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

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Abstract

This paper explores the effects of a large minimum wage hike on firm exits from the formal economy, and its associated impacts on employment and informality. It uses an exceptionally rich linked employer-employee dataset on the universe of formal firms and workers in a developing economy. Data on the full wage distribution in firms allows to precisely measure minimum wage exposure, and to estimate the causal effect of the hike in a difference-in-difference setting. The hike is found to significantly increase the destruction rate of formal firms. Effects are concentrated among small and low-productivity firms while exits of high-productivity firms are unaffected. The increase in firm exits is larger in industries with small profit margins, higher labor shares and stronger market competition. We also evidence negative effects on formal employment, which mainly originate from firm destruction rather than employment cuts in surviving firms. Corroborative evidence indicates that workers from exiting firms mostly transition into informal employment, instead of being jobless after the hike.

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Firm Destruction, Informality and the Minimum Wage

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1. Introduction

The minimum wage is an increasingly popular policy tool in both low and high-income countries. Studies for developing economies find that minimum wages boost labor income by increasing wages in the formal sector, and 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 impact of the minimum wage on earnings, 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).

As labor regulations are enforced to improve workers' welfare, firms - especially small ones which absorb a sizeable share of employment in developing countries - face increasing labor costs. When the minimum wage is binding, rising labor costs can affect the capacity of firms to employ workers or to even survive, by squeezing profit margins (Draca et al, 2011). In contexts where compliance with labor regulations is imperfect and informality is common, minimum wage hikes can also induce firms to employ workers "off the books" to avoid mandatory labor costs.[2] Minimum wage hikes could thus partly offset simultaneous efforts to reduce informality, a common priority among policy makers in developing economies.

The focus of this paper is on the effect of the minimum wage on formal firm destruction and its corresponding impacts on employment and informality.[3] To address this question, we exploit an extremely rich matched employer-employee data on the universe of registered firms and workers in the context of a developing economy. The dataset includes firms of all sizes in all sectors of

[2] According to the 17th International Conference of Labor Statisticians which sets international standards for informality measurement, informality has two dimensions. The first refers to the characteristics of the economic unit an individual is employed in: a business is categorized as informal if it lacks basic accounting registries or is not registered with tax authorities. The second dimension refers the characteristics of the job the individual is employed is. A job is informal if it lacks the benefits and institutional protection required by the legal framework in the country, regardless of whether the firm is formal or informal. Ulyssea (2018) refers to the first and second dimensions as the "extensive" and "intensive" margins of informality, respectively. Throughout this paper, we define "informal workers" as workers who are not registered with social security institutions, and "informal firms" as firms who are not registered with tax authorities or do not employ any formal worker.

activity in Turkey, which is quite rare among studies looking at firm-level responses to the minimum wage. The data also allows to distinguish between employment destruction due to firm exits from employment cuts in surviving firms, and to assess their respective contribution to total employment effects. Furthermore, the data allows to follow workers who were employed in exiting firms and to provide insights on labor reallocation after the minimum wage hike. Finally, by complementing administrative data with survey data sources, the paper also provides indicative evidence on whether the destruction of formal firms and employment primarily results from "pure" job destruction, or from firms now employing workers "off-the-books" in a context where informal employment remains common.

To estimate the causal effect of the minimum wage on firm exits from the formal economy, the paper takes advantage of a 33% increase in the nominal minimum wage in Turkey in January 2016. Compared to prior contributions, our rich employer-employee administrative dataset records the wages of all registered workers in each registered firm in the economy.[4] This allows to precisely measure exposure to the minimum wage hike, as the proportional increase in the wage bill needed to bring all workers in a given unit to the new statutory minimum wage (Draca et al, 2011). We then implement a difference-in-difference estimation where the change in exit rates of high-exposure units (treatment group) before and after the minimum wage hike is compared to that of low-exposure units (control group).

When looking at the effects of the minimum wage on formal firm destruction and informality, Turkey is a relevant country case to analyze for two main reasons. First, about half of workers employed in registered firms were paid at the minimum wage prior to the 2016 minimum wage hike. The minimum wage is thus binding for large proportion of workers and firms, especially small businesses. As a result, any minimum wage increase translates into increased labor costs for formal firms and can trigger adjustment responses. Second, despite a strong decline in informality in the past decade, about a third of total wage employment in the Turkish economy remains

[4] Due to data limitations, prior studies such as Draca at al. (2011) or Mayneris et al. (2018) measure exposure based on the average wage of workers in the firm. Harasztosi and Lindner (2019) use the firm-level fraction of the workers below the new minimum wage.

informal (Figure 1). Operating informally, primarily by employing workers "off-the-books", thus remains a possibility for firms.[5]

Overall, we find that the destruction of formal firms was significantly increased by the minimum wage hike. The magnitude of the effect is sizeable: the minimum wage hike increased exit rates of registered firms by about 10%, and the magnitude of the estimates is robust to alternative specifications, sample restrictions, ant treatment exposure measures. Those effects, however, are primarily concentrated among small and low-productivity firms that were marginally above subsistence levels before the hike. We also find that market conditions matter for the effects of the hike on firm destruction: the rise in firm exits attributable to the minimum wage is stronger in industries with small profit margins, higher labor shares and stronger market competition.

We then link our findings on the exit of low-performing firms to employment effects for workers. Overall, we find a negative and significant effect of the minimum wage on formal employment, one year after the hike. We then distinguish between employment effects originating from formal employment cuts in surviving firms (intensive margin) from those due to firm exits (extensive margin). We find that aggregate employment effects are mostly driven by firms exiting the formal economy, rather than cuts in formal employment among surviving firms. Looking at the transitions of workers employed in exiting firms, we find that a minority had found another formal job one year after the hike, which helps explain the negative employment effects associated with firm exits.

Finally, we provide indicative evidence on whether the destruction of formal firms and formal employment originates from pure firm closure and job loss or, instead, from transitions into informality. This distinction is important with respect to workers' welfare, but also because curbing informality is a common policy priority in developing economies. To investigate this question, we complement our administrative dataset on the universe of formal firms and workers with national household survey data that captures informal employment and employers. Overall,

[5] In the Turkish context, the costs of workers' registration tend to be high while enforcement is weak while the cost of firm-level registration is low and enforcement is strong (Taymaz, 2014). As a result, informality mainly takes place through the lack of registration of workers with social security as opposed to a lack of firm-level registration with tax authorities

this descriptive evidence suggests that the decline in registered employment was mostly driven by workers moving to informal employment, rather than pure job losses.

By focusing on an under-explored firm response mechanism in the context of a developing economy, the paper contributes to the literature on firm adjustment mechanisms to the minimum wage. Although the literature on firm responses other than employment cuts has been growing in recent years, it remains thin, especially for developing economies. In high-income country settings, the literature has been looking at the effect of the minimum wage on firm profitability (Draca et al., 2011), stock market value (Bell and Machin, 2018), firm productivity (Rosazza-Bondibene, 2017), firm location (Rohlin, 2011), firm entries and exits (Aaronson et al., 2017), and consumer prices (Aaronson 2001, Aaronson and French 2007, Lemos 2008, Allegretto and Reich 2018). Harasztosi and Lindner (2019) also look at the effects of a minimum wage hike in Hungary on a wide range of firm responses. In the context of developing economies, evidence on the minimum wage impact on firms' adjustment mechanisms other than employment is very sparse. A recent exception is Mayneris et al. (2018) which focus on the impact of a minimum wage hike on value added, productivity and profits in China. Hau et al. (2016) also examine the substitution of labor for capital by Chinese firms in response to the minimum wage.

Our paper is one the first to estimate the causal impact of the minimum wage on formal firm destruction in the context of a developing economy, together with its effects on employment and informality.[6] Two prior contributions by Aaronson et al. (2018) and Luca and Luca (2019) explore the effects of the minimum wage on firm exits in restaurant industry in the US. In contrast, our paper investigates the effect of the minimum wage on formal firm destruction in all sectors of a developing economy where informality in also common.

Compared to prior work on firm-responses to the minimum wage, this paper uses data on firms of all sizes and in all sectors of the economy.[7] Observing micro and small firms is critical when

[6] Although this is not the primary focus of their paper, Mayneris et al. (2018) have also evidenced a decline in survival rates of firms highly exposed to the minimum wage in China.
[7] The financial sector is the only industry excluded from our firm registry 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 1.4%, and the sector generated 4.3% of the total GDP in the country.

studying the impacts of the minimum wage, as those typically pay lower wages and are thus more exposed to increases in mandatory labor costs. This is especially important in the context of developing economies where micro and small firms represent the majority of firms, and a sizeable share of employment and output. To the best of our knowledge, our paper is the first to examine the effects of the minimum wage on firm destruction with data on firms of all sizes and in all sectors of activity.

Our work also adds to the limited evidence on the impact of the minimum wage on the respective size of the formal and informal economy in contexts where informality remains common. In settings where regulation enforcement is weaker, labor regulations can affect the allocation of employment and economic activity between the formal and informal sector by raising labor costs in the formal sector (Botero et al., 2003; Del Carpio and Pabon, 2016). Our paper thus relates to the broader debate on labor market regulations and informality, initiated by De Soto (1989), and to theories of dualism where the wedge between formal and informal labor costs affects the allocation of firms between the formal and informal sectors (LaPorta and Schleifer, 2014; Meghir at al., 2015; Ulyssea, 2018).[8]

Finally, the paper contributes to the long-lasting debate on the employment effects of the minimum wage. It separately estimates employment effects that take place through adjustments in the number of workers in surviving firms (intensive margin) and job destruction due to firm exits (extensive margin) and quantifies their respective contributions to overall employment effects. In the context of developing economies where informal employment remains common, our paper sheds light on the channels behind formal employment changes as a response to the minimum wage reported by some studies.[9]

The paper is organized as follows. Section 2 provides background information on the minimum wage setting and on the 2016 minimum wage hike in Turkey. Section 3 describes the rich linked employee-employer dataset used in the paper and reports descriptive statistics. Section 4 presents

[8]As highlighted by Del Carpio and Pabon (2017), the minimum wage can affect the allocation of employment and economic activity between the formal and informal sectors by raising labor costs in the formal sector, in settings where regulation enforcement is weaker.
[9] See for example Lemos (2009) or Gindling and Terrell (2005) or Comola (2011) among others.

our identification strategy and provides supportive evidence for its validity. Section 5 reports our main results on the exit of formal firms and formal employment destruction. It also explores whether those effects are mostly driven by pure job losses or transitions into informal employment. Section 6 concludes.

2. Background on the minimum wage in Turkey

2.1. Institutional setting

Since 1989, Turkey implements a nationwide minimum wage which covers in principle all employees working under a labor contract. The national minimum wage must be adjusted at least every two years by law and has been in practice modified every year over the past decade. The new monthly minimum wage level is announced by the Minimum Wage Commission on the last Friday of December of the previous year, after a series of weekly consultations that last from one to two months. 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. Decisions are taken under the majority of votes of its members.

Turkey currently has one of the highest minimum wage to median wage ratios in the OECD. 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 are paid around the minimum wage. In the last quarter of 2015, right before the minimum wage hike, about 50% 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 2016 minimum wage hike

In January 2016, the nominal minimum wage was increased by 33%, from about USD 265 in 2015 to about USD 350 in net terms. Figure 2 displays the annual growth of the real and nominal minimum wage in Turkey, along with the CPI index from 2010 to 2016. It shows a very large hike in the minimum wage in the first quarter of 2016 in both nominal and real terms. With an inflation rate of 8.81% in 2015 (Turkish Statistics Institute-TurkStat), the raise represented an increase of about 24% in real terms. In comparison, the minimum wage increases in previous years ranged from 5 to 8 percent annually in nominal terms and was roughly aligned with the consumer inflation expectations and realizations.

This discrete and large increase in the minimum wage generated by the 2016 reform constitutes a suitable experiment to study firms' responses to the hike. Additionally, this discrete jump in the minimum wage was mostly politically motivated and resulted from the collective bargaining process highlighted in section 2.1., instead of underlying changes in economic fundamentals. In the remainder of the paper, we provide supporting evidence indicating that the hike not been anticipated by firms, and thus constitutes a valid setup to study the causal impact of the minimum wage on firm responses.

3. Data and Descriptive Statistics

3.1. The Enterprise Information System (EIS)

The paper uses an exceptionally rich linked employer-employee dataset in the context of a developing economy. The Enterprise Information System (EIS) records information on all registered workers and firms in the Turkish economy with quarterly frequency from 2006 to 2016.[10] All registered employees can be linked to the records of the registered firm they are

[10] The EIS was constructed by merging a large number of administrative datasets from various Government entities, in an effort led by the Ministry of Industry and Technology (MoIT). Original sources for administrative datasets include: the Ministry of Industry and Technology, the Ministry of Trade (MoT), the Revenue Administration (GIB), the Social Security Institution (SGK), Small and Medium Business Development and Support Administration

employed in. The registry also has a panel structure, as both firms and workers can be followed over time through a unique identifier, starting from 2012. As of 2016, there were around 3 million firms registered in the EIS data set, among which 1.1 million had at least one registered employee. Given that the focus of our analysis is on the impact of mandatory labor costs on firms, we restrict our analysis to firms with at least one registered employee.[11]

The data set contains very rich information on firm financial statements (net sales, asset-liability statements, debt, profits) for firms that pay institutional and corporate taxes. It records data on stock of capital and machinery, capital expenditures, labor costs capacity and production of manufacturing firms, trade between sectors and provinces, exports and imports, intellectual property rights (patents, etc.). It also includes basic information on the firm economic sector (sector- 4- digit ISIC and NACE rev 2), age, and geographic location up to the district level.[12]

A major advantage of the EIS database to study the impact of the minimum wage is that it has no floor in terms of firm size. This is critical when studying firm responses to the minimum wage, especially in the context of a developing economy like Turkey. 50% of all registered firms in the country have at most two employees, and 75% of have at most five employees. Those firms typically pay low wages and are thus expected to be more strongly exposed to minimum wage hikes. The EIS covers all non-financial firms registered in administrative records, except the banking sector and military institutions. It thus allows to look at heterogenous effects of the minimum wage across sectors, contrary to many administrative datasets that are restricted to specific sectors of activity.

The database contains individual-level information on all workers that are registered with the Turkish Social Security Institution. As of 2016, about 12.6 million workers were registered in the EIS database, representing 78% of all wage workers in non-agriculture in Turkey.[13] Information on age, gender, occupation, days worked, and wage is available for each registered worker.[14] This

(KOSGEB), Turkish Statistical Institute (TURKSTAT), Turkish Patent and Trademark Office (TPE), and Scientific and Technological Research Council of Turkey (TUBITAK).

[11] In addition, information of self-employed businesses with no employee is quite parsimonious in the EIS.
[12] Turkey consists of a total of 923 districts.
[13] According to the 2018 Turkish Labor Force Survey, 22% of wage workers in non -agriculture were not registered with social security.

allows to calculate total employment and total wage bill in each firm on a quarterly basis. 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 of registered workers within firms.

By design, the EIS database only records information on formal firms and formal workers. Firms that are not registered with tax authorities, and workers who are not registered with social security institutions, are not captured in the database. This implies that an exit by a worker from the database could be either because of a job loss, or because the worker is now employed "off the books", either in the same firm or in another firm. At the firm level, an exit from the database can thus occur because of firm closure, or because the business now operates in a fully informal manner by not being registered with tax authorities, or with no employee registered with social security. While non-compliance with tax registration is uncommon in Turkey, informality primarily occurs through the non-registration of workers with social security (Taymaz, 2009). [15]

To gain insights on whether the exit of formal firms and workers are the result of firm closure and job loss or , instead, of transitions into informality, we complement the EIS registry with microdata from the Turkish Household Labor Force Survey (HLFS). The HLFS is a nationally-representative survey for Turkey conducted annually that collects detailed information on the labor market outcomes of the Turkish working-age population. While its sample size is much smaller than that of the EIS, it captures both formal and informal workers, which can be identified through a question asking whether they are registered with social security institutions.

3.2. Descriptive statistics

As shown in table 1, micro and small firms represent the large majority of formal firms in the Turkish economy. Half of formal firms are micro firms, with at most two formal employees. 72% of formal firms have at most 5 employees, and 84% have at most 10 employees. This highlights the importance of having data that covers firms of all sizes with no minimum employment threshold. Studies using firm data above a given employment threshold in developing countries would thus miss the bulk of businesses in the economy.

[15] As of 2015, according to the Turkish Household Labor Force Survey (HLFS), about 22% of workers employed in non-agriculture in Turkey were not registered with the Social Security Institution.

Despite the small proportion of large firms in the economy, formal employment is concentrated in large firms. Firms with more than 50 employees represent less than 3% of formal firms but employ more than 50% of formal workers. Medium-size firms (between 10 and 49 workers) employ close to one fourth of total employment, while small firms employ 21% of formal workers. The distribution of formal workers across firms of different sizes, combined with the greater exposure of small firms to the minimum wage, have important implications regarding potential employment effects.

As illustrated in table 1, the minimum wage is strongly binding for formal firms in Turkey. In the quarter before the 2016 minimum wage hike, over 50% of formal workers in formal firms where paid at around the minimum wage. Small and micro firms pay lower wages and employ a very large share of workers at the minimum wage. At the end of 2015, 93% of formal workers in micro firms were paid at the minimum wage before the 2016 hike. Any increase in the minimum wage thus results in sizeable labor cost increases for formal 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 the minimum wage. In larger firms, 40% of workers are paid at around the minimum wage.

Figure 3 reports the number of formal firms in the EIS administrative dataset from 2012 to 2016, with quarterly frequency. The number of formal firms in Turkey has been increasing steadily from the first quarter of 2012 until the last quarter of 2015. In the first quarter of 2016, the number of formal firms dropped and continued to decline in the following quarters, although at a more moderate pace. The drop in the number of formal firms coincides with the 2016 minimum wage hike. Figure 4 also shows that the growth rate of formal employment dropped in the quarter immediately after the hike compared to previous quarters, and that formal employment even declined in absolute terms in the following quarters. The remainder of the paper investigates whether the relationship between the minimum wage hike and the drop in the number of formal firms is causal, and links firm destruction to potential employment effects for formal workers.

4. Identification strategy

4.1 Measuring exposure to the minimum wage hike

The first challenge when trying to identify the effect of the 2016 minimum wage hike relates to the nationwide implementation of the reform. Thus, it is difficult to identify treatment and control groups affected (or not) by the policy change. The approach followed by previous work to address this issue is to use heterogeneity in exposure to the minimum wage at the level of geographical units (Card, 1992; Stewart, 2002 and Caliendo at al. 2017), or at the firm level (Machin et al. 2003, Draca et al. 2011; Harasztosi and Lindner, 2019). Those typically use information on average wages in regions or firms prior to the policy change to construct measures of exposure and classify units into treatment and control group according to their degree of exposure. They then conduct a difference-in-difference estimation to estimate the causal effects of the minimum wage.

In this paper, we follow a similar approach in spirit, but compared to prior work, we can precisely measure exposure to the minimum wage as we have information on the wages of all formal workers employed in formal firms.[16] This attractive feature of the data allows a more accurate measure of exposure to treatment or "Intention to Treat" (ITT), as we directly and accurately observe exposure to the minimum wage for the relevant unit of analysis.

We measure exposure to the minimum wage increase as the proportional increase in the wage bill required to bring all workers paid below the new minimum wage in quarter 4 of 2015, up to the new 2016 minimum wage. We measure minimum wage exposure at the cell level, where a cell is defined as the mass of firms in a given industry in a given district of Turkey. Formally, the degree of exposure to the minimum wage in cell i, denoted E_i, can be expressed as:

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

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 formal workers in all formal firms (the quarter sub-index is omitted here for simplicity).

[16] Draca et al. (2011) or Harsztosi and Lindner (2019) use instead the average wage in the firm as a proxy for firms' exposure to the minimum wage.

In contrast with Draca et al. (2011), we measure minimum wage exposure at the cell level rather than at the firm level. The reason for this choice first relates to the nature of the outcome variable of interest: the exit of firms from the formal sector. Since exiting firms are not observed once a firm exits the EIS registry, implementing a standard difference-in-difference estimator at the firm level is problematic. Specifically, since minimum exposure is measured right before the hike, it is only observed for firms that are present in the database in the last quarter of 2015 and have thus not exited in prior periods. In addition, since the vast majority of firms in the registry only have one or two employees and are fully exposed to the hike, the cell-level approach also ensures greater variation in treatment exposure across units. For these reasons, we measure minimum wage exposure and outcomes of interest at the "cell" level, where a cell is defined as the mass of firms in a given 2-digit NACE industry, in a given district of Turkey.[17]

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

Confirming that the minimum wage hike had a real "bite" and affected wages in the expected direction is a prerequisite to assess its impact in a difference-in-difference setting. In Figure 4, we check whether the minimum wage hike which increased mandatory labor costs for formal firms (Intention-to-Treat) had the expected effects on the distribution of wages in formal firms (treatment). Figure 4 clearly shows that the increase in the statutory minimum wage in 2016 did translate in a sharp increase in the average daily wage for Turkish firms. Time-series show a very clear break in 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 E_i. Cells with exposure above a given exposure threshold ($E > E^*$) are categorized as "high-exposure cells", while cells

[17] We exclude cells with less than 50 firms from our sample. This restriction eliminates about 20% of firms in the original sample. In Appendix A.2., we assess the robustness of our main results to using alternative thresholds for the minimum number of firms in the cell.

with exposure equal or below the exposure threshold ($E \leq E^*$) are classified as "low-exposure cells".[18]We can estimate the impact of the minimum wage hike on exit rates in the cell by comparing what happened before and after the minimum wage increase across these treatment and control cells.

For this procedure to be valid, wages should rise faster in cells with high exposure ($E > E^*$) then in low-exposure cells ($E \leq E^*$). Under the parallel trend assumption, a valid difference-in-difference estimate of the effect of the minimum wage hike on firm exit rates is $\left(\bar{Y}^{E>E^*}_{MWH=1} - \bar{Y}^{E\leq E^*}_{NMW=1} \right) - \left(\bar{Y}^{E>E^*}_{MWH=0} - \bar{Y}^{E\leq E^*}_{MWH=0} \right)$, where MWH is a binary indicator equals to 1 if the cell is observed in quarters after the minimum wage hike, 0 otherwise. The difference-in-difference estimate is the simple difference in exit rates between high-exposure and low-exposure before and after the new minimum wage. 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. Although most exits from the registry are permanent, this restriction is motivated by the fact that we observe a substantial share of firms exiting the registry in one quarter and re-entering in later quarters. This is likely driven seasonality in economic activity in certain sectors. We however assess the robustness of our main findings to calculating exit rates using all firm exits, including non-permanent ones.[19]

In a regression setting, a difference-in-difference estimate of the effect of the minimum wage hike on firm exits can be expressed as:

$$Y_{it} = \alpha + \pi X_{it} + \delta Q_t + \mu R_i + \sigma R_i * Q_t + \theta D(E > E^*) + \beta [D(E > E^*) * MWH] + \varepsilon_{it} \quad (2)$$

[18] We use the median level of exposure E to the minimum wage hike in our sample of cells (0.135) as the treatment threshold E^*.

[19] Our estimation results using this alternative definition of exits are reported in Table A.1. At the firm level, the correlation between the dummy variable for exit and the dummy for permanent exit is relatively high (0.80). The correlation between permanent exit rates and exit rates at the cell level is 0.78.

where X is a vector of cell-level observable characteristics that could be correlated with exposure status and exit rates. Q denotes a set of quarterly effects, R is a vector of regional dummies, R*Q captures region-specific time shocks and ε is a random error term. We are interested in consistently estimating β, which measures the effect of the minimum wage hike on the exit rate of formal firms.

Instead of a binary measure, our preferred treatment measure is the continuous treatment E, as it utilizes the full extent of variation in exposure to the minimum wage the data.[20] Our preferred difference -in-difference specification is thus given by:

$$Y_{it} = \alpha + \pi X_{it} + \delta Q_t + \mu R_i + \sigma R_i * Q_t + \theta E + \beta [E * MWH] + \varepsilon_{it} \qquad (3)$$

4.4. Variation in exposure to the minimum wage hike

Figure 5 reports the distribution of our measure of minimum wage exposure E_i. at the cell level. Treatment exposure ranges from 0 to about 22%. As shown in the figure, there exists substantial variation in exposure across cells in the sample. A sizeable share of cells is weakly exposed to the minimum wage hike, although high levels of exposure are more frequent. The distribution of exposure to the minimum wage hike thus exhibits substantial variation to identify treatment effects. In addition, the high incidence of high exposure among cells reinforces the importance of investigating the effects of the minimum wage hike in the Turkish context.

4.5. Exposure to treatment and actual increases in labor costs

For our estimation strategy to identify the treatment effect of interest, it is important to verify that we observe a disproportionate wage increase in high-exposure cells compared to low-exposure cells after the minimum wage hike. Figure 6 depicts the evolution of wages in these two categories

[20] In the Appendix, we however also report our difference-in-difference estimates using Equation 2 that uses the binary measure of exposure to the minimum wage hike.

of cells in the period surrounding the minimum wage hike. It shows that firms with greater exposure to the minimum wage hike experienced a disproportionate wage growth after the hike. While a very large jump in average wage growth is observed in high-exposure cells, wage growth in low-exposure cells is much smaller after 2016. This shows that high-exposure firms indeed faced greater increase in labor costs after the hike.

5. Results

5.1 Baseline results

Figure 7 visually depicts the evolution of firm exit rates in high-exposure cells compared to low-exposure cells before from 2012 to 2016. While firm exit rates have been higher in high-exposure cells before the hike, they have moved in parallel over the period 2012-2015. In contrast, after the 2016 minimum wage hike, higher-exposure cells experienced a much larger increase exit rates from the formal economy. The figure shows a large increase in exit rates after the hike, especially in the first quarter of 2016 that immediately followed the hike. A rise in exit rates was also observed among low-exposure cells, although it is noticeably smaller in magnitude compared to high-exposure cells.

Table 2 reports the baseline results of our difference-in-difference estimation. Coefficients are estimated for the full 2012-2016 period using he continuous measure of treatment as described in Equation 3. The unconditional difference-in-difference estimate reported in column 1 is positive and statistically significant, indicating that the minimum wage hike significantly increased firm exits from the formal economy. As shown in column (2), controlling for a vector of cell-level characteristics does not significantly affect the magnitude and significance of the baseline estimates. This alleviates concerns that our exposure measure might be correlated with cell and firm characteristics that also affect tends in exit rates. As shown in Table A.1., these findings are robust to using the binary measure of treatment as described in Equation 2. The results also hold when the estimation is restricted to the period 2015-2016 instead of the full 2012-2016 period (Table A.2). In table A.3. and A.4, we also show that our main results are also robust to changes of the exit rate measure and in the minimum number of firms per cell to be included in the sample.

Even after accounting for cell-level observable characteristics, one may still be concerned by systematic differences in unobservable characteristics between high and low-exposure cells, which may be correlated with trends in exits rates. In particular, one may suspect that cells with very low or very high levels of exposure differ according to unobservable characteristics that may drive our results on exit rates. To further alleviate this concern, we first trim our sample from the bottom 5% and top 5% of cells according to their degree of exposure to the minimum wage hike. As reported in column 5 and 6 of table 2, our main results are virtually unchanged once we exclude very low and very high exposure cells. In column 7 and 8, we further trim the sample by excluding cells in the bottom 25% and top 25% of the exposure distribution. The magnitude of the difference-in-difference coefficients is very similar to the baseline estimation and even slightly increased.

To assess the magnitude of 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 2 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% compared to the average exit rate in the low-exposed 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.

Table 4 reports the effects of the minimum wage hike on the total number of firms in the cell, and separately by firm size category. It also reports the effect on average firm size in the cell. As reported in column 1, and consistently with treatment effects on firm exits, the total number of firms in the cell is negatively affected by the minimum wage hike, and the effect is statistically significant at the 1%. In column 2 and 3, we separately estimate the effect of the minimum wage hike on the number of micro and non-micro firms in the cell. We find a negative, large, and statistically significant effect of the minimum wage hike on the number of micro firms (1 to 2 employees). In column 3, we also report a negative and significant effect on the number of non-micro firms, but the coefficient estimate is less than half that of micro firms. This shows that the decline in the number of firms attributable to the minimum wage hike is mainly driven by the exit of micro firms.

To complement these findings, we also look at whether the minimum wage hike affected average firm size. Average firm size can change through two main channels. First, it is impacted by compositional changes in firm size due to firm exit. Since the number of micro firms disproportionally declined due to the minimum wage hike the average firm size in the cell is expected to increase through this channel (column 2). Second, the minimum wage hike can induce surviving firms to shed labor as a response to rising labor costs. Through this second channel, the average size of surviving firms would decline as a result of the minimum wage hike. The two effects thus play out in opposite directions, and the aggregate effect of the hike on firm size is theoretically ambiguous. Column 4 shows that the difference-in-difference estimate for average firm size is negative but small in magnitude, and statistically insignificant. This suggests some decline in formal employment among firms that survived after the hike.

5.2. Validity of the identification strategy

The identification strategy relies on the assumption that changes in exit rates among firms with low exposure to the minimum wage hike are a valid counterfactual for highly exposed firms. As in every difference-in-difference estimation, our estimator 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. While this cannot be tested directly, we examine whether this assumption holds in the period prior to the minimum wage hike. 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 term in high-exposure cells, trends in exit rates prior to the minimum wage hike are not noticeably different in the treatment and control groups.

In Table 4, we formally test whether exit rates rose at a faster rate among high-exposure cells prior to the minimum wage hike, by conducting a series of placebo tests. To do so, we estimate Equation (3), but for 2012-2013, 2013-2014 and 2014-2015 instead of 2015-2016. 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). 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 and suggest that our difference-in-difference estimates are capturing confounding factors that affect control and treatment cells differently.

Table 3 reports the difference-in-difference coefficient estimates for alternative placebo periods. The effect sizes of the placebos are about tenfold smaller than those estimated for the actual treatment, 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 high-exposure and the likelihood to exit the formal sector shifted markedly right after the actual minimum wage hike. Table A.5. reports similar results when the placebo tests are run with a binary treatment measure instead. This provides further comfort that our difference-in-difference estimates are not contaminated by pre-existing trends between low-exposure and high-exposure cells.

Another related threat to identification is the fact that the hike may have been anticipated by firms, which could have started responding to the hike before it took place. Yearly minimum wage increases in years prior to the 2016 minimum wage hike had all closely followed the inflation rate (Figure 2). It is therefore likely that firms had similar expectations regarding the 2016 increase, instead of the 33% increase that actually took place. Additionally, anecdotal evidence indicates that the increase was largely politically motivated rather than driven by changes in economic fundamentals, which further alleviates concerns that it may have been anticipated by firms. Figure 7 provides visual evidence that 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, which is compatible with the hike not being anticipated by firms.

5.3. Heterogeneous effects

We then investigate potential heterogeneous effects of the hike on firm destruction. We first look at heterogeneous effects by level of productivity in the cell (Table 5). We use labor productivity as an indicator of productivity at the cell level, measured as value-added per worker over the period 2012-2015 prior to the minimum wage hike. We then assign cells into labor productivity quintiles according to labor productivity levels in the period prior to the minimum wage hike.[21]

The difference-in-difference coefficient estimates by productivity quintile reported in Table 5 show a clear decline in treatment effects along productivity quintiles. While the impact of the minimum wage hike on firm exits is large in the bottom quintiles of the productivity distribution, treatment effects are much smaller in the upper quintiles and are virtually zero for the top quintile. For a given level of exposure to the minimum wage hike, less productive firms thus respond more strongly to the minimum wage hike by exiting the formal economy. One likely explanation for this finding is that less productive firms are at the limit of survival prior to the minimum wage hike and may also have fewer possible margins of adjustment in response to a high in mandatory labor costs.

In Table 6, we investigate heterogenous effects of the hike on firm exits along other dimensions of cell characteristics. The table reports the effect of the minimum hike interacted with a set of cell-level characteristics, where each of the interaction effects are estimated in separate regressions. The effects of the minimum wage hike on firm exits are stronger in cells with a higher labor share, as reported in column (1). This is rather intuitive and indicates that firms that rely more heavily on labor in their productive technology respond more strongly to the minimum wage hike by exiting, compared to firms to industries that are more capital intensive.

Consistently with table 5, the sign on the labor productivity interaction is negative and highly statistically significant, indicating that the effects of the hike on exits are smaller in higher productivity cells. In column (2), the interaction between the profit share in the cell and the minimum wage hike is negative and statistically significant, implying that formal firm destruction is smaller in cells where profits margins are larger. This is consistent with the hike putting pressure on firm profits, and thus driving out of the formal economy firms for which profit margins where

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[21] We also use Total Factor Productivity (TFP) as an alternative measure of firm productivity in the cell. Results are similar to using labor productivity and are available upon request.

already thin before the hike. Although we cannot observe what happened to profits in firms that exit the market after the minimum wage hike, table 7 reports corroborative evidence that is consistent with this mechanism. It shows that profit margins declined more strongly in cells that were more exposed to the minimum wage hike. Estimates are not statistically significant, but they are likely to be underestimated as exiting firms whose profits may have been hit more strongly are not observed after the hike.

Finally, estimates reported in column (4) indicate that effects on the exit of formal firms are stronger in cells where market competition is stronger, as indicated by a lower Lerner index. This suggests that competitive pressures play a role in whether firms exit the market in response to increased mandatory labor costs. One possible explanation for this relationship is that firms in more competitive markets have less room to report increases in labor costs on product prices, and thus are more likely to see their profit margin shrink and exit the market as a result of a minimum wage hike.

5.4. Employment effects

We then relate our findings on the rise in firm exits to the broader debate on the employment effects of the minimum wage. We first estimate aggregate employment effects at the cell level, but also look separately at employment effects in surviving firms only (employment effects at the intensive margin), and at employment destruction due to firm exits (employment effects at the extensive margin). The outcome of interest in these difference-in-difference regressions is the percentage change in formal employment in the cell measured in each quarter.

Table 8 displays the estimated effects of the minimum wage hike on employment at the cell level. As reported in column (1) and (2) of table 8, the aggregate effects of the minimum wage hike on total employment at the cell level are negative and statistically significant: a 10% increase in exposure to the minimum wage is estimated to reduce total formal employment by about 2%. The following columns estimate separately employment effects in surviving firms only and employment effects associated with firm exits.

As shown in column (3) and (4), employment effects in surviving firms are negative but small in magnitude and statistically insignificant. In contrast, as reported in column (5) and (6), the effects of the minimum wage hike on formal employment destruction associated with firm exits are large and statistically significant. This finding is consistent with our earlier results on the positive and significant effects of the minimum wage hike on firm exits. According to our difference-in-difference estimates, an increase in the wage bill associated with the minimum hike by 10% leads to a 5% increase in gross job destruction due to firm exits. This indicates that employment effects mostly operate at the extensive margin through firm exits rather than formal employment cuts in surviving firms.

5.5. Labor market transitions of workers from exiting firms

One additional question related to employment effects is whether workers that were employed in exiting firms have been re-hired by other formal firms or whether they are now unemployed or informally employed. For workers who found employment in another formal firm, another question of interest is whether those workers found employment in larger, more productive firms, which would indicate some upward mobility among workers after the minimum wage hike. While this question had been so far neglected in the literature, we are able to take advantage of our rich linked employer-employee dataset to investigate this issue.[22] The data allows to follow workers over time as long as they remain employed in formal jobs, and to identify the characteristics of the firms they are employed in. Given the features of our dataset, an exit of workers from the registry can be interpreted as being no longer employed, or as being employed informally "off-the -books".

Table 9 reports transition matrices of workers who were employed in firms that exited the formal economy after the minimum wage hike. As shown in Panel A of table 9, the vast majority of workers from exiting firms were not formally employed by the end of 2016. Only 15% had found another formal job, meaning that 85% of them were either unemployed, or informally employed one year after the minimum wage hike. Workers who were employed in large formal firms that exited are more likely to have found another formal employment, compared to workers who were employed in micro firms.

[22] To the best of our knowledge, the only exception is Dustman et al. (2019) which recently look at workers' reallocation as a result of the minimum wage introduction in Germany.

In Panel B of table 9, we restrict the transition matrix to workers who had found another formal employment by the end of 2016. By doing so, we are interested in looking at whether workers from exiting firms who found another employment transitioned into larger, and presumably higher paying and higher productivity firms. As shown in Panel B, we find some evidence for the upward mobility of workers, who tend to transition into larger firms. Among workers employed in micro firms that had found formal employment by the end of 2016, more than two thirds were employed in non-micro firms. In contrast, we observe limited downward mobility among workers who were employed in large firms: over 80% of workers who were employed in large firms that exited after the hike were employed by another large firm by the end of 2016, among those that were formally employed by the end of 2016. Although the share of workers who had found another formal job by the end of 2016 remains small, this suggest some reallocation of workers towards higher-productivity and higher paying firms after the minimum wage hike.

5.6. Pure job losses or transition into informal employment?

In contexts where enforcement and compliance with labor regulations is imperfect, a minimum wage hike increases the wedge between wages of formal and informal employment, thus making informal employment more attractive for firms. Employing workers "off the books", without registration with social security institutions, is thus a possible response to increased mandatory labor costs in the formal economy. In the Turkish context, informality has been shown to mainly occur through the lack of registration of workers with social security, as opposed to a lack of firm registration, given both the low-cost and strong enforcement of the later (Taymaz, 2014).

In this context, the negative employment effects reported in section 5.4. may not necessarily be driven by "pure" job losses, but also by firms employing more workers "off the books", which cannot be observed in our administrative data. Distinguishing between these two types of employment responses is important not only from the perspective of workers' welfare, but also regarding the policy objective of reducing informal employment and economic activities, which is prevalent in many developing economies like Turkey.

As the EIS data does not capture informal employment, we complement administrative data on formal firms and workers with information from the Household Labor Force Survey (HLFS) in Turkey, available from an annual basis from 2006 to 2018. The HLFS is a nationally representative survey which collects detailed information on the labor market outcomes of the Turkish population. In particular, the survey asks to all employed individuals whether they are registered with social security institutions and thus allows to categorize employment as formal or informal, according to registration with social security institutions.

To shed light on whether the decline in formal employment is driven by job losses or transitions into informal employment, we first depict the evolution of total formal and informal wage employment from the HLFS over the period 2006-2016 (Figure 9). While total formal employment noticeably dropped following the minimum wage hike as evidenced from the EIS (Panel C), we do not observe a break in trends of total wage employment in non-agriculture after 2015 from the HLFS data (Panel A). Total wage employment in agriculture continue to rise at a similar pace post 2015, despite the decline in formal wage employment (Panel C). This is incompatible with workers from exiting firms remaining out of job after the hike. Similarly, we do not observe a significant increase in the employment rate post 2015 as expected if workers from exiting were not employed by the end of 2016. Since we earlier evidenced that only a minority (15%) of workers in exiting firms found another formal employment by the end of 2015, this suggests that the remaining workers may still be employed, but informally.

Panel B shows changes over time in informal wage employment in non-agriculture before and after the minimum wage hike. While informal wage employment had been declining rapidly in years prior to the 2016 minimum wage hike, Panel B of Figure 9 shows a noticeable increase in unregistered employment after 2015 and in the following years. Since we do not observe any drop in total employment, this indicative evidence is compatible with workers transitioning from formal to informal employment, rather than being unemployed as a result of the minimum wage hike. This could occur either because workers are now informally employed by the same firm or moved to another firm which employs them informally.

In Panel D of Figure 9, we provide further descriptive evidence which is compatible with a rise in informal employment as a result of the hike. Panel D depicts the evolution of the compliance rate with the minimum wage among wage workers employed in non-agriculture, calculated as a share of wage workers paid at or above the minimum wage. It shows a noticeable drop in the compliance rate with the mandatory minimum wage post-2015, which is also consistent with a reallocation of workers from formal to informal employment as a result of the increasing labor costs of formal employment. Although we earlier evidenced that the minimum wage hike led to a large wage increase for workers that remain formally employed, the decrease in compliance suggests that these benefits were partly offset by an increase in informal employment.

6. Conclusion

This paper evidenced that a large and unexpected minimum wage hike significantly increases the destruction rate of formal firms in the context of a developing economy. Specifically, our results indicate that the minimum wage operates as a firm selection device by eliminating small and lower productivity business from the formal economy. In contrast, high-productivity firms largely survive the hike in mandatory labor costs. We also find that local and industry-specific market conditions matter for formal firm destruction: exits associated with the minimum wage hike are higher in industries with lower profit margin, lower market concentration, and a higher labor share. We also provide complementary evidence suggesting that workers from exiting firms transition into informal employment, rather than being out of job after the hike.

Those findings have implications in contexts where policy makers are also devoting efforts and resources to reduce informal economic activities and employment, which is the case of many developing economies. Our results are broadly consistent with theories of dualism (De Soto, 1989; LaPorta et al. 2014), by suggesting that a rise in mandatory labor costs in the formal economy increases the relative attractiveness of informality and specifically of informal employment. Thus, when considering minimum wage increases, policy-makers should consider potential effects on informality and compliance in contexts where labor regulation enforcement is weak.

From the workers' perspective, our findings highlight the role of informality in absorbing shocks to the formal sector. In the case of a minimum wage hike, our results indicate that workers who were formally employed in exiting firms tend to be re-absorbed into informal employment. In the short-run, while those workers will typically receive lower wages than the new minimum wage, their welfare losses are reduced if the counterfactual is being unemployed as a result of the hike. This relates to the broader hypothesis that informality can help create greater flexibility in the labor market to cope better with adverse shocks in the presence of strict labor regulations (Dix Carneiro et al, 2018).

Our findings, however, need to be placed in broader context of the beneficial effects of the minimum wage for workers. As evidenced in this paper and by prior work, the minimum wage significantly increases the wages of workers that remain formally employed in surviving firms. These welfare gains are substantial, particularly in the context of developing economies where a large proportion of workers are paid around the minimum wage. Thus, the adverse effects on firm destruction and informality we evidenced in this paper should be weighed against the large wage gains of workers that remain formally employed.

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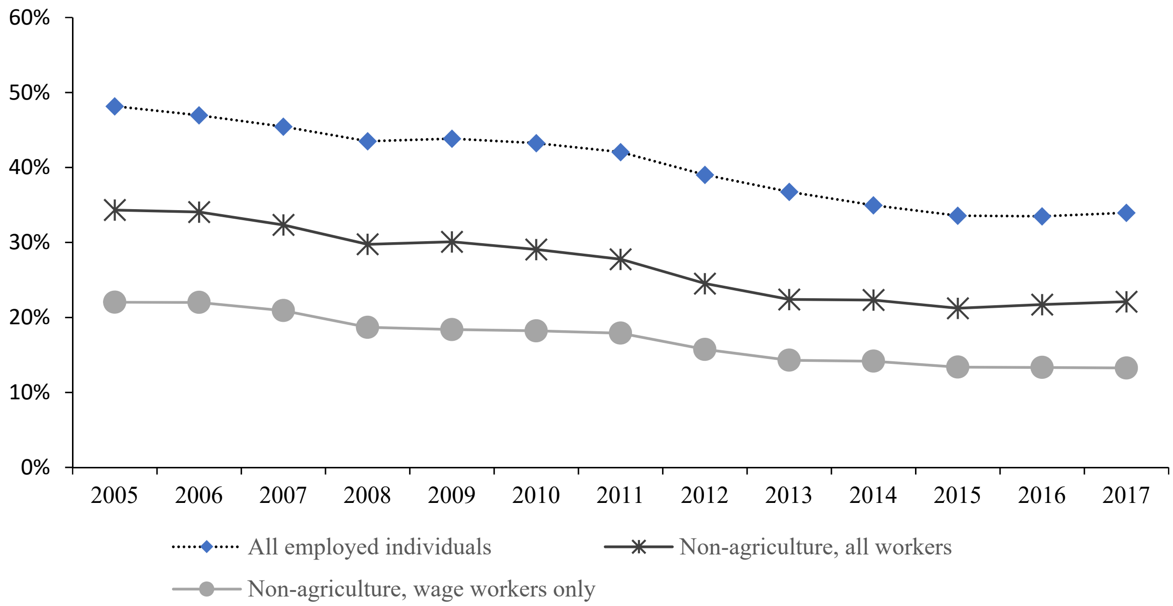
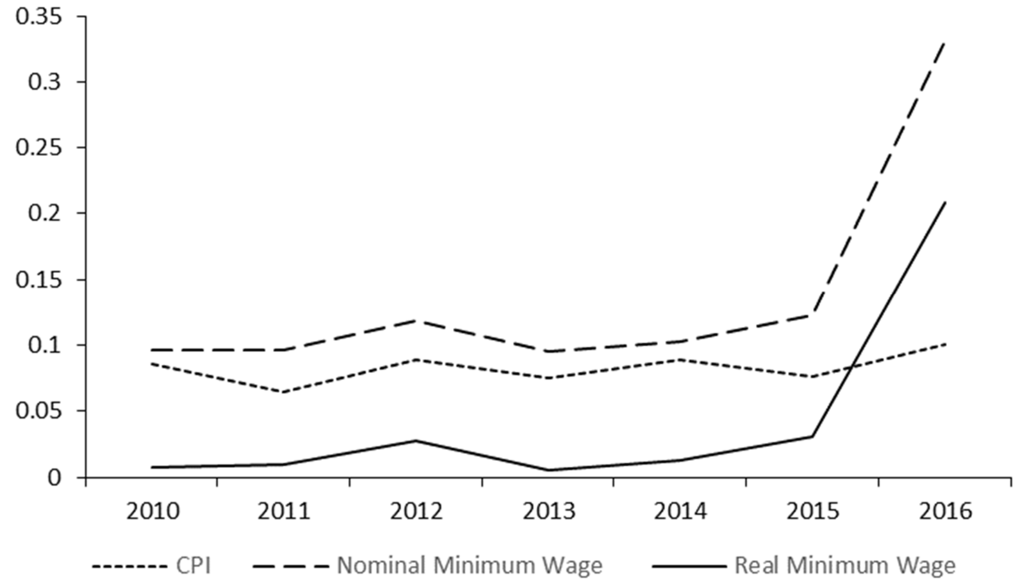
Figures

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



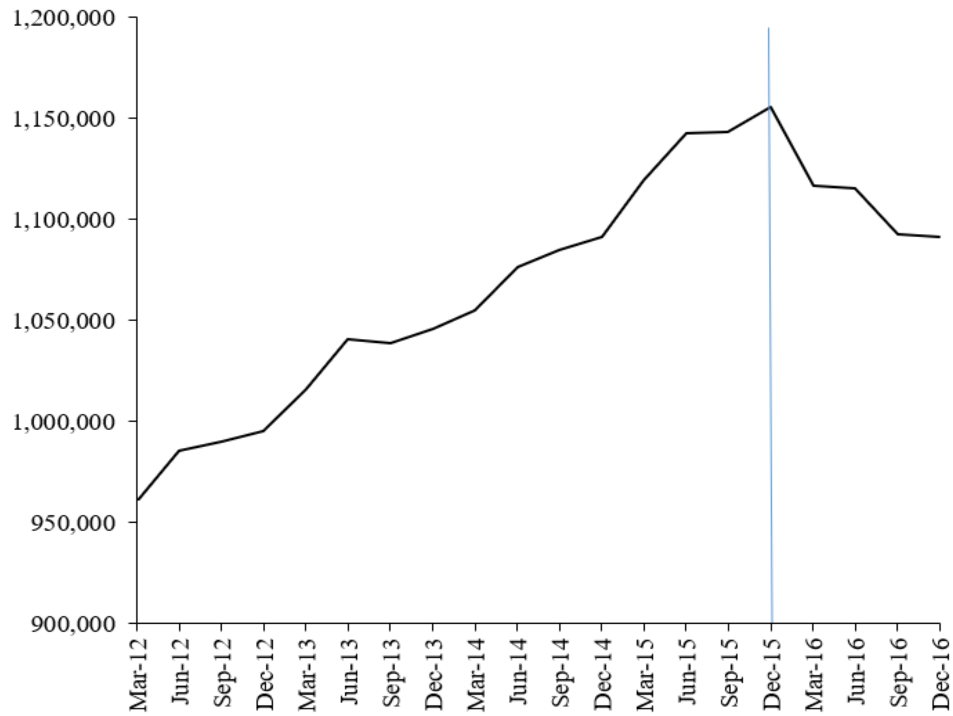
Source: Authors' calculations based on Turkish Household Labor Force Survey (HLFS).
Note. Employment is categorized as unregistered if the worker is not registered with the Turkish Social Security Authority at the time of the survey.

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



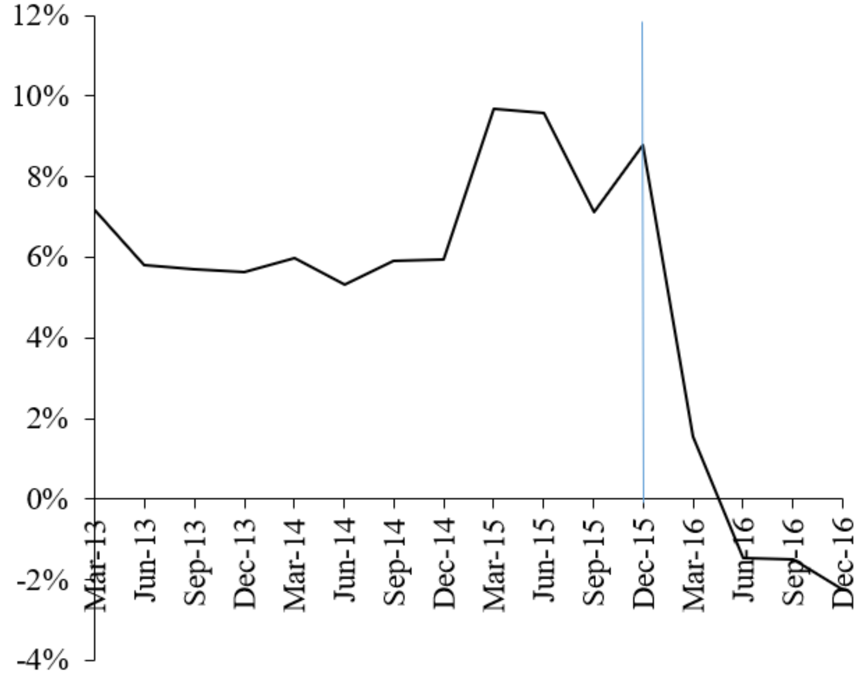
Source. Turkish Statistical Institute (TurkStat).

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



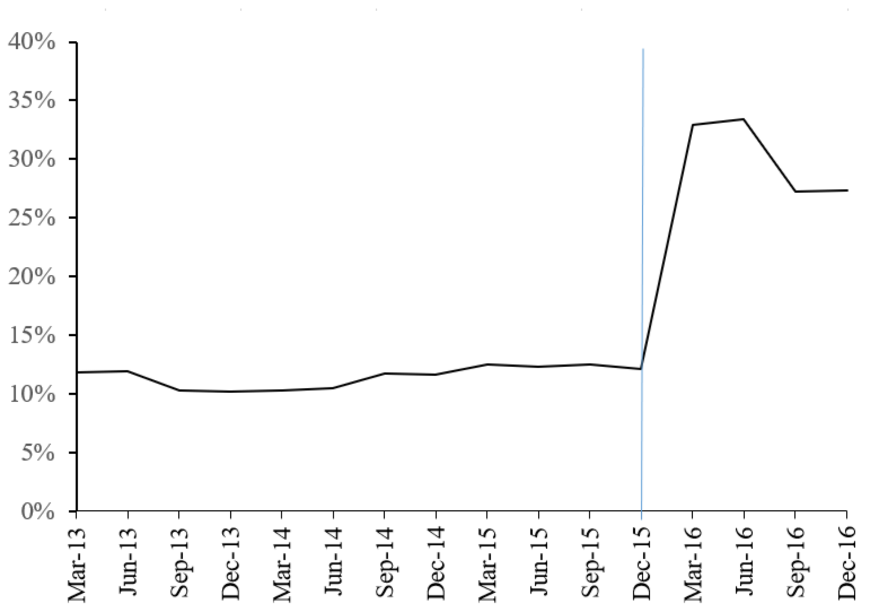
Source. Enterprise Information System (EIS).

Figure 4: Annual growth rate of formal employment, 2013-2016



Source. Enterprise Information System (EIS).

Figure 5: Annual nominal wage growth in formal firms



Source. Enterprise Information System (EIS).

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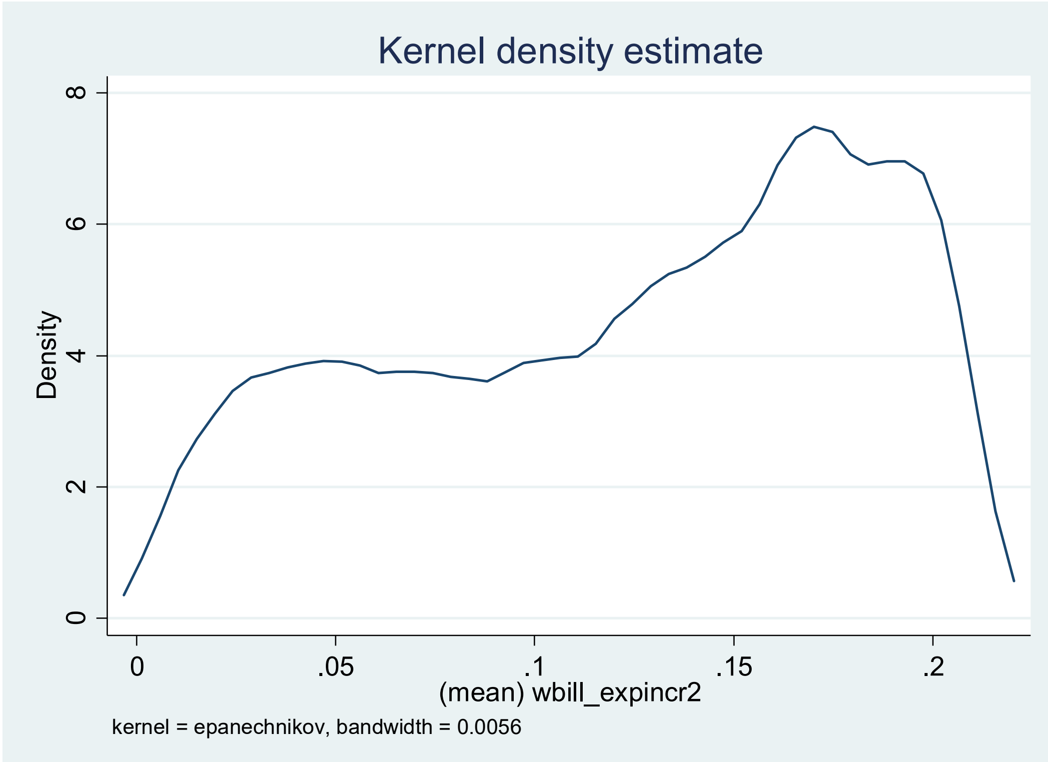
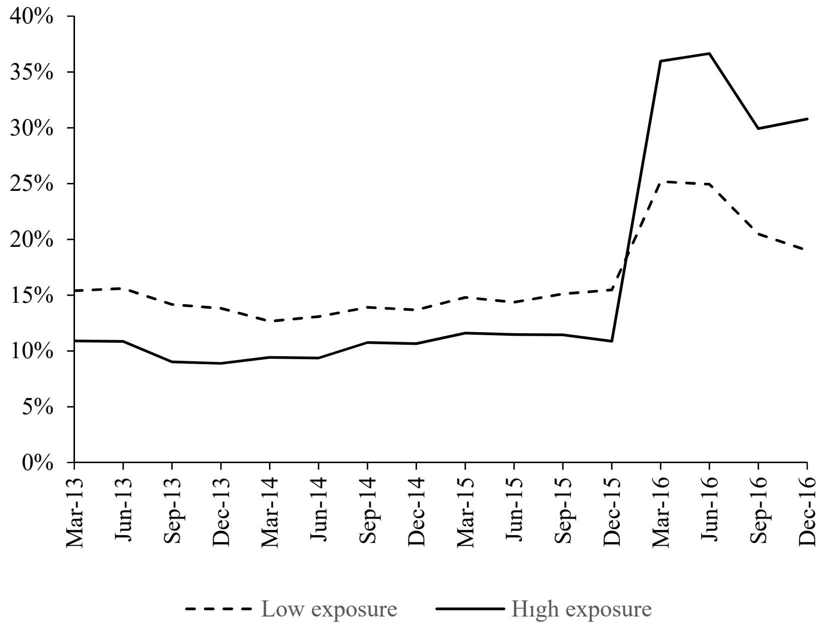
Figure 6: Distribution of exposure to the minimum wage hike at the cell level



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 2016 minimum wage.

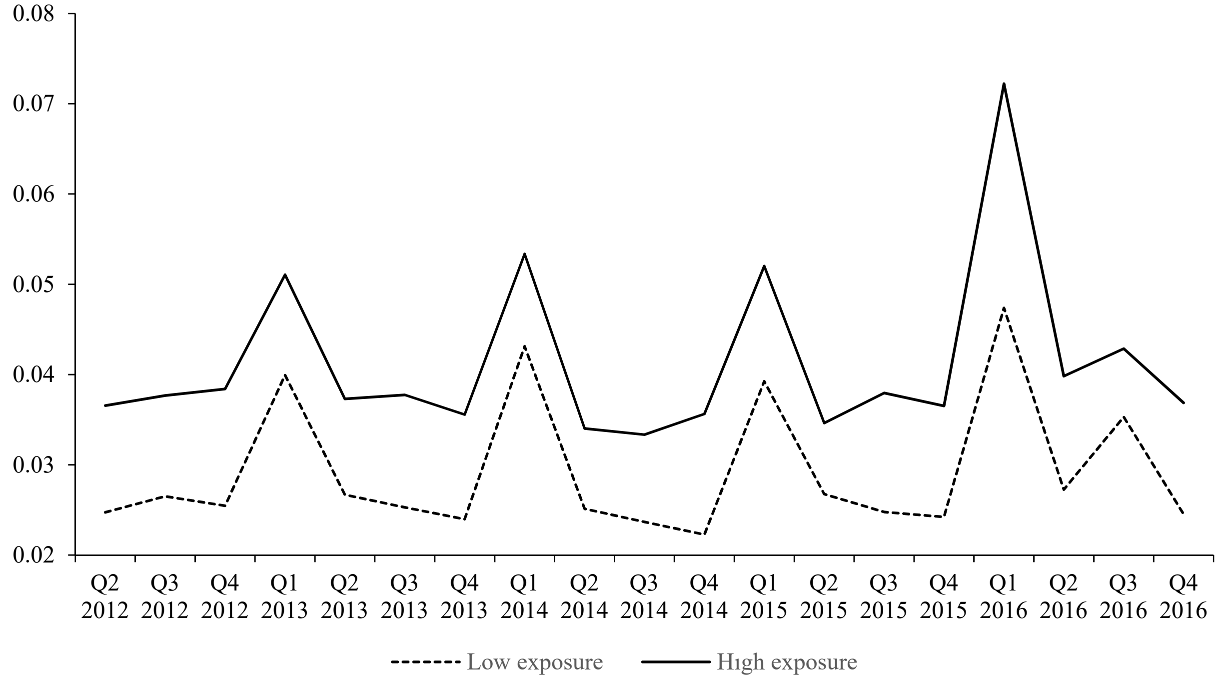
Figure 7: Annual nominal wage growth, by level of exposure to the minimum wage hike at the cell level



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 categorized as "high exposure" if the cell-level measure of exposure to the minimum wage is above the sample median, and as "low exposure" otherwise.

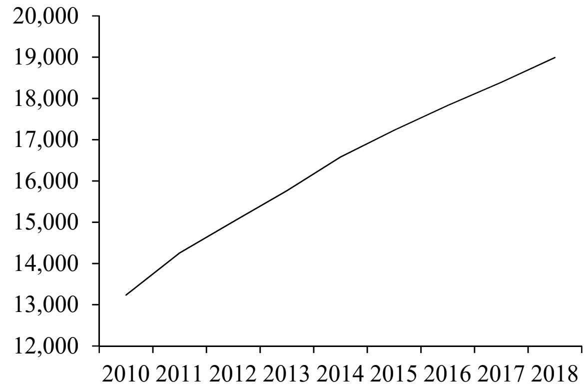
Figure 8: Quarterly cell-level exit rates of formal firms before and after the minimum wage hike, by treatment status



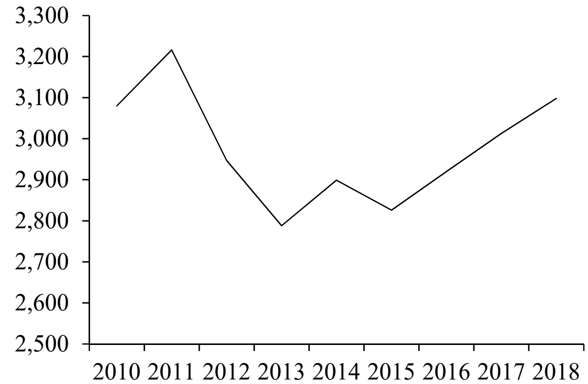
Source. Enterprise Information System (EIS)
Note. Exposure to the minimum wage hike is measured in the 4th quarter of 2015 as the proportional increase in the wage bill required to bring all workers in the cell up to the new minimum wage. Cells are categorized as "high exposure" if the cells' measure of exposure to the minimum wage is above the median exposure in the sample of cells, and as "low exposure" otherwise.

Figure 9. Wage employment in non-agriculture (in 1,000) by type and degree of compliance with the minimum wage

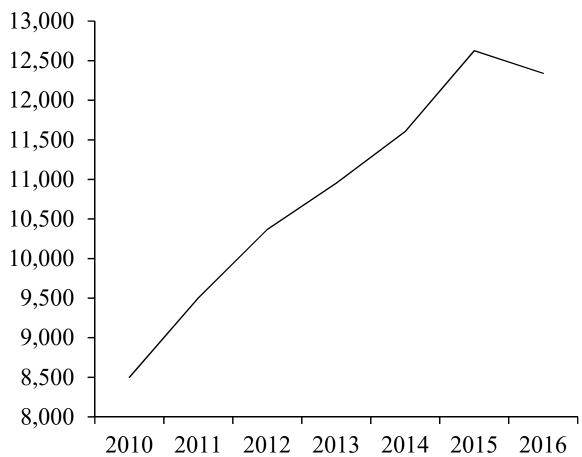
Panel A: Total employment



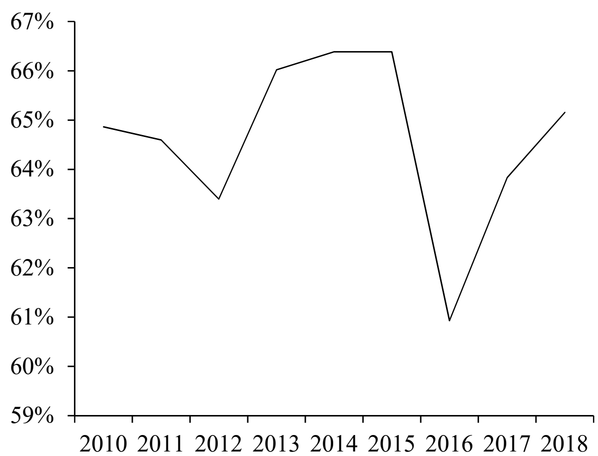
Panel B: Total informal employment



Panel C: Total formal employment



Panel D: Share of workers in non-agriculture paid at the minimum wage of above



Source. Panel A, B and D: Turkish Household Labor Force Survey (HLFS); Panel C: Enterprise Information System (EIS).

Note. Wage employment is categorized as informal if the worker reports not being registered social security institutions.

Tables

Table 1. Descriptive statistics of formal firms in 2015 before the minimum wage hike

	By firm size (Number of registered employees)				
	Micro 1 to 2	Small 3 to 9	Medium 10 to 49	Large 50+	Total
	(1)	(2)	(3)	(4)	(5)
Share of registered firms	50.4	33.3	13.5	2.8	100
Total number of registered firms	582,306	384,818	156,137	32,357	1,155,618
Percentage of total employment	6.4	15.5	25.5	52.6	100
Total employment	741,420	1,779,933	2,932,961	6,064,014	11,518,328
Mean number of employees	1.4	4.9	20.1	210.6	10.9
Mean daily wage	46	49	57	81	68
Share of workers paid below 1.02*MW	93	87	69	32	54
Mean firm age	7.1	7.5	7.4	7.9	7.3
Distribution of firms by sector					
Agriculture (%)	0.9	1.0	1.4	1.7	1.0
Manufacturing (%)	14.0	19.5	24.7	35.3	17.9
Other Industry (%)	6.8	11.3	16.4	15.2	9.8
Wholesale and retail trade (%)	39.7	36.1	25.3	15.1	35.9
Other services (%)	38.6	32.0	32.2	32.8	35.4
Total	100	100	100	100	100
Number of firms					
Agriculture	4,962	3,797	2,210	536	11,505
Manufacturing	81,797	75,187	38,513	11,410	206,907
Other Industry (non-manufacturing)	39,709	43,468	25,550	4,904	113,631
Wholesale and retail trade	230,887	139,085	39,563	4,893	414,428
Other services	224,951	123,281	50,301	10,614	409,147
Total	582,306	384,818	156,137	32,357	1,155,618
Total employment					
Agriculture	6,374	18,027	42,474	86,585	153,460
Manufacturing	107,627	357,435	779,958	2,079,722	3,324,742
Other Industry (non-manufacturing)	52,368	218,571	478,277	845,841	1,595,057
Wholesale and retail trade	294,925	616,283	702,375	857,947	2,471,530
Other services	280,226	569,437	929,877	2,193,999	3,973,539
Total	741,520	1,779,753	2,932,961	6,064,094	11,518,328

Notes. Descriptive statistics are for December 2015, right before the 2016 minimum wgae hike.

Table 2. Difference in difference estimates, baseline results, continuous treatment

Continuous treatment	**Years: 2012-2016**							
Dependent variable: firms' exit rate in the cell	**All cells**		**Balanced panel**		**Excluding top and bottom 5% exposure**		**Excluding top and bottom 25% exposure**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Difference-in-difference coefficient	0.021***	0.026***	0.024***	0.027***	0.024***	0.028***	0.027***	0.032***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)
Cell-level controls	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	71,754	71,754	57,648	57,648	64,621	64,621	35,863	35,863

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 reported in parentheses. The vector of cell-level control variables includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. 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.

Table 3. Difference in difference estimation of Placebo effects on firms' exit rates in pre-treatment periods.

Continuous treatment Dependent variable: exit rate of firms in the cell	Placebo period					
	2012-2013		2013-2014		2014-2015	
	(1)	(2)	(3)	(4)	(5)	(6)
Difference-in-difference coefficient	0.0003 (0.005)	-0.002 (0.004)	0.002 (0.004)	0.003 (0.004)	0.002 (0.004)	0.003 (0.004)
Cell-level controls	No	Yes	No	Yes	No	Yes
Number of observations	26,723	26,723	28,763	28,763	29,977	29,977

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 reported in parentheses. The vector of cell-level control variables includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. Cells are included in the sample if they consist of at least 50 firms. Cells are included in the sample if they consist of at least 50 firms.

Table 4. Difference-in-difference estimates of the effect of the minimum wage hike

Continuous treatment	Years: 2012-2016			
Dependent variable (in quarterly % change)	Number of firms	Number of micro firms	Number of non-micro firms	Average firm size
	(1)	(2)	(3)	(4)
Difference-in-difference coefficient	-0.123***	-0.216***	-0.0914**	-0.0167
	(0.032)	(0.046)	(0.039)	(0.050)
Balanced panel	Yes	Yes	Yes	Yes
Number of observations	66,347	66,347	66,347	66,347

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 reported in parentheses. The dependent variable is the % change in the All regressions include a vector of cell-level control variables which includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. 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.

Table 5. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, by labor productivity levels in the cell

Continuous treatment	Years 2012-2016				
Dependent variable: exit rate of firms in the cell	1st quintile (1)	2nd quintile (2)	3rd quintile (3)	4th quintile (4)	5th quintile (5)
Difference-in-difference coefficient	0.048***	0.036***	0.023**	0.021**	0.012
	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)
N (sample size)	8,361	8,377	8,442	8,398	8,392

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 reported in parentheses. All regressions include a vector of cell-level control variables which include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. Quintile 1 to 5 refer to the productivity quintile the cell belongs to, as measured by the average labor productivity of firms in the cell over the period 2012-2015, prior to minimum wage hike. Quintile 1 refers to the bottom productivity quintile while Quintile 5 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 6. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, heterogeneous effects

Continuous treatment	Years: 2012-2016			
Dependent variable: firm exit rate in the cell	(1)	(2)	(3)	(4)
Variable interacted with DiD coefficient				
Labor share	0.292**			
	(0.135)			
log labor productivity		-0.014***		
		(0.003)		
Profit-to-sale ratio			-0.085**	
			(0.034)	
Lerner index				-0.035**
				(0.018)
Number of observations	71,754	71,755	71,756	71,757

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 reported in parentheses. Each column reports the coefficient of the corresponding cell-level characteristic interacted with Exposure*post. The interaction coefficients reported in column (1) to (5) are estimated in separate regressions. The cell-level characteristics were calculated as the average of the yearly cell-level outcomes over the period 2012-2015, prior to the 2016 minimum wage hike. All regressions include a vector of cell-level control variables which include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms.

Table 7. Difference-in-difference estimates of the minimum wage hike on profits at the cell level

Continuous treatment	Years: 2012-2016	
Dependent variable: profit-to-sale ratio	(1)	(2)
Difference-in-difference coefficient	-0.026	-0.027
	(0.0204)	(0.0203)
Cell-level controls	No	Yes
Number of observations	70,523	70,523

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 reported in parentheses. All regressions include a vector of cell-level control variables which include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms.

Table 8. Difference in difference estimation of the minimum wage hike effect on employment

Continuous treatment	Years: 2012-2016					
Dependent variable (in % change)	Total formal employment		Formal employment in surviving firms		Formal job destruction due to exits	
	(1)	(2)	(3)	(4)	(5)	(6)
Difference-in-difference coefficient	-0.230***	-0.176***	-0.0961	-0.0776	-0.500**	-0.527**
	(0.072)	(0.058)	(0.074)	-0.056	(0.225)	(0.226)
Balanced panel	No	Yes	No	Yes	No	Yes
Number of observations	66,347	47,710	66,348	47,711	66,348	47,711

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 reported in parentheses. All regressions include a set of cell-level control variables which include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms.

Table 9. Labor market transitions of workers who were employed in exiting firms, one year after the minimum wage hike

Panel A: All workes from exiting firms

		Firm size in 2016					
		Micro	Small	Medium	Large	Not employed formally	Total
Firm size in 2015	Micro	2.6%	2.1%	1.8%	1.8%	91.7%	100%
	Small	1.2%	4.5%	3.6%	2.8%	87.9%	100%
	Medium	0.5%	2%	7%	5.4%	84.9%	100%
	Large	0.3%	0.7%	2.1%	16%	90.9%	100%
	Total	0.9%	2.1%	2.7%	8%	85.3%	100%

Panel B: Workers form exiting firms in formal employment by the end of 2016

		Firm size in 2016				
		Micro	Small	Medium	Large	Total
Firm size in 2015	Micro	31.0%	25.5%	22.0%	21.5%	100%
	Small	10.0%	37.2%	29.8%	23.0%	100%
	Medium	3.5%	13.7%	46.8%	36.0%	100%
	Large	1.4%	3.8%	11.0%	83.9%	100%
	Total	6.3%	14.6%	25.0%	54.1%	100%

Note. Numbers in each cell are expressed in percentage. Rows of Panel A and B add up to 100%. Each cell reports the percentage of workers by firm size in 2015 (in rows) that transitioned into a given frim size in 2016 (in columns). For example, the cell in the first row and first column of Panel B indicates that 31% of workers who were employed in micro firms that exited and had found employment by the end of 2016 were employed in another micro firm by the end of 2016.

Appendix Tables

Table A.1. Difference in estimates of the minimum wage hike, continuous treatment measure, 2015-2016

Continuous treatment	**Years: 2015-2016**							
Dependent variable: firms' exit in the cell	**All cells**		**Balanced Panel**		**Excluding top 5% and bottom 5% of exposure**		**Excluding top 25% and bottom 25% of exposure**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Difference-in-difference coefficient	0.014***	0.016***	0.012***	0.014***	0.015***	0.016***	0.019*	0.020*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.012)	(0.011)
Cell-level controls	No	Yes	No	Yes	No	Yes	No	Yes
Number of observations	30,451	30,451	23,376	23,376	27,397	27,397	15,129	15,129

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 reported in parentheses. The vector of cell-level control variables includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. 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.

Table A.2. Difference in estimates of the minimum wage hike, binary treatment measure

Discrete treatment	**Years: 2015-2016**							
Dependent variable: firms' exit rate in the cell	**All cells**		**Balanced Panel**		**Excluding bottom and top 5% exposure**		**Excluding bottom and top 25% exposure**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Difference-in-difference coefficient	0.0018*** (0.0005)	0.0019*** (0.0005)	0.0017*** (0.0005)	0.0018*** (0.0005)	0.0017*** (0.0005)	0.0018*** (0.0005)	0.0023*** (0.0007)	0.0023*** (0.0007)
Cell-level controls	No	Yes	No	Yes	No	Yes	No	Yes
N (sample size)	30,451	30,451	23,376	23,376	27,397	27,397	15,129	15,129
Discrete treatment	**Years: 2012-2016**							
Dependent variable: firms' exit rate in the cell	**All cells**		**Balanced Panel**		**Excluding bottom and top 5% exposure**		**Excluding bottom and top 25% exposure**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Difference-in-difference coefficient	0.0026*** (0.0004)	0.0030*** (0.0004)	0.0026*** (0.0004)	0.0029*** (0.0004)	0.0026*** (0.0004)	0.0030*** (0.0004)	0.0022*** (0.0006)	0.0025*** (0.0006)
Cell-level controls	No	Yes	No	Yes	No	Yes	No	Yes
N (sample size)	71,754	71,754	57,648	57,648	64,621	64,621	35,863	35,863

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 reported in parentheses. The vector of cell-level control variables includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. 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.

Table. A3. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, for alternative cell size cutoffs

Continous treatment	Minimum number of firms in the cell				
Dependent variable:	>=40	>=60	>=70	>=80	>=90
firm exit rate in the cell	(1)	(2)	(3)	(4)	(5)
Difference-in-difference coefficient	0.023***	0.023***	0.024***	0.025***	0.025***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Number of observations	84,897	62,376	54,945	49,050	44,240

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 reported in parentheses. All regressions include a vector of cell-level control variables that include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies.

Table. A4. Difference in difference estimation of the minimum wage hike effect on firms' exit rates, including non-permanent exits

Continuous treatment	Years: 2012-2016			
Dependent variable:	Permanent exits only		All exits	
Exit rate of firms in the cell	(1)	(2)	(3)	(4)
Difference-in-difference	0.021***	0.026***	0.027***	0.034***
coefficient	(0.004)	(0.004)	(0.004)	(0.004)
Cell-level controls	No	Yes	No	Yes
Observations	71,754	71,754	71,754	71,754

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 reported in parentheses. All regressions include a vector of cell-level control variables that include: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. Cells are included in the sample if they consist of at least 50 firms.

Table A.5. Placebo effects of the minimum wage hike, discrete treatment measure

Discrete treatment Dependent variable: exit rate of firms in the cell	Placebo period					
	2012-2013		2013-2014		2014-2015	
	(1)	(2)	(3)	(4)	(5)	(6)
Difference-in-difference coefficient	0.0005	0.0004	0.0001	0.0006	0.0001	0.0003
	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)
Cell-level controls	No	Yes	No	Yes	No	Yes
Number of observations	26,723	26,723	28,763	28,763	29,977	29,977

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 reported in parentheses. The vector of cell-level control variables includes: quarter dummies, the average firm size in the cell, the average firm age, regional dummies, broad sectoral dummies and time dummies interacted with regional dummies. Cells are included in the sample if they consist of at least 50 firms. Cells are included in the sample if they consist of at least 50 firms.