uses a rare, linked employer-employee data set on the universe of firms in the Turkish economy. The database was compiled from various administrative data sources, in an effort led by the Ministry of Industry and Technology (MoIT). The original administrative data come from various sources: Ministry of Industry and Technology, Ministry of Trade (MoT), Revenue Administration (GIB), Social Security Institution (SGK), Small and Medium Business Development and Support Administration (KOSGEB), Turkish Statistical Institute (TURKSTAT), Turkish Patent and Trademark Office (TPE), and Scientific and Technological Research Council of Turkey (TUBITAK).

This effort resulted in the Enterprise Information System (EIS), a panel of the universe of firms registered with social security authorities available from 2006 to 2016. Firm-level information was linked to data on each registered employee in the firm. Firms can also be followed over time through a unique identifier, as well as workers since 2012.

The data set covers all non-financial firms registered in administrative records. As of 2015, there were around 3 million firms registered in the EIS data set, among which about 1 million had at least one employee. A major and unique advantage of the EIS is that it has no floor in terms of firm size and it also records information on firms without paid employees. This is critical in the Turkish context, as most firms employ fewer than 10 workers, and those firms are also likely to be the most exposed to an increase in the minimum wage. Another rare feature of the EIS is that it covers all sectors of activity, except the banking sector and military institutions.

The data set contains rich information on firms' financial statements (net sales, asset-liability statements, debt, profits) for firms that pay institutional and corporate tax, trade between sectors and provinces, exports and imports, intellectual property rights (patents, etc.), grants received (credit and others), capacity of manufacturing firms, and production of manufacturing firms. It also reports detailed information on capital expenditure, labor costs, economic sectors (sector- 4-digit ISIC and NACE rev 2), firm-types and geographic location (district level), and technology level (based on OECD definitions).

The data also report individual information on all registered workers employed in registered firms, obtained from the social security institution, and available at the end of each quarter. This allows to calculate total employment in each firm on a quarterly basis. Information on workers' age, gender, days worked, and wage is available for each registered worker, as well as their occupation from 2014 onwards. The availability of wage data for each worker in the firm is highly valuable when studying minimum wage effects, as it allows to observe the entire wage distribution in the firm. Workers are allocated a unique identifier which allows to follow their movements across firms, as long as they remain employed in firms registered with the social security institution. As of 2016, about 12.6 million workers were registered in the database.

One limitation of the EIS database is that it only provides information on registered firms. An exit from the EIS database may therefore be due to either firm closure, or to the firm still operating but

without registering with social security authorities. To illuminate the mechanisms at play, we use an additional data set that is representative of both formal and informal employment to complement the EIS analysis.

3.2. Descriptive statistics

As shown in Table 1, small firms represent the large majority of registered firms in the Turkish economy. About 84% of firms in the sample have fewer than 10 employees. This reinforces the importance of using firm-level data that cover small firms, as studies using firm data above a given size threshold in developing countries would be missing the bulk of the economy. This is particularly important when looking at firms' responses to the minimum since, as illustrated in Table 1, smaller firms tend to pay lower wages and employ a large share of their workers at the minimum wage. More than 90% of workers in small firms were paid no more than 10% above the minimum wage in place prior to the minimum wage hike of 2016. The minimum wage is therefore strongly binding in those firms, and any increase in the minimum wage would therefore result in sizeable increases in labor costs for those firms. The share of workers paid at the minimum wage remains quite large in medium-sized firms, with about 70% of workers paid no more than 10% above the minimum wage, while 40% of workers in larger firms are paid at the minimum wage.

3.3. Number of registered firms before and after the minimum wage hike

Figure 3 shows a clear decline in the number of registered firms following the hike in the minimum wage of 2016. While the number of registered firms had been increasing steadily from the first quarter of 2012 until the last quarter of 2015, a noticeable drop is observed in the first quarter of 2016. The number of registered firms continues to drop in the following quarters, albeit at a more moderate pace. The timing of the minimum wage hike therefore coincides with a noticeable drop in the number of firms in the formal economy. The remainder of the paper investigates whether there exists a causal relationship between the simultaneous sharp increase in the minimum wage and the drop in the number of registered firms.

4. Identification strategy

4.1 Measuring exposure to the minimum wage hike: Addressing methodological challenges

The first challenge when trying to identify the effect of the 2016 minimum wage hike in Turkey is the fact that the implementation of the reform was nationwide. Further, since Turkey has only one unique minimum wage that applies to all workers and firms, it is difficult to identify "natural" treatment and control groups affected (or not) by the policy change. A few approaches have been proposed in the literature to identify a causal impact when minimum wage reforms took place under these circumstances. For instance, Card (1992) for the US, and Stewart (2002) or, more recently Caliendo at al. (2017) for Germany, rely on the degree to which regional labor markets are affected by the minimum wage, using a difference-in-difference estimation strategy. They argue that between regions, earnings and wages differ due to structural and environmental differences and that these variations imply that a nominal minimum wage affects regions to different intensities. By the same token, Machin et al. (2003) and Draca et al. (2011) use information on the average wage in firms prior to the policy change, to construct firm-level measures of exposure to the minimum wage, and therefore to classify firms by different levels of exposure to a minimum wage increase. They use this degree of exposure to construct treatment and control groups and then conduct a difference-in-difference estimation to estimate the causal effects of the minimum wage introduction.

The second methodological challenge we need to address relates to nature of our variable of interest: the exit of firms from the formal sector. Since firms' characteristics are not observable once a firm exits the EIS registry (either because it shuts down operations, or because it starts operating informally), implementing a standard difference-in-difference estimator at the firm level becomes problematic. In particular, one important limitation of using firm-level information is that exposure to treatment – measured in the last quarter of 2015 prior to the minimum wage hike - is by definition observed only for firms that are present in the database in the last quarter of 2015 and have therefore not exited prior to that time. This rules out any analysis of pre-trends in exits of low-exposure and high exposure firms as, by definition as exit rates prior to the minimum wage hike for both low exposure and high exposure firms would be zero by construction. This would prevent testing for potential pre-tends, a key threat to identification when using difference-in-difference estimation methods. For this reason, instead of conducting our difference-in-difference

estimation at the firm-level, we measure our exposure to treatment and outcome of interest at the "cell" level, meaning the mass of firms existing in every quarter since 2012, at a given 2-digit NACE level, and at a given district level, before and after the 2016 minimum wage hike.

In other words, in this paper, we follow a similar approach as in Machin et al. (2003) or Draca et al. (2011), but we instead measure exposure to the minimum wage hike at the cell level instead of firm level. A cell is defined as the set of firms in a given two-digit industry in a given district of Turkey. As some of these cells are quite small, we restrict our sample of cells to those with a minimum of 50 firms. This sample restriction eliminates about 20% of firms in the original sample. We measure exposure to the minimum wage increase at the cell level, as the difference between the cell-level wage bill prior to the minimum wage increase, and the cell-level wage bill that would result once the new minimum wage is in place. In other words, our measure of exposure is the proportional increase in the wage bill required to bring all workers in the cell paid below the 2016 Minimum Wage level, up to the new minimum wage. Formally, our treatment intensity variable I_i, or exposure to the minimum wage hike, for each cell, can be expressed as:

$$I_i = \frac{\sum_j n_{ij}\, max(W^{min} - W_{ji}, 0)}{\sum_j n_{ji} W_{ji}} \quad (1)$$

where n_{ji} is the monthly number of days worked by worker j in cell i; W_{ji} is the daily wage of worker j in cell i; and W^{min} is the 2016 minimum wage that applies to all registered workers in all registered firms (the quarter sub-index is omitted here for simplicity).

Given this approach, one important improvement of our methodology compared to previous studies is that the full distribution of wages of all registered workers in each cell's firms is observed, in place of just the average wage, as in Draca et al. (2011). This attractive feature of the data allows a more accurate measure of exposure to treatment, known in the literature as the "Intention To Treat" (ITT), as we can directly and accurately measure exposure to the minimum wage increase for each cell of the EIS registry in each quarter.

4.2. Minimum wage hike and actual wage increase in registered firms

Before considering the consequences of the minimum wage hike, we must first establish that the minimum wage increase had the expected effects on the distribution of wages among registered firms. Confirming that the minimum wage introduction had real 'bite' and affected the wages of low-wage workers in the expected direction is clearly a prerequisite before assessing the impact of the policy on employment. Figure 4 shows that the increase in statutory minimum wage in January 2016 indeed translated in a sharp increase in the average daily nominal wage of Turkish firms. Time-series show a clear break of average daily wages in 2016 compared to prior trends.

4.3. Difference-in-difference estimation

For ease of exposition of our difference-in-difference approach, we classify cells into two categories, according to their level of exposure to the minimum wage hike I_i. Cells with exposure above a given exposure threshold ($I > I^*$) are categorized as "high exposure cells", while cells with exposure equal or below the exposure threshold ($I \leq I^*$) are classified as "low-exposure cells".[11] We use the median level of exposure I to the minimum wage hike in our sample of cells (0.135) as the treatment threshold I*.

We can estimate the impact of the minimum wage hike on exit rates in the cell by comparing what happens before and after the minimum wage increase across these treatment and control cells. For this procedure to be valid, the expected response should be that wages rise by more in cells with low wages ($I > I^*$) before and after introduction as compared to cells where wages are high ($I \leq I^*$). Under the parallel trend assumption, a difference-in-difference estimate of the effect of the new minimum wage on firms' exit rates is simply $\left(\bar{Y}^{I>I^*}_{NMW=1} - \bar{Y}^{I\leq I^*}_{NMW=1}\right) - \left(\bar{Y}^{I>I^*}_{NMW=0} - \bar{Y}^{I\leq I^*}_{NMW=0}\right)$, where NNW is a binary indicator taking the value 1 if the cell is observed in a quarter posterior to the minimum wage hike, and 0 otherwise. For example, $\bar{Y}^{I>I^*}_{NMW=1}$ is the mean exit rate in high-exposure cells after the hike in the minimum wage. The difference-in-difference estimate is therefore the simple difference in mean exit rates between high-exposure and low-exposure

[11] We use the median level of exposure to the minimum wage hike in our sample of cells (13.5%) as the treatment threshold I*.

before and after the new minimum wage, unconditional on other cell characteristics. We follow the standard definition of exit rates and compute exit rates Y_{it} in cell *i* and time *t* as:

$$Y_{it} = \frac{n_{it}^{exit}}{N_{it}}$$

Where n_{it}^{exit} denotes the number of exiting firms in cell i and quarter t, and N_{it} the total number of firms that operated in cell *i* at time *t.* A firm is classified as exiting the formal economy in quarter t if it was observed in the registry in quarter *t-1* and is no longer in the registry in quarter t, with no re-entry in subsequent quarters. This later restriction is motivated by the fact that we observe a substantial share of firms exiting the registry in one quarter and re-enter in later quarters, which is likely driven by seasonal economic activities. To address this measurement issue, we restrict our definition of exits to "permanent" exits.[12]

In a regression setting, a difference-in-difference estimate of the effect of the minimum wage increase on the firm exit rate in the cell can be expressed as:

$$Y_{it} = \alpha + \pi X_{it} + \delta Q_t + \theta D(I > I^*) + \beta [D(I > I^*) * NMW] + \varepsilon_{it} \quad (2)$$

where X is a vector of cell-level characteristics that could be correlated with exposure status and exit rates, which include the average firm age in the cell, average firm size, dummies for broad sector of activity and regional dummies. Q denotes a set of quarterly effects and ε is a random error. We are interested in consistently estimating β , which measures the effect of the minimum wage hike on exit rates. In addition to this binary treatment effect, we also estimate the effect of a continuous treatment measure - the degree of exposure to the minimum wage hike I as defined in equation 1 - by the following equation:

$$Y_{it} = \alpha + \pi X_{it} + \delta Q_t + \theta I + \beta [I * POST] + \varepsilon_{it} \quad (3)$$

[12] We also use an alternative definition of exit where the condition of no re-entry in subsequent quarters is relaxed. Estimation results with this alternative definition are very similar to those obtained with our most restrictive definition of exits, and the results are available upon request.

4.4. Variation in exposure to the minimum wage hike in the sample

Figure 5 shows the distribution of our treatment intensity measure I_i - the expected proportional increase in the firms' wage bill in the cell – in our sample. Treatment exposure ranges from 0 to about 21.5%. As shown in the figure, there exists substantial variation in exposure across cells with at least 50 firms in our sample. A sizeable share of firm cells are weakly exposed to the minimum wage hike, although high levels of exposure are more frequent. The distribution of exposure to the minimum wage hike therefore appears to provide sufficient variation to identify the effect of the treatment. In addition, the high incidence of higher degrees of exposure among firm cells reinforces the importance of investigating the effects of exposure to the minimum wage in the Turkish context.[13]

Table 2 reports the summary statistics of our data aggregated to the cell-level overall and by treatment status. The average minimum wage exposure in our sample of cells is of 12.5%, below the median level of exposure of 13.8%, with a maximum level of exposure of 21.5%. Table 2 also illustrates a few notable differences between high-exposure and low-exposure cells. The share of firms in wholesale and retail and in industry other than manufacturing is larger in high-exposure cells compared to low exposure cells, where manufacturing is more prevalent. As expected, given the evidence reported in Table 1, firms in high-exposure cells also tend to be smaller than in low-exposure cells. Finally, exit rates prior to the minimum wage hike also tend to be larger in high-exposure firms.

4.5. Exposure to treatment and actual increases in labor costs

For our identification strategy to identify the treatment of interest, it is important to verify that we observe a larger wage increase in low-exposure cells compared to high-exposure cells after the minimum wage hike. Figure 6 depicts the evolution of wages in these two categories of cells in the period surrounding the minimum wage hike. Figure 6 shows a very large jump in average wages in high-exposure cells. In contrast, the increase in wages in low-exposure cells is much

[13] When our sample of cells is not restricted to cells with at least 50 firms, the distribution of cells is further skewed towards high levels of exposure.

smaller after 2016. Therefore, firms that remain registered after the minimum wage hike experienced a disproportionally higher increase in mean wages. This visual evidence indicates that our measure of exposure to treatment also generates substantial heterogeneity in actual treatment intensity, allowing us to identify the effects of the minimum wage hike.

4.6. Evidence for the validity of the identification strategy

A common threat to the identification strategy in a difference-in-difference setup is the violation of the parallel trend assumption. Our difference-in-difference estimation consistently identifies the effect of the minimum wage hike only if low-exposure and high-exposure firms exhibit parallel trends in exit rates in the absence of the treatment. The identifying assumption would be violated if, for example, exit rates among low paying firms were increasing faster than those of higher paying firms prior to the hike, which would confound our difference-in-difference estimates. Figure 7 provides some initial visual comfort about the validity of the parallel trend assumption in our context. The figure shows that although exit rates are higher in absolute value in high-exposure cells, trends in exit rates prior to the minimum wage hike do not exhibit noticeable difference between the treatment and control groups. In Section 5.3, we provide further quantitative evidence showing that a range of placebo tests conducted in periods prior to the minimum wage hike do not have any effect on exit rates after the minimum wage hike.

A related concern is the fact that low and high-exposure cells may systematically differ in terms of certain characteristics such as firm size or productivity for example, in ways that could affect trends in exit rates. To further alleviate this concern, we control for a full set of observable cell-level characteristics in our difference-in-difference estimations such as average firm size, average firm age, broad sector of activity, as well as regional dummies. As detailed in Section 5, our estimation results show that the magnitudes of the difference-in-difference coefficients are not affected by the inclusion of cell-level characteristics. This further alleviates concerns that a spurious association between the characteristics of firms in the cell and the degree of exposure to the minimum wage hike might be driving our results.

Another potential threat to identification is the fact that the hike may have been anticipated by firms, which could have then started adjusting before the actual treatment took place. Such anticipation effects would contaminate our estimates of the true effect of the minimum wage hike. While the minimum wage is regularly adjusted, anecdotal evidence suggests that such a large increase in the minimum wage in 2016 was unexpected by firms. Yearly minimum wage increases in the decade prior to the 2016 minimum wage hike had all closely followed the inflation rate, and it is therefore likely that firms has similar expectations regarding the 2016 increase, instead of the minimum wage hike of 25% in real terms. Figure 7 provides visual evidence which is comforting in that respect. It does not show any noticeable increase in exit rates in quarters prior to the minimum wage hike, both among high and low-exposure cells, suggesting that the hike was largely unanticipated. In section 5.3, we provide formal statistical evidence supporting this assumption.

5. Results

5.1 Baseline results

Visual evidence reported in Figure 7 shows that cells that were more exposed to the minimum wage hike, as measured by the exposure indicator I, experienced significantly higher exit rates from the formal sector following the minimum wage hike. The figure shows a large increase in exit rates following the minimum wage hike, particularly in the first quarter of 2016 that immediately follows the hike. A rise in exit rates was also observed among low-exposure firms, although it is smaller in magnitude compared to that of highly-exposed firms.

Estimates from equation 2 using the difference-in-difference methodology are displayed in Table 3. Table 4 performs a similar estimation where the binary treatment variable is replaced by a continuous measure of treatment, as detailed in equation 3. Table 3 reports a positive and statistically significant effect of the minimum wage hike on firms' exit rates form the formal economy. These results hold when the estimation uses the 2015-2016 period only (Panel A), as well as the entire 2012-2016 period (Panel B), although estimates are somehow larger in the latter estimation. These findings are also robust to using the continuous measure of treatment exposure (Table 4) instead of the binary treatment. Adding control variables for cell-level characteristics

does not significantly affect the magnitude and significance of the estimates, alleviating concerns that our measure of treatment exposure might be correlated with other firm characteristics that could affect trends in exit rates. Finally, as shown in column 3 to 8 of both table 3 and table 4, key findings are also robust to different sample restrictions.

To assess the magnitude of the treatment effects, we compare our estimates to the mean pre-treatment value of the outcome of interest, the firm's exit rate. The exit rate of firms in the control group – with minimum wage exposure below median exposure in our sample - was of about 3% in the last quarter of 2015. Estimates reported in Table 3 suggest that being highly exposed to the minimum wage hike increases exit rates by 0.26 to 0.3 percentage point depending on the specification, which represents an increase by 9 to 10% in the average exit rate in the control group. In terms of effect size, being highly exposed to the minimum wage hike increases the firms' exit rate by about 0.11 of a standard deviation. When looking at the estimation results that use the continuous treatment exposure measure, an increase in labor costs by 10% due to the minimum wage raises firms' exit rates by about 0.10 of a standard deviation.

5.2. Heterogeneous effects

We then disaggregate our sample of firm cells to investigate potential heterogeneous effects across different types of cells. Tables 5 and 6 report treatment effects by average firm size in the cell, divided into three categories: small, medium, and large average firm size. Although estimated effects somehow vary with the period of analysis and treatment measure – binary or continuous – the results overall show a statistically significant effect on exit rates in cells when the average firm size is small or large, but no statistically significant effect in cells with medium average firm size.

Tables 7 and 8 report the effects of the minimum wage hike on exit rates by sector of activity. Overall, the effects on exits are larger in wholesale and retail as well as in other industry for some specifications, relative to manufacturing and other services. Effects are statistically significant and large in magnitude in the wholesale and retail sector for all specifications. One potential explanation for this finding is the fact that profit margins are typically low in wholesale and retail relative to other industries. As a result, if the minimum wage is squeezing profits by increasing labor costs in all sectors, effects on exits are likely to be particularly pronounced in sectors where profit margins are already low. In those sectors, firms are lacking room to adjust their profits

downwards and may therefore be more likely to exit as a response to a minimum wage hike compared to sectors where profit margins are larger.

Finally, Tables 9 and 10 display our results by levels of labor productivity in the cell. Average levels of labor productivity - as measured by value-added per worker – are disaggregated into five quintiles according to the average productivity in the cell measured prior to our period of study, in 2011. The results displayed in both tables show a clear decline in the magnitude of the treatment effect along the productivity distribution. While the response of exit rates to the treatment exposure is quite large in the bottom quintiles of the productivity distribution, the magnitude of the effect decreases in the upper quintiles and becomes statistically insignificant in the top productivity quintile. These results are robust to using either the continuous or binary measures of the treatment. This pattern of the results is however more striking in the specification using the continuous treatment measure where the effect size declines almost linearly across productivity quintiles. For a given level of exposure to the minimum wage hike, less productive firms therefore respond more strongly to the minimum wage hike by exiting the formal sector. This is rather intuitive as one would expect less productive firms to also have lower profits and therefore to be less able to absorb a sharp increase in labor costs. In other words, less productive firms may resort to exiting the formal sector in response to the minimum wage hike more frequently, as they may lack other possible adjustment mechanisms.

5.3. Testing the common-trend assumption

The main threat to identification is that firms' exit rates in high exposure cells were already rising relative to low exposure cells prior to the minimum wage hike, and that our estimates are capturing these pre-trends instead of the true effect of the minimum wage hike. Besides visually inspecting the pre-treatment trends in the exit rate among treatment and control cells, we now formally test for the existence of pre-trends by conducting a series of placebo tests. To do so, we estimate the same equation as for 2015-2016 reported in Tables 2 and 3, but for 2012-2013, 2013-2014 and 2014-2015. Although the minimum wage was also increased at the end of 2012, 2013 and 2014, it is legitimate to consider these periods as "placebo" periods as the annual increase in the minimum wage in those years roughly followed the inflation rate (Figure 2). Therefore, no minimum wage

increase took place in real terms. The rationale behind these placebo tests is to pretend that the minimum wage hike was implemented at the beginning of 2013, 2014 and 2015 prior to its actual implementation. Finding significant and positive coefficients for these placebo periods would cast doubt on the validity of our identification strategy and suggest that our difference-in-difference estimates are capturing confounding factors that affect control and treatment cells differently.

Table 11 reports the magnitude and statistical significance of the difference-in-difference coefficients for the different placebo periods. The effect sizes of the placebos are about tenfold smaller than those estimated for the treatment period of 2015-2016, and statistically insignificant. This result is consistent across the different placebo periods, and the results are very similar in the specifications with or without control variables. This indicates that the relationship between the low paying status of cells highly exposed to the minimum wage hike and the likelihood to exit the formal sector shifted markedly right after the new minimum wage was implemented in 2016. This provides further comfort that our difference-in-difference estimates are not contaminated by pre-existing diverging trends between low-exposure and high exposure cells. In addition, this lack of effects in 2014-2015 in quarters immediately before the minimum wage hike also indicates that anticipation effects have not been at play.

6. Conclusion

In this paper, we have shown that a large and unexpected minimum wage hike in Turkey led to sizable flows of firms out of the formal sector, particularly for low-productivity firms. According to our estimates, the exit rate of firms out of the formal sector increased on average by 12 percent as a consequence of the 2016 increase in the national minimum wage. This finding implies that the 33 percent minimum wage increase, in nominal terms, could have contributed to the destruction of up to 130,000 formal jobs in 2016, either because of firms ceasing activities, or because of firms becoming unregistered and continuing activities only informally. The magnitude of the effect found (around 0.74% of total formal employment prior to the minimum wage hike) is substantial, as it corresponds to approximately one-third of the reduction in total formal job creation that took

place between 2015 and 2016.[14] Further, an idea of the magnitude of the effect can be given by the fact that total informal employment increased by 173,000 units between 2015 and 2016 (though, in this case, some of the informally employed can be new entrants into the labor market, rather than previously formally employed).

Those findings have important implications in contexts where policy makers are also devoting efforts and resources to reduce informality, which is the case of Turkey and many developing economies. They imply that, in a context where informal economic activities remain widespread, the intended effects of a minimum wage increase on workers' welfare can be partly offset by firms moving out from the formal sector, and by the resulting losses in formal jobs. While total registered employment has noticeably dropped following the minimum wage hike, total employment kept rising according to Household Labor Force Survey data. This indicates that the exit of firms from the formal sector was accompanied by a reallocation of employment from the formal to the informal sector of the economy. In parallel, the HLFS shows a drop in the rate of compliance with the new minimum wage post-2015, suggesting that the reallocation of labor from formal to the informal was indeed accompanied by lower wages compared to a counterfactual where firms would have kept operating formally. This corroborative evidence is consistent with firms moving from the formal sector to the informal economy as a response to the minimum wage hike, rather than shutting down their activity. Overall, this paper also represents an important empirical contribution to the research area that seeks to assess the effects of changes in the minimum wage, in the presence of a unique national minimum wage, binding for all workers and firms.

[14] According to the Turkish Household Labor Force Survey data, formal employment creation declined from about 819,000 in 2015 to about 411,000 in 2016.

References

Aaronson, D. 2001. Price pass-through and the minimum wage. The Review of Economics and Statistics, 83(1): 158–169.

Aaronson, D., and E. French. 2007. Product market evidence on the employment effects of the minimum wage. Journal of Labor Economics, 25(1): 167–200.

Aaronson, D., E. French., I. Sorkin and T. To. 2017. Industry dynamics and the minimum wage: A Putty-Clay approach. International Economic Review, 59(1): 51–84.

Alaniz, E., T. Gindling, and K. Terrell. 2011. The impact of minimum wages on wages, work and poverty in Nicaragua. Labour Economics, 18(S1): S45–S59.

Allegretto, S. and M. Reich. 2018. Are local minimum wages absorbed by price increases? Estimates from internet-based restaurant menus. ILR Review, 71(1): 35-63.

Autor, D. 2003. Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing. Journal of Labor Economics, 21, 1–42.

Bhorat, H., R. Kanbur, and N. Mayet. 2013. The impact of sectoral minimum wage laws on employment, wages, and hours of work in South Africa. IZA Journal of Labor & Development, 2(1): 1–27.

Bell, B. and S. Machin. 2018. Minimum wages and firm value. Journal of Labor Economics 36(1): 159–195.

Bird, K. and C. Manning. 2008. Minimum wages and poverty in a developing country: Simulations from Indonesia's household survey. World Development, 36(5):916–933.

Caliendo, M., A. Fedorets, M. Preuß, C. Schröder, and L. Wittbrodt, 2017. The short-run employment effects of the German minimum wage reform. IZA Discussion Papers 11190, Institute for the Study of Labor (IZA).

Card, D. 1992. Using regional variation in wages to measure the effects of the federal minimum wage. Industrial and Labor Relations Review, 46 (1):22–37.

Card D, and A. Krueger. 1995. Myth and Measurement: The New Economics of the Minimum Wage. Princeton University Press.

Comola, M. and L.D. Mello. 2011. How does decentralized minimum wage setting affect employment and informality? The case of Indonesia. Review of Income and Wealth, 57(S1): S79–S99.

De Janvry, A. and E. Sadoulet. 1995. Household modeling for the design of poverty alleviation strategies. Revue d'Economie du Développement, 3:3–23.

Del Carpio, X., J. Messina, and A. Sanz-de-Galdeano. 2014. Minimum wage: Does it improve welfare in Thailand? IZA Discussion Papers 7911, Institute for the Study of Labor (IZA).

Del Carpio, Ximena V. and L. M. Pabon. 2017. Implications of Minimum Wage Increases on Labor Market Dynamic: Lessons for Emerging Economies. Policy Research Working Paper 8030. World Bank, Washington, DC.

Devereux, S. 2005. Can minimum wages contribute to poverty reduction in poor countries? Journal of International Development, 17(7):899–912.

Draca, M., Machin, S. and J. van Reenen. 2011. Minimum wages and firm profitability. American Economic Journal: Applied Economics, 3(1): 129–151

Gindling, T. and K. Terrell. 2005. The effect of minimum wages on actual wages in formal and informal sectors in Costa Rica. World Development, 33(11):1905–1921.

Gindling T and K. Terrell. 2007. The effects of multiple minimum wages throughout the labour market: The case of Costa Rica. Labour Economics, 14(3):485–511.

Gindling, T. and K. Terrell. 2010. Minimum wages, globalization, and poverty in Honduras. World Development, 38(6):908–918.

Hau, H, Y. Huang ad G. Wang. 2016. Frim response to competitive shocks: Evidence from China's minimum wage policy. Swiss Finance Institute Research Paper Series, 16-47.

Khamis, M. 2013. Does the minimum wage have a higher impact on the informal than on the formal labour market? Evidence from quasi-experiments. Applied Economics, 45(4):477–495.

Luca, D. L. and M. Luca. 2017. Survival of the fittest: The impact of the minimum wage on firm exit. Harvard Business School Working Papers 17-088, Harvard Business School, revised Mar 2018.

Lemos, S. 2008. A survey of the effects of the minimum wage on prices. Journal of Economic Surveys, 22(1):187–212.

Lemos, S. 2009. Minimum wage effects in a developing country. Labour Economics, 16(2): 224–237.

Loayza, N. V. and J. Rigolini. 2006. Informality trends and cycles. Policy Research Working Paper Series 4078, The World Bank.

Lustig, N. and D. McLeod. 1997. Minimum wages and poverty in developing countries: Some empirical evidence. In Edwards., S. and Lustig, N., editors, Labor Markets in Latin America. Brookings Institution Press.

Machin, S., A. Manning and L. Rahman. 2003. Where the minimum wage bites hard: Introduction of minimum wages to a low wage sector. Journal of the European Economic Association, MIT Press, 1(1): 154–180.

Mayneris, F., S. Poncet, and T. Zhang, 2018. Improving or disappearing: Firm-level adjustments to minimum wages in China. Journal of Development Economics, 135, 20-42.

Maloney, W. and J. Mendez. 2004. Measuring the impact of minimum wages. Evidence from Latin America. In Law and Employment: Lessons from Latin America and the Caribbean, NBER Chapters, pages 109-130. National Bureau of Economic Research, Inc.

Meghir C., Narita R. and J.M. Robin. 2015. Wages and informality in developing countries, American Economic Review, 105(4): 1509–1546.

Metcalf, D. 2008. Why has the British national minimum wage had little or no impact on employment? Journal of Industrial Relations, 50(3): 489–512.

Rohlin, S. M. 2011. State minimum wages and business location: Evidence from a refined border approach. Journal of Urban Economics, 69(1): 103–17.

Riley, R. and C. Rosazza-Bondibene 2017. Raising the standard: Minimum wages and firm productivity. Labour Economics, 44:27–50.

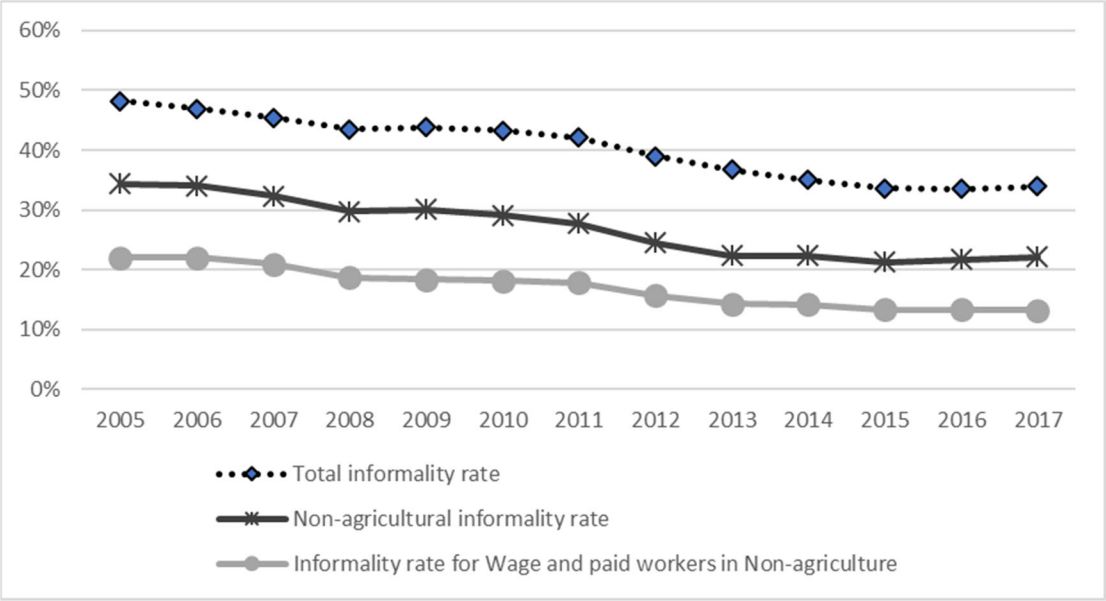
Saget, C. 2001. Poverty reduction and decent work in developing countries: Do minimum wages help? International Labour Review, 140(3):237–269.

Stewart, M. 2002. Estimating the impact of the minimum wage using geographical wage variation. Oxford Bulletin of Economics and Statistics, 64, 583–605.

Stigler, G. 1946. The economics of minimum wage legislation. The American Economic Review, 36(3): 358–365.

Figures

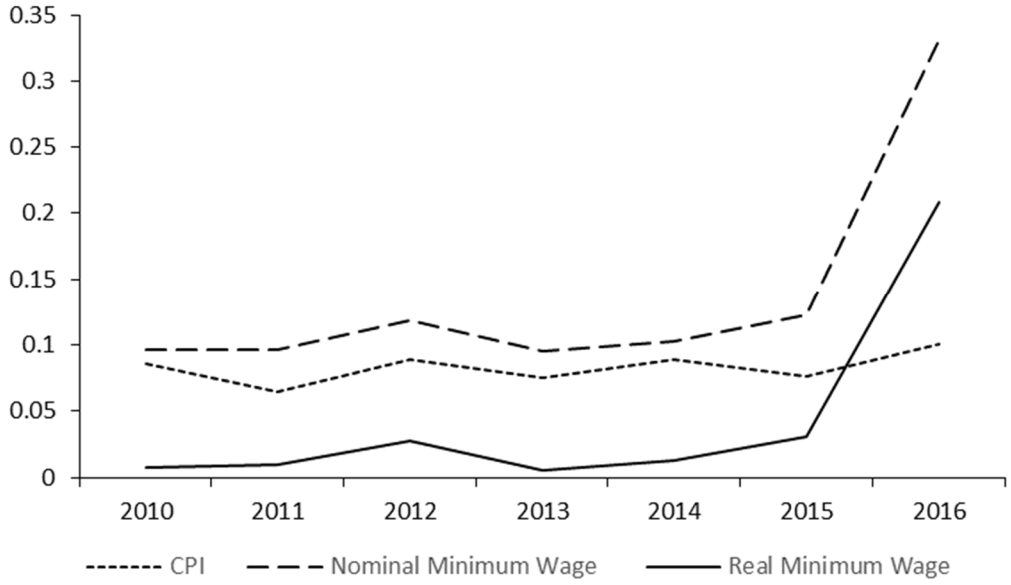
Figure 1: Share of informal employment in Turkey, 2005-2017



Source: Authors' calculations based on Household Labor Force Survey (HLFS); TurkStat

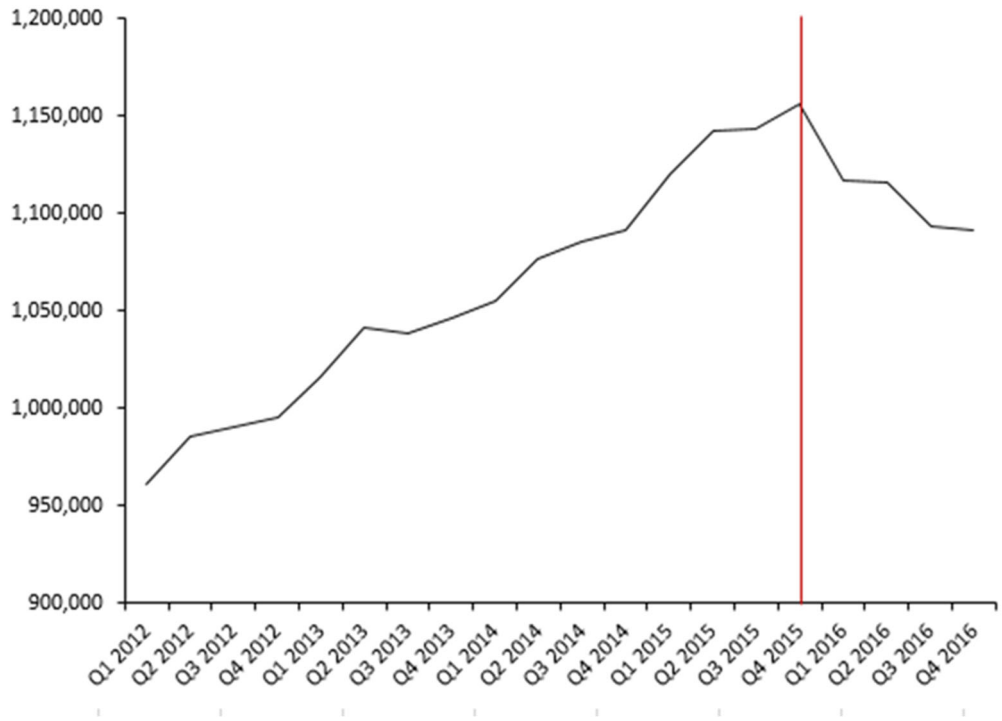
Note. Employment is categorized as informal if the worker is not registered with the Turkish Social Security Authority.

Figure 2: Annual growth rate of the minimum wage and CPI: 2010-2016



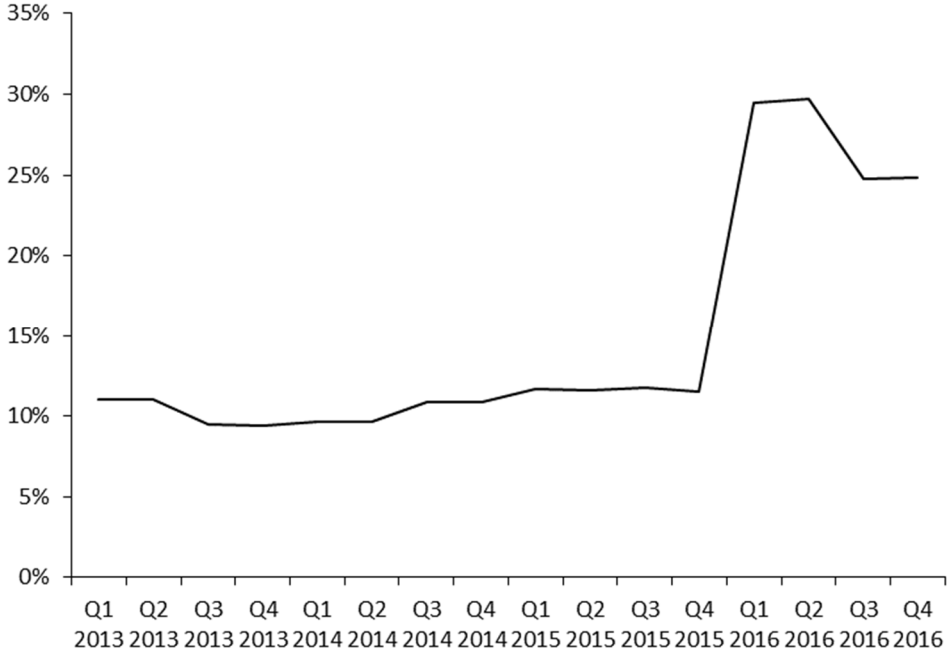
Source. Turkish Statistics Institute (TurkStat)

Figure 3: Number of registered firms with at least one employee in Turkey: 2012-2016



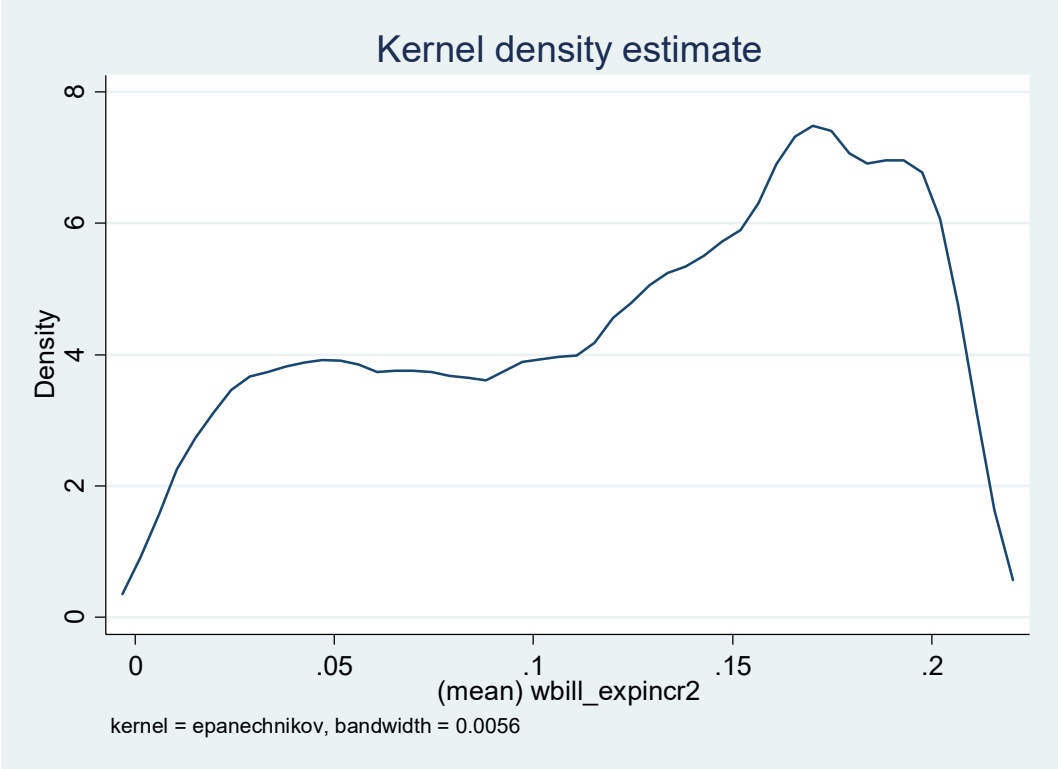
Source. Enterprise Information System (EIS)

Figure 4: Annual nominal wage growth among registered firms



Source. Enterprise Information System (EIS)

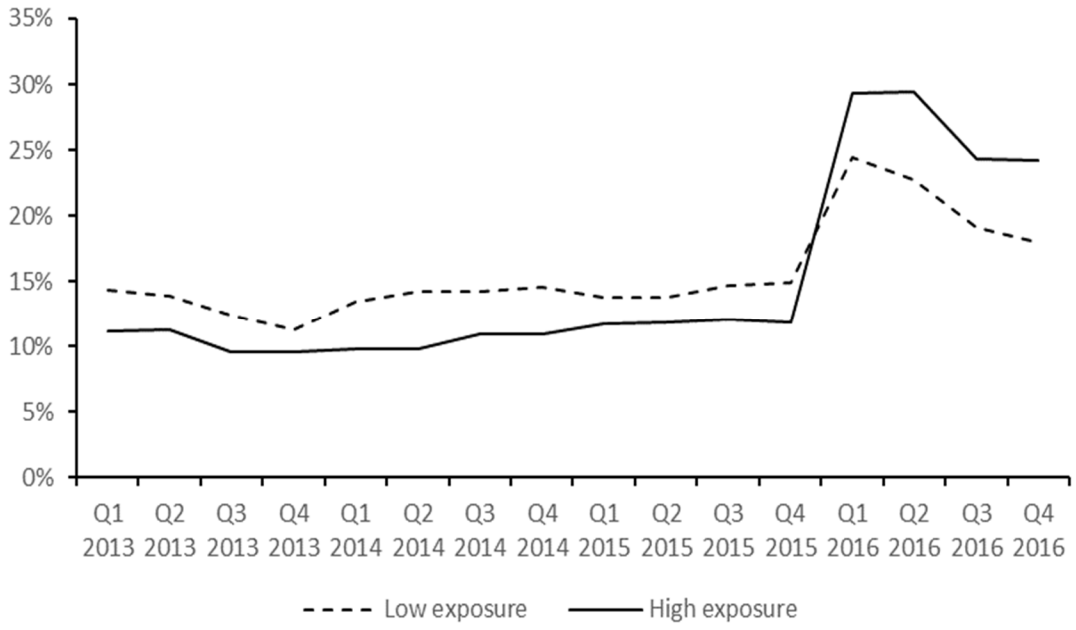
Figure 5: Density distribution of exposure to the minimum wage at the cell level



Source. Enterprise Information System (EIS)

Note. Exposure to the minimum wage hike is measured in the 4th quarter of 2015 as the proportional increase in the wage bill required to bring all workers in the cell up to the new 2016 minimum wage.

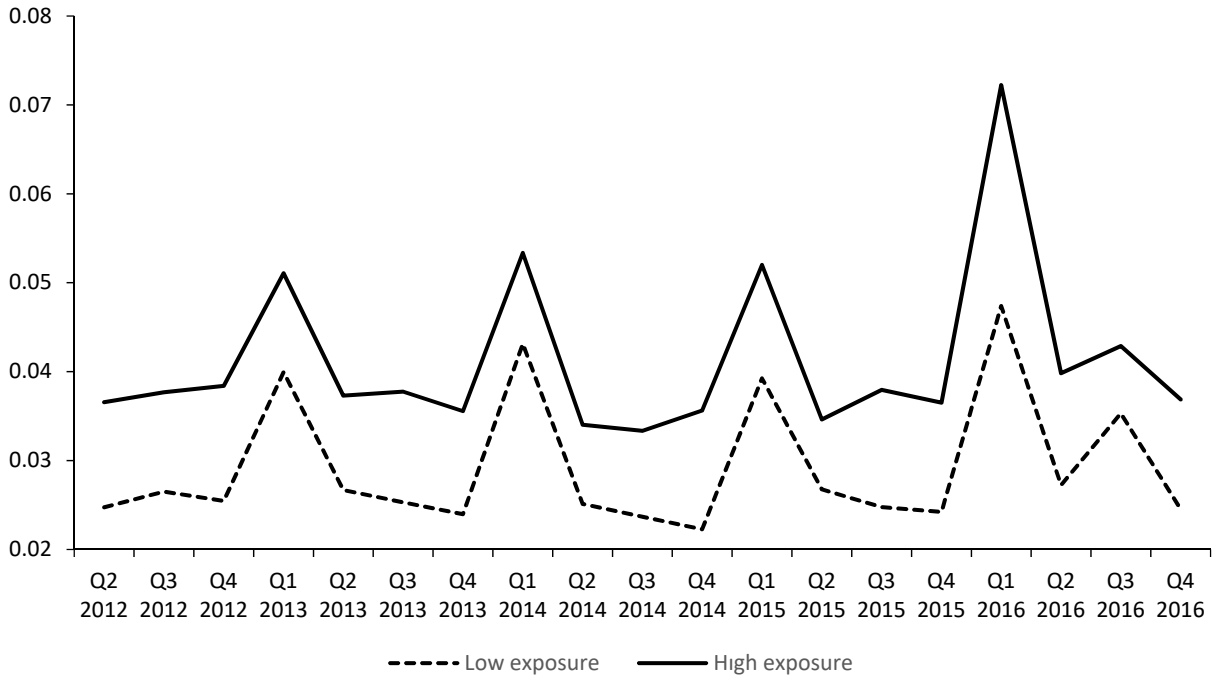
Figure 6: Annual nominal wage growth, by level of exposure to the minimum wage hike at the cell level



Source. Enterprise Information System (EIS)

Note. Exposure to the minimum wage hike is measured in the 4th quarter of 2015 as the proportional increase in the wage bill required to bring all workers in the cell up to the new minimum wage. Cells are classified as "high exposure" if the cells' measure of exposure to the minimum wage is above the median for our sample of cells, and as "low exposure" otherwise.

Figure 7: Quarterly cell-level exit rates of registered firms before and after the minimum wage hike, by treatment status



Source. Enterprise Information System (EIS)

Note. Exposure to the minimum wage hike is measured in the 4th quarter of 2015 as the proportional increase in the wage bill required to bring all workers in the cell up to the new minimum wage. Cells are classified as "high exposure" if the cells' measure of exposure to the minimum wage is above the median for our sample of cells, and as "low exposure" otherwise.

Tables

Table 1. Descriptive statistics in registered firms, 2015

	By Firm size (number of employees)			
	<10	10 to 49	50+	All
Share of registered firms	83.7	13.5	2.8	100
Total number of registered firms	967,124	156,137	32,357	1,155,618
Share of total employment	21.2	24.8	54	100
Total employment	2,675,972	3,137,173	6,813,493	12,626,638
Mean number of employees	2.8	20.1	210.6	10.9
Mean daily wage	48	58	83	69
Share of workers paid below 1.02*MW	91	71	44	87
Mean firm age (based on starting operation date)	7.3	7.4	7.9	7.3
Agriculture (%)	0.7	0.74	0.47	0.7
Manufacturing (%)	16.2	24.7	35.3	17.9
Other Industry (non-manufacturing), %	8.6	16.5	15.1	9.8
Wholesale and retail trade (%)	38.3	25.3	15.1	35.9
Other services (%)	36.3	32.8	34.1	35.7
Total	100.0	100.0	100.0	100.0
Number of firms				
Agriculture	6,750	1,160	152	8,062
Manufacturing	156,984	38,513	11,410	206,907
Other Industry (non-manufacturing)	82,787	25,766	4,879	113,432
Wholesale and retail trade	369,972	39,563	4,893	414,428
Other services	350,631	51,135	11,023	412,789
Total	967,124	156,137	32,357	1,155,618
Total employment				
Agriculture	18,926	22,340	19,528	60,794
Manufacturing	491,591	834,295	2,356,057	3,681,943
Other Industry (non-manufacturing)	283,910	512,617	853,155	1,649,682
Wholesale and retail trade	971,528	756,338	949,715	2,677,581
Other services	910,017	1,011,583	2,635,038	4,556,638
Total	2,675,972	3,137,173	6,813,493	12,626,638

Table 2. Cell characteristics by level of exposure, before and after the minimum wage hike

	Before (2012-2015)			After (2016)		
	Low exposure cells	High exposure cells	All cells	Low exposure cells	High Exposure cells	All cells
	(1)	(2)	(3)	(5)	(5)	(6)
Number of firms in the cell	274.8	198	235.7	271.6	199.2	234.7
	(464.2)	(274.2)	(380.5)	(453.6)	(295.6)	(372.1)
Firm size	39.4	5.7	10.5	40.2	5.6	11.1
	(235.8)	(18.0)	(93.7)	(267.8)	(18.7)	(109.5)
Daily wage	60.2	37.1	40.4	86.3	55.9	61.2
	(36.7)	(5.8)	(18.3)	(47.7)	(5.5)	(23.8)
Firm age	6.8	7.6	7.4	7.2	8.1	7.9
	(3.2)	(2.7)	(2.8)	(3.4)	(2.8)	(3.0)
Cell exposure to minimum wage hike	0.074	0.174	0.124	0.074	0.174	12.4%
	(0.037)	(0.021)	(0.059)	(0.037)	(0.124)	(0.059)
Exit rate	0.033	0.040	0.036	0.042	0.052	0.047
	(0.022)	(0.025)	(0.024)	(0.027)	(0.031)	(0.03)
Distribution of firms by sector of activity						
Share of agicultural firms	1%	0%	1%	1%	0%	0%
Share of manufacturing firms	21%	18%	18%	21%	18%	18%
Share of other industry firms	10%	9%	9%	10%	10%	10%
Share of wholesale & retail	34%	39%	39%	32%	38%	36%
Share of other services	35%	34%	34%	36%	34%	35%
Total	100%	100%	100%	100%	100%	100%
Number of cell-quarrter observations	28,821	28,897	57,685	7,444	7,610	15,062

Notes. A cell refers to the set of firms operating in a given industry (2 digit) in a given district of Turkey. Cells are included in the sample if they consist of at least 50 firms. Cells are categorized as low exposure if their measure of exposure to the minimum wage hike is below or equal to the sample median (13.8%), and as high exposure if it is above the sample median. Exposure is calculated as the proportional increase in the wage bill in the cell if all workers paid below the new minimum wage prior to the hike are brought to the new minimum wage after the hike.

Table 3. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, baseline results

Discrete treatment	**Years: 2015-2016**							
Dependent variable: exit rate	**All cells**		**Balanced Panel**		**Excluding very low exposure**		**Excluding very high exposur**	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0018***	0.0020***	0.0014***	0.0016***	0.0019***	0.0020***	0.0017***	0.0020***
(t-stat)	3.73	4.05	3.61	2.73	3.07	3.53	4.58	4.72
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	31,108	30,938	30,982	30,812	28,628	28,475	28,807	28,645

Discrete treatment	**Years: 2012-2016**							
Dependent variable: exit rate	**All cells**		**Balanced Panel**		**Excluding very low exposure**		**Excluding very high exposur**	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0026***	0.0028***	0.0020***	0.0021***	0.0028***	0.0029***	0.0024***	0.0026***
(t-stat)	6.17	6.67	3.91	4.59	6.4	6.95	5.59	6.05
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	73,729	73,409	73,584	73,264	67,831	67,540	68,592	68,288

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include the average firm size in the cell, the average firm age, regional dummies, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). The discrete treatment dummy takes the value one if the cells' continuous measure of exposure to the minimum wage is above the median for our sample of cells. Cells are included in the sample if they consist of at least 50 firms. Balanced panel include only cells that have at least 50 firms in all quarters from 2012 to 2016. Very low-exposure cells are defined as cells with treatment exposure under 3%. Very high exposure cells are defined as cells with treatment exposure over 20%.

Table 4. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, baseline results

Continuous treatment	Years: 2015-2016							
Dependent variable: exit rate	All cells		Balanced Panel		Excluding very low exposure		Excluding very high exposure	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0135***	0.0150***	0.0106**	0.0120***	0.0154***	0.0160***	0.0132***	0.0147***
(t-stat)	3.23	3.63	2.39	2.71	3.49	3.71	2.79	3.12
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	31,108	30,938	30,982	30,812	28,628	28,475	28,807	28,645

Continuous treatment	Years: 2012-2016							
Dependent variable: exit rate	All cells		Balanced Panel		Excluding very low exposure		Excluding very high exposure	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0214***	0.0242***	0.0201***	0.0214***	0.0244***	0.0270***	0.0204***	0.0229***
(t-stat)	5.98	6.83	5.28	5.64	5.3	6.54	4.95	5.62
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	73,729	73,409	73,584	73,264	67,831	67,540	68,592	68,288

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms. Balanced panel include only cells that have at least 50 firms in all quarters from 2012 to 2016. Very low-exposure cells are defined as cells with treatment exposure under 3%. Very high exposure cells are defined as cells with treatment exposure over 20%.

Table 5. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by average firm size

Discrete treatment	Years: 2015-2016					
Dependent variable: exit rate	By average firm size in the cell					
of firms in the cell	below 5 employees		between 5 and 10		Above 10	
	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0036***	0.0031***	0.0000	0.0002	0.0017	0.0015
(t-stat)	3.23	2.81	0.05	0.32	1.48	1.38
Controls	no	yes	no	yes	no	yes
N (sample size)	11,143	11,143	9,907	9,907	8,941	8,941

Discrete treatment	Years: 2012-2016					
Dependent variable: exit rate	By average firm size in the cell					
of firms in the cell	below 5 employees		between 5 and 10		Above 10	
	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0027***	0.0028***	0.0007	0.0009	0.0022**	0.0020**
(t-stat)	2.82	2.97	0.098	1.26	2.2	2.06
Controls	no	yes	no	yes	no	yes
N (sample size)	27,117	27,117	23,214	23,214	20,331	20,331

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services).. Cells are included in the sample if they comprise of at least 50 firms. Small firm cells are defined as having an average firm size below 5 employees. Medium firm cells are defined as having an average firm size between 5 and 10 employees. Large firm cells are defined as having an average firm size above 10 employees.

Table 6. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by average firm size

Continous treatment	**Years: 2015-2016**					
Dependent variable: exit rate	**By average firm size in the cell**					
of firms in the cell	**below 5 employees**		**between 5 and 10**		**Above 10**	
	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0247*	0.0183	-0.0084	-0.0073	0.0195**	0.0192**
(t-stat)	1.87	1.41	1.9	1.97	2.43	2.43
Controls	no	yes	no	yes	no	yes
N (sample size)	11,143	11,143	9,907	9,907	8,941	8,941

Continous treatment	**Years: 2012-2016**					
Dependent variable: exit rate	**By average firm size in the cell**					
of firms in the cell	**below 5 employees**		**between 5 and 10**		**Above 10**	
	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0195*	0.0206*	-0.0009	0.0013	0.0238**	0.0237**
(t-stat)	0.97	1.71	-0.11	0.16	3.38	3.46
Controls	no	yes	no	yes	no	yes
N (sample size)	27,117	27,117	23,214	23,214	20,331	20,331

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms. Small firm cells are defined as having an average firm size below 5 employees. Medium firm cells are defined as having an average firm size between 5 and 10 employees. Large firm cells are defined as having an average firm size above 10 employees.

Table 7. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by sector of activity

Discrete treatment	**Years: 2015-2016**							
Dependent variable: exit rate	**All cells**							
of firms in the cell	**Manufacturing**		**Other industry**		**Wholesale& retail**		**Other services**	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	-0.0013	-0.0010	0.0016	0.0015	0.0021**	0.0021**	0.0007	0.0014
(t-stat)	-1.08	-0.89	1.15	1.11	2.72	2.7	0.88	1.77
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	6,966	6,941	3,353	3,347	7,664	7,664	12,999	12,986

Discrete treatment	**Years: 2012-2016**							
Dependent variable: exit rate	**All cells**							
of firms in the cell	**Manufacturing**		**Other industry**		**Wholesale& retail**		**Other services**	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	-0.0004	0.0000	0.0024**	0.0024**	0.0024***	0.0024***	0.0008	0.0016*
(t-stat)	-0.4	-0.1	2.11	2.15	3.64	3.24	1.16	2.17
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	16,146	16,104	7,668	7,659	17,612	17,612	28,743	28,722

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.

Table 8. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by sector of activity

Continous treatment	Years: 2015-2016							
Dependent variable: exit rate	All cells							
of firms in the cell	Manufacturing		Other industry		Wholesale& retail		Other services	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0011	0.0027	0.0051	0.0047	0.0202**	0.0202**	0.0008	0.0066
(t-stat)	0.13	0.3	0.29	0.27	2.5	2.56	0.22	0.99
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	6,966	6,941	3,353	3,347	7,664	7,664	12,999	12,986

Continous treatment	Years: 2012-2016							
Dependent variable: exit rate	All cells							
of firms in the cell	Manufacturing		Other industry		Wholesale& retail		Other services	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Diff-in-diff coefficient	0.0123*	0.0154**	0.0210	0.0212	0.0248***	0.0243***	0.0022	0.0082
(t-stat)	1.67	2.1	1.52	1.53	3.66	3.55	0.39	1.54
Controls	no	yes	no	yes	no	yes	no	yes
N (sample size)	16,146	16,104	7,668	7,659	17,612	17,612	28,743	28,722

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.

Table 9. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by labor productivity levels in the cell

Discrete treatment	Years: 2015-2016									
Dependent variable: exit rate	All cells									
of firms in the cell	Q1		Q2		Q3		Q4		Q5	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Diff-in-diff coefficient	0.0034**	0.0036***	0.0016	0.0014	0.0018	0.0019	0.0014	0.0015	0.0018	0.0019
(t-stat)	2.34	2.49	1.1	0.09	1.29	1.4	1.17	1.21	1.37	1.34
Controls	no	yes	no	yes	no	yes	no	yes	no	yes
N (sample size)	3,598	3,598	3,619	3,619	3,504	3,504	3,512	3,512	3,441	3,441

Discrete treatment	Years: 2012-2016									
Dependent variable: exit rate	All cells									
of firms in the cell	Q1		Q2		Q3		Q4		Q5	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Diff-in-diff coefficient	0.0046***	0.0047***	0.0030**	0.0029**	0.002	0.0019	0.0019	0.0018	0.0018	0.0020*
(t-stat)	3.59	3.71	2.5	2.44	1.62	1.55	2.24	2.18	1.56	2.78
Controls	no	yes	no	yes	no	yes	no	yes	no	yes
N (sample size)	8,343	8,343	8,307	8,307	8,367	8,367	8,311	8,311	8,075	8,075

Notes: *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms. Q1 to Q5 refer. to the productivity quintile the cell belongs to, as measured by the average labor productivity of firms in the cell in 2011, prior to the period of study. Q1 refers to the bottom productivity quintile while Q5 refers to the top productivity quintile. The number of cells with available productivity measures is lower than for the full sample used for other estimations, as productivity can only be calculated for the subset of firms that are mandated to report their balance sheet by law.

Table 10. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by labor productivity levels in the cell

Continous treatment	**Years: 2015-2016**									
Dependent variable: exit rate	**All cells**									
of firms in the cell	**Q1**		**Q2**		**Q3**		**Q4**		**Q5**	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Diff-in-diff coefficient	0.0282**	0.0308**	0.0289**	0.0279**	0.0133	0.0120	0.0231**	0.0237**	0.0052	0.0080
(t-stat)	1.84	1.9	2.26	2.18	1.08	0.99	2.35	2.41	0.34	0.52
Controls	no	yes	no	yes	no	yes	no	yes	no	yes
N (sample size)	2,967	2,962	3,383	3,380	4,578	4,577	4,872	4,865	2,444	2,441

Continous treatment	**Years: 2012-2016**									
Dependent variable: exit rate	**All cells**									
of firms in the cell	**Q1**		**Q2**		**Q3**		**Q4**		**Q5**	
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Diff-in-diff coefficient	0.0384***	0.0413***	0.0481***	0.0505***	0.0246**	0.0211**	0.0185**	0.0181**	0.0103	0.0129
(t-stat)	2.75	2.96	4.1	4.34	2.47	2.14	2.19	2.15	0.8	0.96
Controls	no	yes	no	yes	no	yes	no	yes	no	yes
N (sample size)	6,705	6,696	7,614	7,610	10,388	10,386	11,191	11,184	5,554	5,546

Notes: *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms. Q1 to Q5 refer. to the productivity quintile the cell belongs to, as measured by the average labor productivity of firms in the cell in 2011, prior to the period of study. Q1 refers to the bottom productivity quintile while Q5 refers to the top productivity quintile. The number of cells with available productivity measures is lower than for the full sample used for other estimations, as productivity can only be calculated for the subset of firms that are mandated to report their balance sheet by law.

Table 11. Difference in difference estimation of Placebo effects on firms' exit rates in pre-treatment periods.

Discrete treatment	**Years: 2012-2013**		**Years: 2013-2014**		**Years: 2014-2015**	
Dependent variable: exit rate	**All cells**		**All cells**		**All cells**	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0006	0.0005	0.0004	0.0004	0.0002	-0.0001
(t-stat)	1.17	0.341	0.89	0.346	0.44	-0.13
Controls	no	yes	no	yes	no	yes
N (sample size)	24,471	24,393	29,085	28,966	30,522	30,363

Continous treatment	**Years: 2012-2013**		**Years: 2013-2014**		**Years: 2014-2015**	
Dependent variable: exit rate	**All cells**		**All cells**		**All cells**	
of firms in the cell	[1]	[2]	[3]	[4]	[5]	[6]
Diff-in-diff coefficient	0.0032	0.0024	0.0020	0.0023	0.0044	0.0031
(t-stat)	0.73	0.55	0.49	0.57	1.03	0.75
Controls	no	yes	no	yes	no	yes
N (sample size)	24,471	24,393	29,085	28,966	30,445	30,286

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.

Appendix

Table A1. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by Turkish region (Nuts 1)

Discrete treatment	**Years: 2015-2016**											
Dependent variable: exit ra	**All cells**											
of firms in the cell	**Istanbul**	**West Marmara**	**Aegean**	**East Marmara**	**West Anatolia**	**Mediter raenan**	**Central Anatolia**	**West black sea**	**East black sea**	**Northeast Anatolia**	**Central East Anatolia**	**Southeast Anatolia**
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	(11)	(12)
Diff-in-diff coefficient	0.0004	0.0008	0.0026**	0.0020	0.0027*	0.0042***	0.0017	0.0015	-0.0053	0.0210***	0.0041	-0.0011
(t-stat)	0.34	0.31	2.12	1.43	1.78	2.78	0.65	0.58	-1.36	8.68	0.71	-0.41
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N (sample size)	8,267	1,365	4,847	3,284	2,514	3,560	1,190	1,529	845	404	607	1,516

Discrete treatment	**Years: 2012-2016**											
Dependent variable: exit ra	**All cells**											
of firms in the cell	**Istanbul**	**West Marmara**	**Aegean**	**East Marmara**	**West Anatolia**	**Mediter raenan**	**Central Anatolia**	**West black sea**	**East black sea**	**Northeast Anatolia**	**Central East Anatolia**	**Southeast Anatolia**
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	(11)	(12)
Diff-in-diff coefficient	0.0012	-0.0002	0.0031***	0.0028***	0.0043***	0.0041***	0.001	0.002	-0.0040	0.019**	0.0027	0.0150
(t-stat)	1.28	-0.14	2.99	2.17	3.25	3.13	0.43	1.12	-1.27	2.61	0.66	0.521
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N (sample size)	19,928	3,196	11,325	7,705	6,067	8,346	2,734	3,639	1,924	975	1,326	3,497

Notes: *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.

Table A2. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by Turkish region (Nuts 1)

Continous treatment	Years: 2015-2016											
Dependent variable: exit rate	All cells											
of firms in the cell	Istanbul	West Marmara	Aegean	East Marmara	West Anatolia	Mediterraenan	Central Anatolia	West black sea	East black sea	Northeast Anatolia	Central East Anatolia	Southeast Anatolia region
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	(11)	(12)
Diff-in-diff coefficient	0.0058	-0.0022	0.0233*	0.0256**	0.0127	0.0483***	-0.0002	0.0339	-0.0384	0.1048	0.0162	-0.0348
(t-stat)	0.66	-0.75	1.86	2.11	1	2.99	-0.1	1.09	-0.96	1.47	0.26	-1.23
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N (sample size)	8,267	1,365	4,847	3,284	2,514	3,560	1,190	1,529	845	404	607	1,516

Continous treatment	Years: 2012-2016											
Dependent variable: exit rate	All cells											
of firms in the cell	Istanbul	West Marmara	Aegean	East Marmara	West Anatolia	Mediterraenan	Central Anatolia	West black sea	East black sea	Northeast Anatolia	Central East Anatolia	Southeast Anatolia region
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	(11)	(12)
Diff-in-diff coefficient	0.0154**	-0.0128	0.0312***	0.0348***	0.0305***	0.0437***	-0.0027	0.037	-0.0478	0.0646	0.0002	-0.0164
(t-stat)	2.17	-0.56	3.07	2.99	2.81	3.23	-0.14	2.42	-1.42	0.76	0	-0.703
Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
N (sample size)	19,928	3,196	11,325	7,705	6,067	8,346	2,734	3,639	1,924	975	1,326	3,497

Notes: *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.

Table A3. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, Large urban centers only

Dependent variable: exit rate of firms in the cell	Years: 2015-2016							
	Provinces with large urban centers				Other provinces			
	Binary treatment		Continuous treatment		Binary treatment		Continuous treatment	
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
Diff-in-diff coefficient	0.0011	0.0014*	0.0091*	0.0114**	0.0019**	0.0018**	0.0109	0.0106
(t-stat)	1.53	1.97	1.50	1.95	2.26	2.16	1.34	1.30
Controls	no	yes	no	yes	yes	no	yes	no
N (sample size)	16,306	16,306	16,306	16,306	13,160	13,415	12,820	12,225

Dependent variable: exit rate of firms in the cell	Years: 2012-2016							
	Provinces with large urban centers				Other provinces			
	Binary treatment		Continuous treatment		Binary treatment		Continuous treatment	
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
Diff-in-diff coefficient	0.0023***	0.0027***	0.0206***	0.0248***	0.0021***	0.0021**	0.0150*	0.0140**
(t-stat)	3.78	4.49	4.18	5.10	3.00	3.08	2.31	2.37
Controls	no	yes	no	yes	yes	no	yes	no
N (sample size)	39,215	39,215	39,215	39,215	31,176	31,176	31,176	31,176

Notes. *: statistically significant at the 10% level; **: statistically significant at the 5% level; ***: statistically significant at the 1% level. Robust standard errors clustered at the cell level are used in all estimations. Control variables include year dummies, quarter dummies, region dummies, the average firm size in the cell, average firm age, broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services). Cells are included in the sample if they comprise of at least 50 firms.