

# The Impact of the Minimum Wage on Firm Destruction, Employment and Informality

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## Abstract

This paper studies the effects of a large increase in the minimum wage on the destruction of formal firms, and the associated impacts on employment, wages, and informality in a developing economy. It examines the ramifications of a 33 percent nominal increase in the minimum wage that took effect in Turkey in 2016. It utilizes an exceptionally rich, employer-employee-linked dataset that shows the wage distribution within firms, which enables to measure the degree of firms' minimum-wage exposure, and to estimate causal effects using a difference-in-differences approach. The paper shows that raising the minimum wage substantially increased the destruction of formal firms, leading to a fall in the number of formal firms in the economy. Effects are concentrated among small firms with low levels of productivity;

highly productive firms are unaffected. The minimum-wage increase had negative effects on formal employment that largely originated through firm destruction, rather than through cuts in formal employment within surviving firms. Among workers who lost jobs in firms that ultimately exited, only a minority had obtained new employment a year later. The minimum-wage increase was accompanied by a rise in inactivity and unemployment, rather than growth of informal employment, suggesting that workers who lost formal employment mostly failed to find new jobs one year after the minimum wage hike, even informally. While the higher minimum wage had large, positive effects on the wages of formally employed workers, limited effects on the wages of informal workers are reported.

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# The Impact of the Minimum Wage on Firm Destruction, Employment and Informality\*

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# 1. Introduction

The minimum wage is an increasingly popular policy tool globally. Studies on countries of various income levels and stages of development find that minimum wages boost labor income by raising wages in the formal sector, thereby lessening deprivation (de Janvry and Sadoulet, 1996; Devereux, 2005; Bird and Manning, 2008; Gindling and Terrell, 2010; Lustig and McLeod, 1997; Saget, 2001). Such labor wage regulations are intended to improve workers' welfare, but a rise in labor costs can reduce the number of employees firms have the capacity to hire and retain, and can squeeze profit margins to such a degree that firms' survival may be at risk (Draca, Machin, and van Reenen, 2011). The minimum-wage literature on firm-level responses has been growing in high-income countries in recent years, but it remains quite sparse for developing countries.<sup>1</sup> In addition, due to data limitations, firm-level outcomes are typically analyzed in isolation from worker-level outcomes. The issue warrants greater attention; firm-level responses and welfare effects of the minimum wage may be different in developing-country settings, given prevailing labor-market characteristics, such as weak allocative efficiency, low firm productivity, and high informality.

This paper addresses this gap by studying the effects of raising the minimum wage on formal firm destruction, and the accompanying impacts on informal and informal employment in the context of a developing economy. We analyze the repercussions of this increase by using an extremely rich, employer-employee-match dataset that covers the universe of registered private firms and formal workers in Turkey.<sup>2</sup> This enables us to look jointly at the impacts of the minimum wage on firms and workers. We supplement this with data from a nationally representative survey on labor-market outcomes of the Turkish population; these data include representative samples of those who are employed (in formal and informal work), and those who are unemployed or out of the labor force. We estimate the effects of the minimum wage increase by exploiting a sharp rise by 33 percent in nominal terms that took effect in 2016. Though we mainly focus on firm destruction, our findings also shed light on impacts on workers' employment in formal and informal firms, and unemployment in the wake of the wage increase. Thus, the paper also provides insights on the broader employment and welfare

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<sup>1</sup> In high-income countries, primarily in the US and the UK, the literature has looked at the effect of the minimum wage on firm profitability, stock market value, productivity, location, entries and exits, and consumer prices (Aaronson, 2001; Aaronson and French, 2007; Aaronson et al., 2018; Allegretto and Reich, 2018; Bell and Machin, 2018; Draca, Machin, and van Reenen, 2011; Riley and Rosazza-Bondibene, 2017; Rohlin, 2011).

<sup>2</sup> In contrast, the vast majority of studies looking at firm responses to the minimum wage, including in high-income countries, rely on a sample of firms above a given size threshold and in specific sectors of the economy.

effects of the minimum wage in the context of a developing economy, in which workers are more likely to rely on informal employment to a greater degree.

Our work distinguishes between two sources of employment effects: employment destruction coming from firm exits (the extensive margin), and employment cuts in surviving firms (the intensive margin). The paper assesses their respective contributions to aggregate effects. Because the data allow us to track workers over time, we also study the labor-market trajectories of workers in firms that were eliminated after the minimum-wage increase, revealing potential reallocation effects. By complementing the administrative data with data from the nationally representative survey, we provide evidence on whether the destruction of formal firms and formal jobs was accompanied by a rise in informal employment and/or a rise in unemployment.

We find that raising the minimum wage substantially increases the destruction of formal firms and reduces the number of formal firms in the economy. The magnitude of the effect is sizable and robust to alternative specifications, sample restrictions, and treatment measures. Firm destruction, however, is primarily concentrated among firms that are small and had such low productivity levels that they were only marginally above subsistence before the minimum-wage increase. This suggests that minimum-wage increases can contribute to productivity gains in the formal economy by driving out less-productive firms. As expected from simple economic theory, the findings show that market conditions matter: the rise in firm destruction attributable to the minimum wage is stronger in industries with small profit margins, higher labor shares, and stronger market competition.

The paper also finds negative effects on formal employment overall and shows that firm destruction (the extensive margin) is the main driver, as opposed to employment cuts in continuing firms (intensive margin). In theory, the elimination of low-performing firms can help workers upgrade to higher-quality jobs in higher-performing firms; however, we find that, a year after the rises in the minimum wage, only a minority of workers from firms that exited had found in other, formal employment. Using complementary data from surveys, we find that the decline in formal employment was accompanied by a rise in inactivity and unemployment, as opposed to a rise in informal employment. This suggests that workers from these exiting firms mostly failed to find employment one year after the minimum wage hike.

The paper makes several contributions to the minimum wage literature. First, it is one of very few papers to investigate firm responses going beyond employment cuts for a developing country.<sup>3</sup> Compared to the prior contributions that looked at firm-level responses to the minimum wage in developing economies (Hau, Huang, and Wang, 2016; Mayneris, Poncet, and Zhang, 2018), we take advantage of a very rich linked employer-employee dataset that enables us to link firm destruction to boarder employment and reallocation effects, as well as informality. Overall, our paper is also one of the very few in the minimum-wage literature to jointly examine impacts on both firm- and worker-level outcomes, which has been even more rare for developing economies.<sup>4</sup>

To the best of our knowledge, it is also the first paper to assess impacts on firm destruction for the universe of registered firms in the economy, including small firms which predominate in developing countries.<sup>5</sup> Compared to prior contributions, the granularity of the data allows us to shed light on heterogeneous effects across firm types – an area of study that is critical for understanding productivity and allocative efficiency – which may have been missed by prior contributions.

Our paper also contributes to the very thin literature on the efficiency gains and reallocation effects of the minimum wage. It is only the second paper to examine reallocations among workers as a result of the minimum wage by tracking workers who leave exiting firms, and it is the first to address this issue in a developing-country economy.<sup>6</sup> Our results suggest that productivity gains from the minimum wage in the formal sector emerge through the elimination of firms with low levels of productivity. However, these productivity gains are somewhat offset by a lack of worker reallocation into more-productive firms, at least in the short run. One year after the minimum-wage increase, a minority of workers from exiting firms were employed in formal firms, and indicative evidence suggests that most had exited the labor force or were unemployed.

The paper also shades new light on the long-standing debate on the employment effects of the minimum wage. To the best of our knowledge, this is the first paper to explicitly distinguish between employment effects originating from employment cuts made by surviving firms (the intensive margin),

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<sup>3</sup> To the best of our knowledge, recent exceptions are Mayneris, Poncet, and Zhang (2018), who focus on the impact of a minimum wage increase on value added, productivity, and profits in China. Hau, Huang, and Wang (2016) also examine the substitution of labor for capital by Chinese firms in response to the minimum wage.

<sup>4</sup> To the best of our knowledge, the only recent paper using employer-employee linked dataset to look at the impacts of the minimum wage in the context of a developing economy is Engbom and Moser (2021), although their dataset does not include detailed information on firm outcomes as in this paper. In the context of an advanced economy, Dustmann et al. (2020) also look at the joint effects of the minimum wage on firms and workers.

<sup>5</sup> Prior contributions looking at the minimum-wage impacts on firm exits are restricted to the restaurant industry in the US (Aaronson et al., 2018; Luca and Luca, 2019; Ashenfelter and Jurajda, 2021).

<sup>6</sup> Dustmann et al. (2020) have recently looked at this question in the context of Germany.

and those from firm destruction (the extensive margin); and to assess the respective contributions to net employment effects in the context of a developing economy. In contexts where informal employment remains common, the paper also sheds light on the channels of formal employment changes in response to a change in the minimum wage.<sup>7</sup>

Finally, the paper adds to the limited evidence on the impact of the minimum wage on the respective size of the formal and informal sectors in contexts in which informality remains common. In settings in which regulation enforcement is weak, labor regulations can affect the allocation of employment and economic activity between the formal and informal sectors by raising relative labor costs in the formal sector (Brown, 1999; Botero et al., 2004; Del Carpio and Pabon, 2017). The paper thus links to the broader debate on labor market regulations and informality introduced by De Soto (1989), as well as to theories of dualism, where the gap between formal and informal labor costs affects the allocation of firms between the formal and informal sectors (La Porta and Shleifer, 2014; Meghir, Narita, and Robin, 2015; Ulyssea, 2018).

Because Turkey shares many similarities with other developing economies, we expect the findings of this paper to be of wider relevance. First, the informal sector in Turkey remains prominent, as is the case in many developing economies. In this context, the existence of a large informal sector may help alleviate adverse employment effects of a minimum wage, but also may contribute to increasing the use of informal employment. For example, firms may employ some of their workers off the books without social security registration to avoid labor regulations and mandatory labor costs set by the minimum wage. Second, the economy of Turkey is characterized by weak allocative efficiency, with a large share of small firms with low levels of productivity; this is a characteristic of many developing-country economies. Third, labor productivity remains low due to lower levels of human capital among workers. As a result, a large proportion of workers are low-wage workers and paid the minimum wage – features that characterize many developing-country economies.<sup>8</sup>

To estimate the causal effect of an increase in the minimum wage on firm exits from the formal economy, we take advantage of a new, national law that led to a 33 percent increase in the nominal minimum wage in Turkey. The new minimum wage was set at the end of 2015 and took effect at the beginning of 2016. The dataset that we use to analyze the effects of the change include the wages of all registered workers in each registered firm in the Turkish economy. Thus, we are able to precisely

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<sup>7</sup> For example, see Comola and de Mello (2011); Gindling and Terrell (2005); and Lemos (2009).

<sup>8</sup> Before the 2016 minimum-wage increase, 54 percent of registered workers in Turkey were paid the minimum wage.

measure the exposure of a given firm to the minimum wage as the proportional rise in the wage bill that is needed to bring the wages of all workers up to the new statutory minimum level (Draca, Machin, and van Reenen, 2011). We then implement a difference-in-differences estimation strategy whereby we measure and compare the change in exit rates among high-exposure firms (the treatment group) and low-exposure firms (the control group) before and after the minimum- wage increase. To ensure the validity of the identification strategy, we run several placebo tests in periods prior to the minimum-wage increase. We also provide evidence that the estimated effects are unlikely to have been driven by other shocks that affected the Turkish economy.

The paper is organized as follows: Section 2 provides background information on the minimum wage in Turkey, and on the increase that took effect in 2016. Section 3 describes the employee-employer-linked dataset and the national labor force survey that we use for our estimations and reports descriptive statistics. Section 4 presents the identification strategy and provides supportive evidence for its validity. Section 5 reports the main results on the exit of formal firms and on formal employment destruction. It also explores the potential reallocation of workers from exiting firms. Section 6 concludes.

## **2. Background on the minimum wage in Turkey**

### **2.1. Institutional setting**

In 1974, Turkey established a nationwide minimum wage, with no variations across regions, industries, or occupations (Gürçihan and Yüncüler, 2016). By law, the national minimum wage must be adjusted at least every two years, although it has been modified every year over the past decade. Following a series of weekly consultations, the new, monthly minimum wage is typically announced for each year in December prior to the year in which it will take effect. The minimum wage can be set either as a single minimum wage that will be implemented for the full year, or for a graduated wage that has one level for the first half of the year, followed by another level for the second half. The minimum-wage-setting consultations are conducted by the Minimum Wage Fixing Commission, a tripartite process of collective bargaining involving the government, the largest labor unions, and the largest employer associations. Decisions are made based on the majority in the voting among members.

As of 2016, Turkey exhibited the highest Kaitz ratio – the ratio of minimum wage to the mean or the median wages – among countries of the Organisation for Economic Co-operation and

Development (OECD) (Figure A.1). The ratio in Turkey was 0.74 compared with the OECD average of 0.53. As result, a large share of workers formally employed in Turkey are paid around the minimum wage. In the last quarter of 2015, shortly before the minimum wage rose, over half the registered workers in Turkey were paid at around the minimum wage. This implies that any sizable increase in the minimum wage would have a substantial impact on labor costs among formal-sector firms that employ workers.

While the minimum wage to median wage ratio in Turkey is on the high end of the distribution of minimum wages in advanced economies, high Kaitz ratios are quite common in developing economies. For example, the ratio of the minimum wage to median wages was 0.68 in Peru, 0.78 in Brazil, 0.98 and Philippines and 1.05 in Indonesia (Rani et al., 2013). Therefore, the relative level of the minimum wage in Turkey is similar to that observed in many other developing economies that have a mandatory minimum wage in place.

Firms in Turkey strictly comply with the minimum wage when their workers are registered with social security.<sup>9</sup> Informality at the firm level is rare due to low cost of firm registration and a high probability of detection. Formality at the worker level within firms, on the other hand, is more widespread as it is costly while the probability of detection of unregistered employment by authorities is fairly low (Taymaz, 2009). Employers must pay between 22 percent and 27 percent of registered workers' monthly gross wage in a security premium, which is high by international standards. As a result, informal employment – that is, not registering workers with social security institutions – remains common at the worker level, even though it has declined in recent years (Figure 1). As of 2015, about 22 percent of wage workers in non-agricultural employment (the population of interest in this paper) were not registered with social security institutions. This proportion rises to 30 percent when all workers in non-agricultural worker, included the self-employed, are considered, and to 40 percent when the agricultural sector is included.

## 2.2. The 2016 minimum-wage increase

In December 2015, Turkey drastically increased the national minimum wage compared to previous years. The nominal minimum wage was raised by 33 percent, from an average of 975 TL (about

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<sup>9</sup> According to social security records, virtually 100 percent of workers who are registered with social security institutions are paid at least the minimum wage.

260 USD) per month in 2015 to 1300 TL (about 350 USD) in net terms.<sup>10</sup> With an inflation rate of 8.8 percent in 2015, the increase represented a rise of about 24 percent in real terms. By contrast, the minimum-wage increases in previous years had ranged from 5 percent to 8 percent annually in nominal terms, levels that were roughly aligned with consumer expectations and realizations about inflation (Figure 2). To alleviate possible negative employment effects of the 2016 minimum-wage increase, the government introduced a subsidy of 100TL of employers' social security contributions for employees whose wages were at a level below twice the minimum wage of 2015. As a result, the cost of minimum wage to employers increased by about 26 percent in January 2016.

The increase in the minimum wage was largely politically motivated and driven by the electoral competition in 2015 (Akgunduz et al., 2019). All political parties promised a sharp increase in the minimum wage in their campaigns before the November 2015 elections, and they competed with one another over the magnitude of the raise promised. The ruling Justice and Development Party (AK Party), which was re-elected, promised a net minimum wage of 1300 TL. Consequently, the new minimum wage was set at this level on January 1<sup>st</sup>, 2016. The political process that led to the new minimum wage suggests that the change was largely exogenous to the internal dynamics of the economy, and instead was mainly driven by the exogenous political competition. The 2016 minimum wage thus appears to constitute a valid experiment to study the causal effects of the minimum-wage increase on firms and employment.<sup>11</sup>

### **3. Data**

#### **3.1. The Turkish Enterprise Information System**

The primary data source used in this paper is the Turkish Enterprise Information System (EIS), an exceptionally rich, linked, employer-employee dataset covering the universe of registered non-financial firms in the economy. The records of registered employees of a given registered firm are linked to the records of that firm. The firms and their employees are observed every quarter from

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<sup>10</sup> The Turkish minimum wage was of 950 TL in the first half of 2015, and 1000 TL in the second half.

<sup>11</sup> We provide further evidence on the validity of the identification strategy in the remainder of the paper.

2006 to 2016.<sup>12</sup> In 2012, the registry adopted a panel structure with unique firm and worker identifiers that allow both firms and workers to be followed over time.

The registry includes very detailed information at the firm level. It has rich information on financial statements—net sales, asset and liability statements, debt, and profits—among firms that pay institutional and corporate taxes. The database also contains records on capital and machinery stocks, capital expenditures, labor costs, exports and imports, and output and income. The data also include standard information on age, the economic sector at the four-digit level, and the geographical location of firms up to the district level.<sup>13</sup>

At the worker level, the registry includes individual-level information on workers who are registered with the Turkish Social Security Institution and employed in those firms. As of 2016, the EIS database included about 12.6 million workers, representing the universe of formal wage workers in nonfinancial sectors, and about 80 percent of all wage workers.<sup>14</sup> Information on the age, gender, occupation, days worked, and wages is available for each registered worker. This allows us to calculate total employment and the total wage bill for each registered firm by quarter.

A first major advantage of using the EIS database to study the impacts of the minimum wage is that it has no minimum threshold for firm size. This is a critical feature for analyzing firm responses to the minimum wage, especially in the context of a developing economy in which small firms predominate. In Turkey, 50 percent of all registered firms have at most two employees, and 75 percent have at most five employees. These firms typically pay low wages, and, as a result they are more exposed to increases in the minimum wage. A second attractive feature of the EIS is the broad coverage of sectors of activity: it includes registered private firms in all sectors of activity, apart from the financial sector. We can thus examine the effects of the minimum wage on the formal economy as a whole, and we can examine heterogeneous effects across sectors.

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<sup>12</sup> The EIS was constructed by merging various administrative datasets across government entities in an effort led by the Ministry of Industry and Technology. The original sources of the administrative datasets included the Ministry of Industry and Technology, the Ministry of Trade, the Revenue Administration, the Social Security Institution, the Small and Medium Business Development and Support Administration, the Turkish Statistical Institute, the Turkish Patent and Trademark Office, and the Scientific and Technological Research Council of Turkey.

<sup>13</sup> Turkey has 923 districts.

<sup>14</sup> Those in the remaining 20 percent are largely agricultural workers who are rarely registered with social security institutions.

One limitation of the EIS database is that it only covers registered firms and workers. In Turkey, about a fifth of wage workers are informally employed. This means that workers drop out of the registry when they either lose their job, or when they accept jobs that are “off the books” in the same firms or in another firm. Workers who transition into informal employment or unemployment are no longer observed in the database. Similarly, firms are no longer observed in the database if they shut down or, alternatively, if they no longer employ registered workers.

### 3.2. The Turkish Household Labor Force Survey

To assess the impacts of the minimum wage on informal employment and total employment, we complement our causal analysis (which relies on the EIS registry) with data from a nationally representative survey. This allows us to gain insights into whether workers who lost their formal jobs due to firm destruction following the raising of the minimum wage remained formally employed, transitioned into informal employment, or became unemployed. We use data from the Turkish Household Labor Force Survey (HLFS), a nationally representative household survey conducted annually from 2000 to 2018. The survey collects detailed information on labor-market outcomes of the Turkish population, including representative samples of those in formal and informal employment, and those who are unemployed or out of the labor force. The survey distinguishes the formality status of each worker by the response given to a question on whether employed individuals are registered with social security institutions – the definition of formality also used by the EIS registry. In addition, the survey records the wages of both formal and informal workers, allowing one to look at potential “lighthouse” effects of the minimum wage on the wage of informal workers who are outside the scope of formal labor regulations.

### 3.3. Descriptive statistics

Table 1 reports summary statistics from the EIS data on the composition and characteristics in the population of registered firms in Turkey. Microenterprises and small firms represent the large majority of formal firms in Turkey. Half of all formal firms are microenterprises with no more than 2 formal employees each; 72 percent of formal firms have no more than 5 employees, and 84 percent have no more than 10 employees. These statistics highlight the importance of having data that cover firms of all sizes with no minimum-employment threshold when assessing the impact of the minimum wage on firms in developing economies.

Despite the small share of firms with more than 50 employees, formal employment is concentrated in large firms. Firms with more than 50 employees represent fewer than 3 percent of formal firms, but employ more than 50 percent of formal workers. Medium firms (10–49 workers) account for close to one-fourth of total employment; small firms employ 21 percent of formal workers. The distribution of formal workers across firms by size, and the greater exposure of small firms to the minimum wage have implications for the potential employment effects of the minimum wage.

Table 1 also shows that the minimum wage is strongly binding for formal firms in Turkey. In the quarter before the 2016 minimum-wage increase, more than half of the formal workers in formal firms received a wage roughly equal to the formal minimum wage. There is a clear relationship between the size of firms and the wages of workers. Microenterprises and small firms pay the lowest wages in the formal sector, and they employ a large share of workers at the minimum wage. Shortly before the 2016 increase, 93 percent of formal workers in microenterprises earned the minimum wage. By comparison, about 70 percent of workers in medium firms earned the minimum wage, and 40 percent of workers in large firms earned the minimum wage. Thus, any increase in the minimum wage thus results in sizable labor cost expansions among formal firms, but particularly within small firms.

Figure 3 reports the total number of formal firms in the EIS administrative dataset by quarter in 2012–16. The number of formal firms in Turkey rose steadily from the first quarter of 2012 to the last quarter of 2015. The number of formal firms then dropped during the first quarter of 2016, right after the new minimum wage, and this number then continued to decline in the following quarters. Similarly, the growth rate in formal employment fell during the quarter immediately after the minimum wage rose; formal employment then continued to decline in absolute terms in the following quarters (Figure 4). This paper investigates whether the relationship between the minimum-wage increase and the drop in the number of formal firms and in formal employment is causal.

## **4. Identification strategy**

### **4.1 Measuring exposure to the minimum-wage increase**

The main challenge in identifying the effects of the 2016 minimum-wage increase is related to the nationwide implementation of the reform. The approach followed by previous work to address this

issue involves using heterogeneity in exposure to the minimum wage across geographical administrative units or firms (Caliendo et al., 2017; Card, 1992; Draca, Machin, and van Reenen, 2011; Harasztosi and Lindner, 2019; Machin, Manning, and Rahman, 2003; Stewart, 2002). The studies use information on average wages in regions or firms prior to the policy change to construct measures of exposure. They classify economic units into treatment and control groups according to the degree of exposure, and they then conduct a difference-in-differences estimation to identify causal effects.

This paper follows a similar approach in spirit, but we can more precisely measure exposure to the minimum wage than was possible in earlier work because we rely on information that incorporates the wages of all formal workers in each formal firm.<sup>15</sup> This attractive feature of the data makes a more accurate measure of exposure to treatment or intention to treat possible by allowing direct observations of exposure to the minimum wage.

We measure exposure to the minimum wage as the proportional increase in the wage bill required to pay the new, 2016 minimum wage to all workers who had earned wages below that level in the fourth quarter of 2015. Exposure is measured at the level of the cell, defined as the mass of firms in a given district in a given two-digit industry according to the European Classification of Economic Activities. Formally, the degree of exposure to the minimum wage in cell  $i$ , denoted  $E_i$ , may be expressed as follows:

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

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 formal workers in all formal firms. (The quarter subindex is omitted here for simplicity.) The measure (if multiplied by 100) reflects the percentage wage increase necessary to increase the wages of all workers in the region to the level of the minimum wage.

The reason for measuring minimum-wage exposure at the cell level rather than at the firm level relates first to the nature of the outcome variable of interest – that is, the exit of firms from the formal sector. While a firm-level approach can be suitable when studying firm-level outcomes

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<sup>15</sup> Draca, Machin, and van Reenen (2011) and Harasztosi and Lindner (2019) use the average wage in the firm as a proxy for firm exposure to the minimum wage.

among those enterprises that continue before and after a minimum-wage increase, it is problematic to study firm exits in the context of a one-time nationwide increase like ours.<sup>16</sup> Because we measure minimum-wage exposure shortly before the minimum wage rose, the exposure is only observed among firms that were still operating in the last quarter of 2015, and had not exited before then. The wage distribution within firms that exit before the last quarter of 2015 – our measure of exposure to the minimum wage – cannot be observed. The pretreatment exit rate of firms among which minimum-wage exposure is observed at the end of 2015 is therefore zero by design, for both low and high exposure firms. This precludes the use of a difference-in-difference estimator at the firm level.

Second, using a cell-level approach allows for greater variation in the minimum-wage exposure measure. Most firms in the data have only one or two employees, and 54 percent of registered workers in the database were paid at the minimum wage prior to increase in its level. In micro firms – which constitute more than half of firms in the data – over 90 percent of workers were paid at the minimum wage prior to the rise in the minimum wage (Table 1). Because of these features of the Turkish economy, around three-quarters of firms in the database have a maximum exposure of 0.26 to increases in the minimum-wage level. This generates significant lumping in the firm-level exposure measure, with an average exposure of 0.22, and a standard deviation of 0.01. By contrast, the cell-level approach ensures greater variation in treatment exposure across geographical administrative units.<sup>17</sup> The mean and median of the cell-level exposure are 0.13 and 0.15, respectively, with a standard deviation of 0.07.

## 4.2. Increases in the minimum wage and the actual wage in formal firms

Before assessing the impact of the increase in the minimum wage on formal firm destruction, we first document whether raising the minimum wage affected firms' labor costs in the expected direction. Given the large share of registered workers paid the minimum wage in Turkey, we expect the rise in mandatory labor costs (intention to treat) to have a positive and large effect on

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<sup>16</sup> Dustmann et al. (2020) also use a regional cell-based approach when studying the effects of a nationwide increase of the minimum wage on firm exits and on the number of firms in Germany. Luca and Luca (2018) use a firm-level approach, but they are able to exploit temporal and spatial variation in minimum-wage increases across cities; this is not possible in our context of a nationwide increase.

<sup>17</sup> The analysis excludes cells with fewer than 50 firms from the sample. This restriction eliminates about 20 percent of firms in the original sample. Appendix A, Table A.3., assesses the robustness of the main results to using alternative thresholds for the minimum number of firms in the cell.

the wages paid by firms to registered workers (the treatment). Figure 5 clearly shows that the increase in the statutory minimum wage in 2016 translated into a sharp rise in the average daily wage among formal workers in formal firms. Time series show a clear break in the growth rate of average daily wages paid to registered workers in 2016 relative to prior trends.

### 4.3. Difference-in-differences estimation

We undertake a difference-in-differences approach by separating economic cells into two categories according to the level of exposure to the minimum-wage increase  $E_i$ . Cells with exposure above a given threshold ( $E > E^*$ ) are categorized as high-exposure cells, while cells with exposure equal to or below the exposure threshold ( $E \leq E^*$ ) are classified as low-exposure cells.<sup>18</sup> The impact of the minimum-wage hike on exit rates in the cell can be estimated by comparing outcomes before and after the minimum-wage increase across these treatment and control cells.

Under the parallel-trend assumption, a valid difference-in-differences estimate of the effect of the minimum-wage hike on firm exit rates is  $(\bar{Y}_{POST=1}^{E>E^*} - \bar{Y}_{POST=1}^{E \leq E^*}) - (\bar{Y}_{POST=0}^{E>E^*} - \bar{Y}_{POST=0}^{E \leq E^*})$ , where  $POST$  is a binary indicator equal to one if the cell is observed in quarters after the minimum-wage hike, and equal to zero otherwise. The difference-in-differences estimate is the simple difference in exit rates between high-exposure and low-exposure cells before and after the minimum wage rose. We follow the standard definition of exit rates, and compute exit rates  $Y_{it}$  in cell  $i$  and time  $t$  as follows:

$$Y_{it} = \frac{n_{it}^{exit}}{N_{it}} \quad (2)$$

where  $n_{it}^{exit}$  denotes the number of exiting firms in cell  $i$  and quarter  $t$ , and  $N_{it}$  is 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 if it is no longer in the registry in

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<sup>18</sup> The median level of exposure,  $E$ , to the minimum-wage hike in the sample of cells (0.135) is used as the treatment threshold,  $E^*$ .

quarter  $t$ , with no reentry in subsequent quarters. Although most exits from the registry are permanent, this restriction is motivated by the fact that a sizable share of firms exiting the registry in one quarter reentered in later quarters.<sup>19</sup> This pattern is likely driven by seasonality in economic activities in certain sectors. In a regression setting, a difference-in-differences estimate of the effect of the minimum-wage hike on firm exits can be expressed as follows:

$$Y_{it} = \alpha + \beta [D(E_i > E^*) \times \text{POST}] + \theta D(E_i > E^*) + \varphi \text{POST} + \pi X_i + \delta Q_t + \mu R_i + \sigma R_i \times Q_t + \varepsilon_{it} \quad (3)$$

where  $X_i$  is a vector of cell-level observable characteristics that may be correlated with exposure status and exit rates.  $Q_t$  denotes a set of quarter dummies from the first quarter of 2012 to the fourth quarter of 2016;  $R_i$  is a vector of region dummies; the interaction  $R_i \times Q_t$  captures region-specific time shocks; and  $\varepsilon$  is a random error term. Our main coefficient of interest is  $\beta$ , which measures the effect of the minimum-wage hike on the exit rate of formal firms. Instead of a binary measure, the preferred treatment measure is the continuous treatment  $E_i$  because it utilizes the full variation in exposure to the minimum wage in the data.<sup>20</sup> The preferred difference-in-differences specification is thus given by:

$$Y_{it} = \alpha + \beta [E_i \times \text{POST}] + \theta E_i + \varphi \text{POST} + \pi X_i + \delta Q_t + \mu R_i + \sigma R_i \times Q_t + \varepsilon_{it} \quad (4)$$

#### 4.4. Variations in the exposure to the increase in the minimum wage

Figure 6 reports the distribution of the minimum-wage exposure measure  $E$  at the cell level. The treatment exposure ranges from 0 percent to about 22 percent, and the median exposure is 13.3 percent. As shown in Figure 6, there is substantial variation in exposure across the economic cells in the sample. A sizable share of the 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 increase thus exhibits substantial variation to identify treatment effects. The substantial incidence

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<sup>19</sup> To assess the robustness of our findings, we also use an alternative measure by calculating exit rates using all firm exits, including nonpermanent ones.

<sup>20</sup> Appendix A, table A.1, however, also reports the difference in differences estimates using equation 4, which relies on the binary measure of exposure to the minimum wage increase.

of high exposure levels among cells also reinforces the importance of investigating the causal effects of the rise in the minimum wage.

#### 4.5. Exposure to treatment and actual increases in labor costs

Before estimating the treatment effect of interest, we verify that a disproportionate wage rise is observed in high-exposure cells relative to low-exposure cells after the minimum-wage hike. Figure 7 depicts the trends in wages in these two categories of cells during the periods surrounding the minimum-wage increase. It shows that firms with greater exposure to the minimum-wage increase experienced disproportionate wage growth afterwards. While a 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 greater exposure to the minimum-wage level in high-exposure firms translated into greater wage rises after the minimum wage rose. By contrast, the trends in the annual growth of wages in low-exposure and high-exposure cells appear to have been parallel prior to the 2016 minimum-wage increase (Figure 7). Table 4 reports our difference-in-difference estimates of wage effects at the cell level and shows that the effect of the minimum wage on the wages of formal workers is large and highly statistically significant. In terms of magnitude, the difference-in-differences coefficient estimates indicate that wages increased by 5.5 percent more in cells with 10 percent exposure to the hike compared to cells that were not exposed at all to the minimum wage. The increase in the minimum wage thus disproportionately increased labor costs in cells with high exposure to the minimum wage increase.

## 5. Results

### 5.1 Baseline results

Simple economic theory posits that firms remain in the market if they generate nonnegative profits from their activities. If firms cannot fully report wage rises in output prices, the exit of firms from the formal economy is expected to expand as a result of higher, mandatory labor costs. In this setting, the firm-specific effects on exits will depend both on how close firms are to a zero-profit margin prior to the minimum-wage rise, and on the ability of firms to use other margins of adjustments to absorb the growing labor costs. Figure 8 illustrates descriptive trends in firm exit rates in high-exposure cells relative to low-exposure cells from 2012 to 2016. Firm exit rates were greater in high-exposure cells before the minimum wage rose, but they moved in parallel over the pre-minimum wage hike period from 2012 to 2015. However, once the 2016 wage increase took

effect, the gap between the two cells widened, with firm exit rates among higher-exposure cells experiencing a pronounced rise (Figure 8).

Table 2 reports the baseline results of the difference-in-differences estimation. Coefficients are estimated for the full 2012–16 period using the continuous measure of treatment as described in Equation 4. The unconditional difference-in-differences estimate reported in Column 1 is positive and statistically significant, indicating that the minimum-wage hike substantially increased the exit of firms from the formal economy. The inclusion of a vector of cell-level characteristics as control variables does not substantially affect the magnitude or significance of the baseline estimates (Table 2, Column 2). This alleviates potential concerns that the exposure measure might be correlated with cell and firm characteristics that also might affect the trends in exit rates. These findings are robust to the use of a binary measure of treatment (Appendix A, Table A.1). The results also hold if the period of estimation is restricted to the 2015–16 period rather than to the full 2012–16 period (Appendix A, Table A.2). The main results are also robust to changes in the exit rate measure and in the minimum number of firms per cell to be included in the sample (Appendix A, tables A.3 and A.4).

Even after accounting for cell-level observable characteristics, one may still be concerned by systematic differences in unobservable characteristics that could be correlated with trends in exits rates in high- and low-exposure cells. Specifically, one may suspect that cells with low or high exposure may differ in several unobservable characteristics that could drive the results on exit rates. To alleviate this concern, we first trim the sample from the bottom 5 percent and top 5 percent of cells according to the degree of exposure to the minimum-wage increase. The main results are virtually unchanged once low- and high-exposure cells are excluded (Table 2, columns 3 and 4). Then, we trim the sample again by excluding cells in the bottom 25 percent and top 25 percent of the exposure distribution (Table 2, columns 5 and 6). The magnitude of the difference-in-differences estimates is similar to the baseline estimation and even slightly greater.

To assess the magnitude of treatment effects, we compare our estimates with the mean pretreatment value of the outcome of interest – that is, firm exit rates. Among firms in the control group, which had minimum-wage exposure below the median exposure level in the sample, the exit rate was about 0.03 percent during the last quarter of 2015. The estimates reported in Table 2 indicate that a 1 percent increase in minimum-wage exposure – by which we mean that a firm’s

wages must increase by 1 percent to comply with the new minimum wage – raises firm exit rates by about 0.3 percentage points. Thus, we find that a 1 percent increase in exposure to the minimum wage also increases firm exit rates by about 1 percent. In terms of effect size, a rise in the minimum-wage exposure by one standard deviation raises firm exit rates by about 0.08 of a standard deviation in the full sample.

Because the relationship between the minimum wage and firm destruction has been understudied, there are few benchmark estimates with which to compare our estimates. Available estimates so far are restricted to specific industries in the US, where the bite of the minimum wage is particularly strong. Aaronson et al. (2018) find that a 1 percent increase in the minimum wage raises the exit rates by about 2.4 percent among “limited service” restaurants, which heavily rely on minimum-wage workers, but has almost no impact on the exit rates of “full service” restaurants which rely less on minimum-wage workers. A study by Luca and Luca (2019), which also examines the US restaurant industry, finds that a 1 percent increase in the local minimum wage increases firm exit rates in the restaurant industry between 0.4 percent and 1 percent. Therefore, our estimates for firms in all sectors of activity of Turkey lie on the high end of previous estimates reported for the restaurant industry in the US.

To complement our findings on firm destruction, we also investigate the effect of the minimum wage on the total number of firms. That is, we examine the net effects of the wage increase on firm destruction and creation. In addition, we examine this issue by firm size, by distinguishing between the total number of microenterprises and firms that are larger. The results of these difference-in-difference estimations are reported in Table 3. As displayed in the table, the total number of firms is negatively affected by the minimum-wage hike, and the effect is statistically significant at the 1 percent level (Table 3, Column 1). Thus, the minimum-wage increase led to a net destruction of firms, with the entry of new firms failing to compensate for the loss of others.

Columns 2 and 3 of Table 3 report separate estimates of the net effect of the minimum-wage hike on the number of microenterprises and non-microenterprise firms separately. The effect of the minimum-wage increase on the number of microenterprises (one or two employees) is negative, large, and statistically significant at the 1 percent level. The effect on the number of non-microenterprise firms is also negative and statistically significant, but the coefficient estimate is less than half that among microenterprises (Table 3, Column 3). Relative to larger firms, the

number of microenterprises thus declines disproportionality as a result of the minimum-wage increase, and the decline in the total number of firms after the increase is mainly driven by the exit of microenterprises.

## 5.2. Validity of the identification strategy

The identification strategy relies on the assumption that changes in exit rates among low-exposure firms are a valid counterfactual for high-exposure firms. In a difference-in-differences setting, the estimator consistently identifies the effect of the minimum-wage hike if low-exposure and high-exposure firms would have exhibited parallel trends in exit rates in the absence of the treatment. While this cannot be directly tested, we examine whether this holds during the period prior to the rise in the minimum wage. Figure 8 provides some initial visual evidence about the validity of the parallel trend assumption. It shows that, although exit rates are higher in absolute terms in high-exposure cells, trends in exit rates prior to the minimum-wage hike are very similar for high-exposure cells (treatment group) and low-exposure cells (control group).

To formally assess whether exit rates rose more quickly among high-exposure cells prior to the minimum-wage increase, we run a series of placebo tests in periods before the change took place. To do so, we run the same difference-in-difference specification as in Equation 4 but for three previous time frames (2012–13, 2013–14, and 2014–15) rather than for the 2015–16 period. The logic behind these placebo tests is, in effect, to explore what would have happened if this level of increase in the minimum wage had been implemented at the beginning of 2013, 2014, or 2015 – that is, prior to the actual implementation in 2016. A finding that the coefficients associated with these placebo periods were significant and positive would cast doubt on the validity of the identification strategy, and suggest that the difference-in-differences estimates may capture confounding factors that affect control and treatment cells differently. Although, in fact, the minimum wage did increase at the end of these years (2012, 2013, and 2014), it is legitimate to consider these periods as placebo periods because the annual increase in the minimum wage in those years roughly followed the inflation rate (see Figure 2).

Table 4 reports the difference-in-differences coefficient estimates for the alternative placebo periods. The effect size of the placebos is about one-tenth of the effect size estimated in the actual treatment, and the effect size is statistically insignificant. This result is consistent across the placebo periods, and the results are similar in specifications with or without control variables. This indicates that shortly after the wage rise, a marked shift took place in the relationship between the low-paying status of firms and the likelihood of exiting the formal sector. Table A.5 reports similar results if the placebo tests are run with the binary treatment measure. This provides additional comfort that the difference-in-differences estimates are not contaminated by earlier trends in low- and high-exposure cells.

To further alleviate this potential concern, we also interact all year-quarter dummies from the period ranging from the first quarter of 2012 to the fourth quarter of 2016 with the continuous measure of exposure to treatment (see Autor, 2003). We then estimate a regression of the exit rate in the cells on this set of year-quarter dummies and exposure interactions, controlling for quarter effects, regional dummies, and a set of cell characteristics.<sup>21</sup> The interaction coefficients of this saturated regression are reported in Figure 9, along with the 95 percent confidence intervals. The first quarter of 2012 is the omitted category. The results suggest that the interaction coefficients are indistinguishable from zero in quarters prior to the first quarter of 2016. By contrast, the interaction coefficient in the first quarter of 2016 is large relative to the pretreatment period, and it is highly statistically significant.

A threat to the identification strategy is the fact that the minimum-wage hike may have been anticipated by firms, which could have begun responding in anticipation before it actually took effect. Yearly minimum-wage increases in years prior to the one in 2016 had all closely followed the inflation rate (Figure 2). One may thus expect that firms had similar expectations regarding the 2016 increase, and that they did not anticipate the passage of a 33 percent increase. The political process that led to the new minimum wage in 2016 suggests that the change was largely independent of the economic situation in Turkey. Moreover, the rise was not discussed throughout 2015; it only became likely after the elections in November of that year. Even after the elections, uncertainties and ambiguities about the minimum wage continued. For example, firms were uncertain whether the minimum wage would increase sharply in January or rise gradually

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<sup>21</sup> The characteristics include the average firm size in the cell, average firm age, and a broad sector of activity dummies (manufacturing, other industry, wholesale and retail, and other services).

throughout 2016. There were also questions about whether the promised minimum wages would include a minimum living allowance. Figure 8 also provides visual evidence that is reassuring in this respect. It does not show any noticeable increase in exit rates during the quarters prior to the minimum-wage hike among either high- or low-exposure cells, suggesting that firms did not anticipate the size of the wage increase that occurred. Therefore, the passage of such a sizable increase be treated as an exogenous shock.

Another possible concern relates to contemporaneous shocks that may contaminate causal estimates. In July 2016, a coup attempt took place in Turkey; however, there are several reasons why the coup attempt is unlikely to be a confounding factor in our estimates. First, the event took place in July 2016; by contrast, the sharpest decline in the number of registered in the wake of the wage increase occurred in the first quarter of 2016, six months prior to the coup attempt. The trends we observe in terms of firms and employees do not show any noticeable break or change after the coup; indeed, the quarterly difference-in-difference estimates reported in Figure 9 confirm this. These estimates also show that the effects of the hike largely manifested in the first quarter of 2016 before the coup. In addition, though isolated closures took place for large public firms run by suspected coup sympathizers after the coup, our population of focus is different. We study private firms only. Thus, effects on our estimates, if any, are expected to be minimal. Figure A.2 does not show a noticeable drop in the number of large private firms after the coup attempt compared to quarter three of the previous year. Even if the coup influenced firm destruction in a sizeable manner, this would disproportionately affect large firms. However, as reported in Table 3, our estimates for the impact of the minimum wage on firm destruction are larger for small firms. This is not compatible with the hypothesis that firm closures linked to the coup attempt are driving our results. Finally, even if larger firm closures were affected in a sizeable way, those firms tend to pay higher wages and, thus, they are less exposed to the minimum wage. As a result, if anything, the confounding effects of the coup attempt would lead to underestimate the impact of the minimum-wage hike on firm exits.

Another potential threat to identification concerns a geopolitical incident which took place with Russia towards the end of 2015 (Özgüzel and Aytun, 2020). The downing of a Russian fighter in the Syrian border region in late 2015 triggered a diplomatic incident between Russia and Turkey, resulting in targeted economic sanctions against Turkey in specific sectors of activity. Following

the incident, Russia temporarily banned the import of 17 Turkish agricultural products including fruits and vegetables, poultry and salt; prohibited the sale of charter holidays for Russians to Turkey; and halted construction projects with Turkish firms in Russia, unless a special exemption was granted. Among the population of firms in the EIS registry, only 3 percent were exporters in 2015; moreover, those firms that were exporting were mostly engaged in manufacturing, a sector which was not targeted by the sanctions (Akgunduz et al., 2019). In addition, Russia is not among the highest ranking destinations for exports from Turkey (it ranks 14<sup>th</sup> among all destinations), and less than 1 percent of firms in the registry were exporting to Russia as of 2015. An adverse effect of the sanctions on the survival probability of those firms, if any, would thus have a minimal influence on our estimates. Furthermore, exporting firms are typically larger and pay higher wages, making them less exposed to variations in the minimum wage. Thus, the confounding effect of the Russian sanctions, if any, would lead us to underestimate the effect of the minimum wage on firm destruction.<sup>22</sup>

A final consideration in the interpretation of our difference-in-difference estimates is the stable unit treatment value assumption (SUTVA), which states that the control group should be unaffected by the treatment intervention; that is, the control group should not react to the introduction of the new minimum wage. In our context, this assumption would be violated if there are spillovers from cells that are highly exposed to the minimum wage to those that are weakly exposed in a way that triggers firm closure. To provide comfort on the validity of the assumption, we examine whether the exit behavior of firms in low-exposure cells significantly changed after the minimum-wage increase. As shown in Figure 8, the firm exit rate in low-exposure cells (below-median exposure) hardly increased after the minimum-wage hike, compared to quarters in the previous years and compared to high-exposure cells. Since cells below the median exposure are still exposed to the minimum wage to some extent, we also examined the exit behavior of firm in cells whose level of exposure is in the bottom 10 percent of the sample of cells. Exit rates in those very low-exposure cells were virtually identical to the rates evidenced prior to the minimum-wage hike. This suggests that spillovers from high-exposure cells to low-exposure cells associated with the minimum-wage hike have been minimal. Even if there were some degree of influence of these

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<sup>22</sup> To further alleviate concerns about the possibly confounding effects of the Russian sanctions, we also ran our estimations excluding firms that were trading with Russia prior to the rise in the minimum wage. Our estimates were virtually identical to our main results with the full universe of firms.<sup>22</sup>

spillovers on our estimates, one would expect the control group to be influenced in the same direction as the treatment group, and, in such a situation, our estimates would be a lower bound for the actual treatment effects of the minimum wage on firm destruction.

### 5.3. Heterogeneous effects

Because we observe all registered firms in Turkey through the data, we are able investigate heterogeneous effects of the minimum-wage hike on firm destruction. Heterogeneous effects by firm productivity are reported in Table 5.<sup>23</sup> The difference-in-differences coefficient estimates show a clear decline in the magnitude along productivity quintiles. While the impact of the minimum-wage hike on firm exits is large among the bottom-productivity quintiles, treatment effects are much smaller in the upper quintiles, and are virtually zero in the top-productivity quintile. At a given level of exposure to the minimum-wage hike, less-productive firms thus respond more strongly to the minimum-wage increase by exiting the formal economy. The magnitude of the destruction effect for firms in the bottom quintile is quite large compared to estimates from the US, and about twice the effect for the full sample. One intuitive explanation for this finding is that less-productive firms are at the limit of survival prior to the increase in the minimum wage. They may also have fewer possible margins of adjustment available to deploy in response to a rise in mandatory labor costs.

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

Consistently with Table 5, the sign on the labor productivity interaction in Table 6 is negative and highly statistically significant. Column 2 of Table 6 shows that the interaction between the profit

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<sup>23</sup> We use labor productivity as an indicator of productivity at the cell level, measured as value added per worker over the 2012–15 period – that is, prior to the minimum-wage hike. Cells are then assigned into labor productivity quintiles according to labor productivity prior to the minimum-wage increase. Total factor productivity is also used as an alternative measure of firm productivity in the cells. The results are similar to using labor productivity. The results are available upon request.

share in the cell and the minimum-wage increase is negative and statistically significant, implying that formal firm destruction is less prevalent in cells where profit margins are larger. This is consistent with a simple economic model whereby firms continue their activity only if they earn nonnegative profits. In this setup, a rise in labor costs squeezes firm profits if the firms cannot fully report costs in prices (Draca, Machin, and van Reenen, 2011), and drives out firms that already had thin profit margins before the minimum wage rose. Although we do not, by construction, observe the profits of firms after they exited, Table A.6. reports corroborative evidence that is consistent with this mechanism. It shows that profit margins declined more strongly in cells that were more highly exposed to the minimum-wage hike. Estimates are not statistically significant, but they are likely to be underestimated because the exiting firms, whose profits are likely to have been hit more severely, are not observed after the minimum wage rose.

The estimates reported in Table 6, Column 4 also indicate that the effects on the exit of formal firms are stronger in cells in which market competition is more pronounced, as indicated by a lower Lerner index.<sup>24</sup> One plausible explanation for this relationship is that firms in more competitive markets have less room to report rises in labor costs on product prices, and, thus, they are more likely to see their profit margins shrink, and to exit the market as a result of a minimum-wage increase. Finally, we examine the effects of the minimum-wage increase by sector of activity. The magnitude of the exit effects is highest in wholesale and retail, followed by manufacturing; the effect is small and statistically insignificant in other services (Table A.7).

#### 5.4. Employment effects

We now link our findings on the rise in firm exits caused by the minimum wage hike to the broader debate on employment effects. We estimate aggregate effects on formal employment at the cell level, but we also separately estimate employment effects in surviving firms (the intensive margin), and employment destruction caused by firm exits (the extensive margin). The employment effects reported in Table 8 are consistent with the earlier results on the positive and significant effects of the minimum-wage hike on firm destruction. According to the difference-in-differences estimates, a rise in the wage bill associated with a minimum-wage increase of 1 percent leads to a 0.5 percent expansion of gross job destruction because of firm exits. By contrast, the effects on formal

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<sup>24</sup> The Lerner index is a measure of the degree of market power for a given market. It is calculated as the sum of total profits in the cell over the total value added in the cell.

employment in continuing firms are quite small in magnitude and statistically insignificant. Therefore, employment effects one year after the minimum-wage increase mostly operate at the extensive margin through firm destruction rather than through reductions in formal employment among surviving firms. This finding adds understanding to the ongoing debate about the employment effects of the minimum wage in the context of developing economies. One possible explanation for this finding is the predominance of small, low-productivity firms in developing economies; such firms are on only on the edge of survival, and, thus, a sharp increase in mandatory labor costs tips them over the edge, eliminating them from the market.

The order of magnitude of the net effects on formal employment are in the range of -0.1 to -0.3 as suggested by Neumark and Wascher (2010) and Brown (1999). This range, however, is drawn from contexts in which employment is almost entirely formal. By contrast, our estimates capture effects on formal employment only, rather than the effects on total employment. The size of the employment effect should also be compared to the wage effects (Machin et al., 2003). To weight wages effects against employment effects, we calculate the employment elasticity with respect to the wage (i.e., the ratios of the (estimated) percentage change in employment and the (estimated) percentage change in wages). Using wage-effect estimates from Table 4, the employment elasticity with respect to wages is around 0.33, which lies about in the middle of the distribution of estimates reported by previous literature and summarized in Harasztosi and Lindner (2019). By contrast, employment elasticities calculated by using employment cuts in surviving firms only (intensive margin), are very small in magnitude, and lie on the low end of estimates in the literature.

## 5.5. Reallocation effects

An important, related issue is the reallocation of workers who were formally employed in the exiting firms. These are workers who may have found other formal employment, who may have found informal employment, or may have become unemployed after the minimum wage rose. A related issue of interest is whether workers who found other formal employment found jobs in larger, more productive firms – a result that would indicate some positive relocation. With the recent exception of Dustmann et al. (2020) in Germany, this question has not been investigated in the literature.<sup>25</sup>

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<sup>25</sup> Dustmann et al. (2020) find strong reallocation effects in Germany because of the many workers who move to better jobs in higher-quality firms after the introduction of the new minimum wage.

We are able to shed light on this issue by following the labor-market trajectories of workers leaving firms that exit the market. To follow them, we use our linked employer employee panel datasets. Workers' trajectories can be tracked as long as they remain formally employed, and as long as the characteristics of the firms in which they gain employment can be identified. Given the features of the dataset, an exit of workers from the registry can be interpreted as evidence that the workers are either no longer employed, or that they are employed in informal work.

Table 9 reports the transitions of workers who were employed in firms that exited after the 2016 minimum-wage increase. The vast majority of workers from exiting firms had not been formally reemployed by the end of 2016 (Table 9, Panel a). Only 15 percent had found another formal job, meaning that 85 percent were either unemployed, or employed informally one year after the minimum wage rose. Workers who were employed in large, formal firms that exited are more likely to have found other formal employment, compared with workers who were employed in microenterprises.

Table 9, Panel b, restricts the transition matrix to the minority of workers who had found other formal employment by the end of 2016. The panel exhibits evidence for the upward mobility of some workers who transitioned into larger firms. Among workers who had been employed in microenterprises prior to the wage increase, and who had found formal employment by the end of 2016, more than two-thirds found employment in non-microenterprises. Meanwhile, only limited, downward mobility is evident among formal-sector workers who had been employed in large firms that exited after the minimum-wage increase. More than 80 percent of these workers had been reemployed by other large formal firms by the end of 2016. This indicates a certain level of positive reallocation among workers who had found other formal jobs.

The EIS data do not allow us to observe what happened to workers who were employed by firms that wound up existing, and who were no longer formally employed after the minimum wage increased. We do not know whether these workers transitioned into informal employment, became unemployed, or dropped out of the labor force. To provide indicative evidence on this question, we complement the EIS data with microdata from the Turkish Household Labor Force Survey (HLFS) published by the Turkish Statistical Institute, a nationally representative household survey that is available annually from 1998 to 2018. The survey asks all employed individuals whether they are registered with social security institutions through their primary employment. This allows

a categorization of employment as either formal or informal based on registration with the social security system. It also captures individuals who are not employed. Responses to the questions asked allow us to distinguish between workers who are informally employed and those who are unemployed.

To shed light on whether the decline in formal employment was accompanied by an increase in informal employment, unemployment or inactivity, we estimate the effects of the minimum-wage increase using data from seven annual waves of the Turkish Household Labor Force Survey, from 2010 to 2016. To estimate the causal effects of the minimum wage using the HLFS data, we use a grouping estimator in a similar way as Blundell et al. (1998) and Harasztozi and Lindner (2019). We assign working-age individuals in the survey to mutually exclusive groups formed from combinations of the 26 regions (NUTS 2), age in five categories (16-19, 20-24, 25-34, 45-54, 55-60), gender, and education (low, medium and high). We measure group-level exposure to the 2015 minimum-wage increase in the same way as we did previously with the EIS registry data; we define exposure as the percentage change in the wage bill that is necessary to bring all workers in a given group to the new minimum wage, relative to the 2015 wage bill.<sup>26</sup> Formally, the group-level difference-in-difference equation that we are estimating is the following:

$$y_{gt} = \alpha + \beta POST \times E_g + \varphi E_g + \gamma X_g + T_t + R_g + T_t \times R_g + \varepsilon_{gt} \quad (5)$$

where  $y_{it}$  is the percentage change in the labor-market outcome of interest of group  $g$  between year  $t-1$  and year  $t$ .<sup>27</sup>  $E_g$  is the measure of minimum-wage exposure to the 2016 minimum-wage increase at the group level, measured in 2015.  $POST$  is a dummy variable that takes the value one if the group is observed after the minimum-wage increase (i.e., after 2015) and zero otherwise. The coefficient  $\beta$  on  $POST \times E_g$  is the difference-in-difference coefficient that we are interested in estimating. It measures the effect of the minimum wage on labor-market outcomes at the group level.  $T_t$  and  $R_g$  are year and region fixed effects, respectively, and  $T_t \times R_g$  is the interaction between region and year effects to account for region-specific labor-market shocks.  $X_g$  is a vector of control variables at the group level that includes dummies for age groups, education and gender. It also includes an interaction between education groups and year effects, which account for labor

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<sup>27</sup> To avoid the influence of extreme observations, we trim the top and bottom 2.5 percent of each outcome when estimating the difference-in-difference equation.

market shocks that may hit specific educational groups. We cluster the standard errors by group, and weight the regressions by the number of observations used in calculating group-level exposure.

The results of the difference-in-difference estimations using the grouping estimator are displayed in Table 10. The estimate reported in Column 1 shows a negative effect of the minimum wage on total employment (including both formal and informal employment). This indicates that the minimum-wage increase had negative effects on employment overall – although the estimated effect is only statistically significant at the 10 percent level. As with the estimates using the EIS data, estimates from the HLFS data show a highly significant negative effect of the minimum wage on formal employment – which includes both private and public sector. The estimates are of similar magnitude with using the HLFS data as with the EIS data (Column 2). As shown in Column 3, we do not find that the minimum-wage hike increased informal employment. This finding contrasts with the findings of some studies in other contexts.<sup>28</sup> Our findings seem incompatible with the notion that formal workers who were employed by firms that wound up exiting the market transitioned instead into informal employment – at least in the short run. One possible explanation for our finding is the higher degree of segmentation between formal and informal employment in Turkey, documented by some studies (Tansel and Acar, 2017; Duman, 2020). This higher level of segmentation contrasts with the situation that characterizes other contexts, such as in some Latin American countries, where frequent transitions between formal and informal employment have been evidenced.<sup>29</sup>

The difference-in-difference coefficient in Column 4 indicates that raising the minimum wage led to a sizeable increase in unemployment – although the coefficient is insignificant due to large standard errors at the group level. The estimate reported in Column 5 also shows a significant effect of the minimum-wage increase in raising levels of inactivity. This suggests that the destruction of formal firms and formal jobs was accompanied by an increase in the degree to which workers were discouraged, leading them to drop out of the labor force as a result. Thus, the

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<sup>28</sup> The minimum wage has been found to increase informal employment at least for some groups of workers in various studies: Honduras (Ham, 2017), Indonesia (Comola and de Mello, 2011), Russia (Muravyev and Oschepkov, 2016), and Thailand (Del Carpio et al., 2019). In contrast, Lemos finds no such employment effects in Brazil and Madruger (2013) finds a positive effect of the minimum wage on formal employment in Indonesia. In Turkey, a recent paper by Isik et al. (2020) finds that the minimum-wage increase boosts informal employment among workers who are young and those who have low levels of education, but not for other groups.

<sup>29</sup> See for example, Maloney (1999) for evidence from Mexico, among others.

destruction of formal firms due to the rise in the minimum wage was accompanied by an increase in both inactivity and unemployment – rather than a rise in informal employment.

We also use the HLFS data to investigate whether the minimum-wage increase impacted the wages of workers who are informally employed using the HLFS data. In contrast to the EIS registry data, the HLFS data also collect information on the wages of informal workers. While informal workers are by nature not covered by official labor regulations including the minimum wage, prior literature suggests that minimum-wage increases for formal workers can have positive spillovers on workers who are informally employed.<sup>30</sup> The existence of such spillovers has important welfare implications because it implies that workers' wages benefit from the minimum wage even for those whose employment is outside the formal sector. Columns (6) to (8) of Table 10 report the difference-in-difference estimates of the minimum-wage increase on wages using the HLFS data. We find a large, positive, and statistically significant effect of the minimum wage on the wages of formal workers (Column 7). We do find a positive effect of the minimum wage on the wages of informal workers, but the magnitude of the estimate is about three times smaller, and it is not statistically significant (Column 8). Thus, the spillover effects of the minimum wage on the informal sector appear to be limited; this finding contrasts with findings of some studies in other contexts, particularly for some Latin American countries.<sup>31</sup> However, this result is compatible with the lack of impact of the minimum-wage increase on informal employment that we have also found. This lack of a pronounced spillover effect could be explained by the high degree of segmentation between formal and informal employment in Turkey, compared to greater integration between the two types of employment in other developing economies.

## 6. Conclusion

This paper examines the impacts of a large increase in the minimum wage on firms and workers in Turkey. We find that increase in the minimum wage that took place in 2016 substantially raised the destruction rate among formal firms. The results suggest that the minimum wage operates as a firm-selection mechanism by eliminating smaller, less-productive businesses from the formal

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<sup>30</sup> Such “lighthouse” effects have been evidenced, for example, in Colombia (Maloney and Mendez, 2004), Brazil (Lemos, 2009) and Argentina (Khamis, 2013).

<sup>31</sup> Evidence for positive effects of the minimum wage on wages in the informal sector has been found in Colombia (Maloney and Mendez, 2004), Brazil (Lemos, 2009) and Argentina (Khamis, 2013). By contrast, Ham (2018) reports negative effects of the minimum wage on the wages of informal workers in Honduras.

economy. By contrast, firms with high levels of productivity largely survive the increase in mandatory labor costs. We also find that local and industry-specific market conditions matter in formal firm destruction. Thus, firm exits associated with the minimum-wage increase are more numerous in industries with lower profit margins, lower market concentrations, and a higher labor share.

The elimination of firms that are not good performers mechanically raises productivity in the formal economy. However, these efficiency gains appear to be offset by a lack of worker reallocation from exiting firms into higher-quality, higher-paying firms in the short run. We examine the effects on workers who had been employed by firms that wound up exiting the market, and find that only a minority of these workers had found other formal employment within the first year after the wage increase took effect. We find that the decline in formal employment was accompanied by a rise in inactivity and unemployment, as opposed to a rise in informal employment. This suggests that workers from these failed firms mostly failed to find other employment. We also find that the increase in the minimum wage had only limited spillover effects on the wages of those in informal jobs.

Our study is the first to analyze the issue of firm destruction and the wider distributive effects that stem from a minimum-wage increase in a developing country. Our findings contrast with those from similar research in Germany (Dustmann et al., 2020). We argue that this is largely because of the different economic contexts between the two countries. Workers in Turkey are relatively low skilled compared to those in Germany. Informal, less-productive economic activities are also more common in Turkey than in Germany. Our findings thus underscore the importance of examining these issues in the developing-country context, where there may be key differences in the costs and benefits of a minimum wage, and in the relationship between formal and informal employment. The high level of the minimum wage in Turkey relative to worker wages more generally should also be considered in interpreting our results. Turkey currently shows the highest ratio of minimum wage to median wage among countries of the Organisation for Economic Co-operation and Development, and, importantly, the minimum wage is binding for a large share of workers and firms in Turkey compared to other contexts, even those in other developing economies.

As demonstrated in this paper and in the previous literature, the minimum wage significantly raises the wages of workers who remain formally employed in surviving firms. These welfare gains are substantial, particularly in the context of developing economies, such as Turkey, where a large proportion of workers earn low wages, which are close to the formal minimum level. Thus, the adverse effects through firm destruction and informality detailed in this paper should be weighed against the large wage gains of the workers who remain formally employed.

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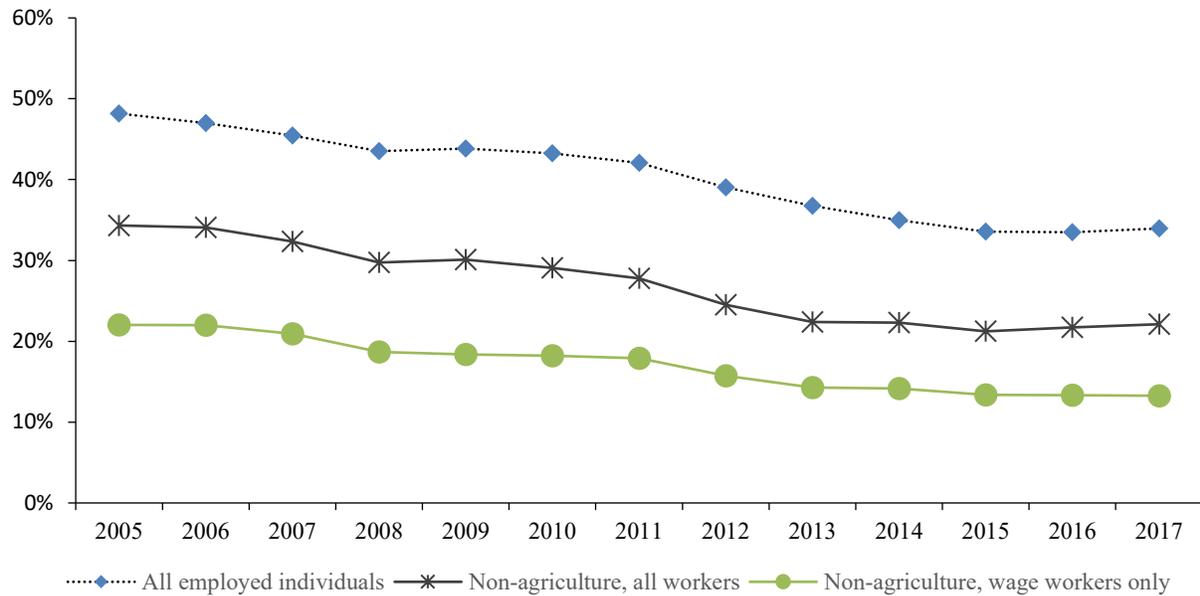
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# Figures

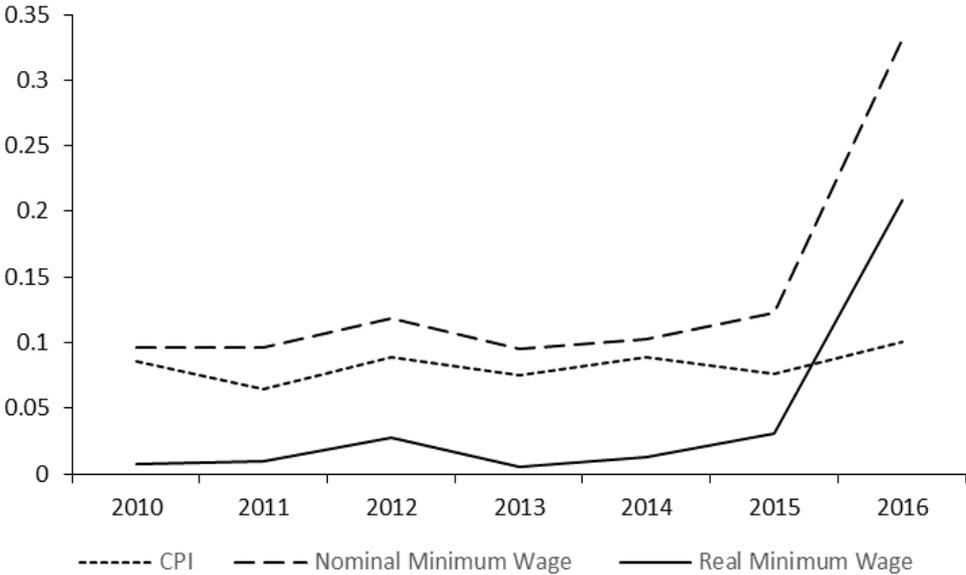
**Figure 1: Informal Employment, Turkey, 2005–17**



*Source:* Calculations based on data from the Turkish Household Labor Force Survey.

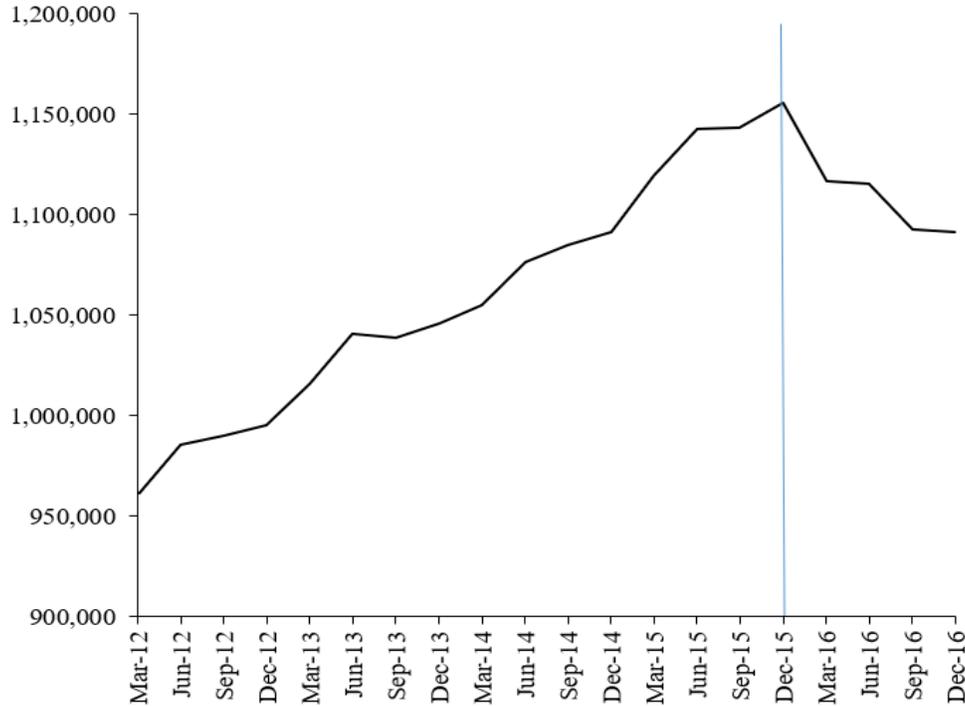
*Note:* Employment is considered unregistered if the worker is not registered with the Turkish Social Security Authority at the time of the survey.

**Figure 2: Annual Growth Rates, Minimum Wage and Consumer Price Index, 2010–16**



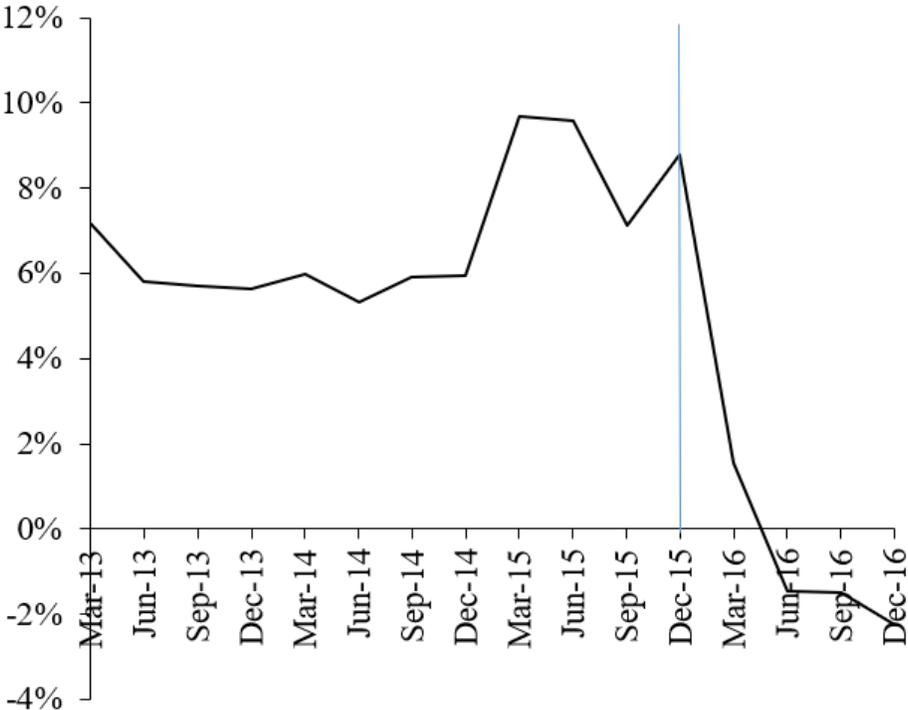
Source: Turkish Statistical Institute.

**Figure 3: Firms with at Least One Registered Employee, Number, 2012–16**



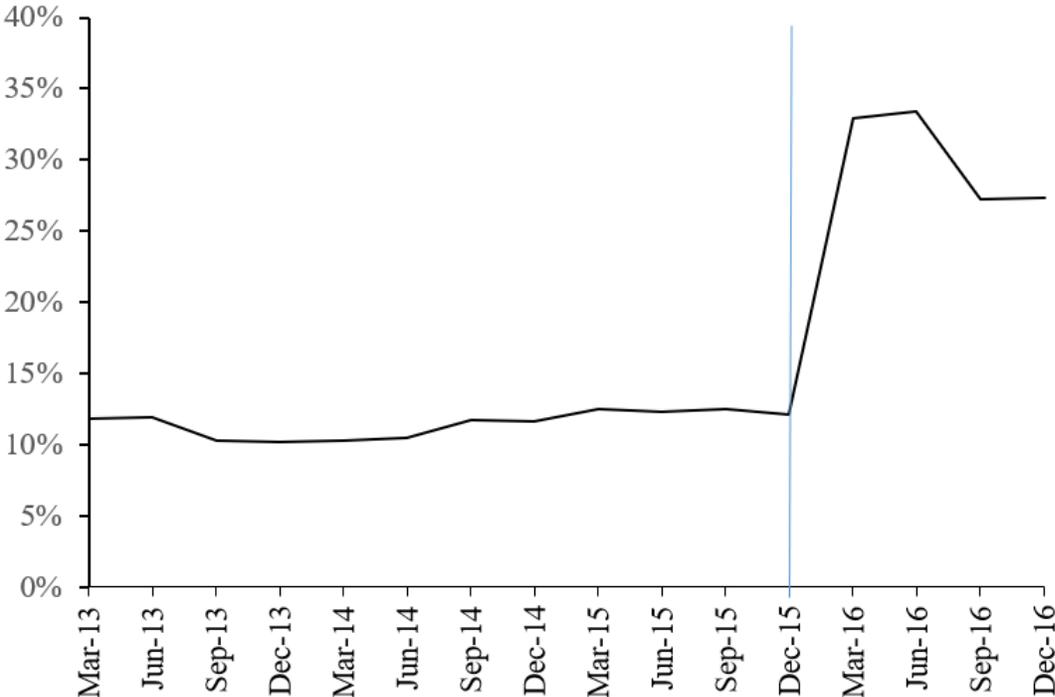
Source: Turkish Enterprise Information System.

**Figure 4: Annual Growth Rate in Formal Employment, 2013–16**



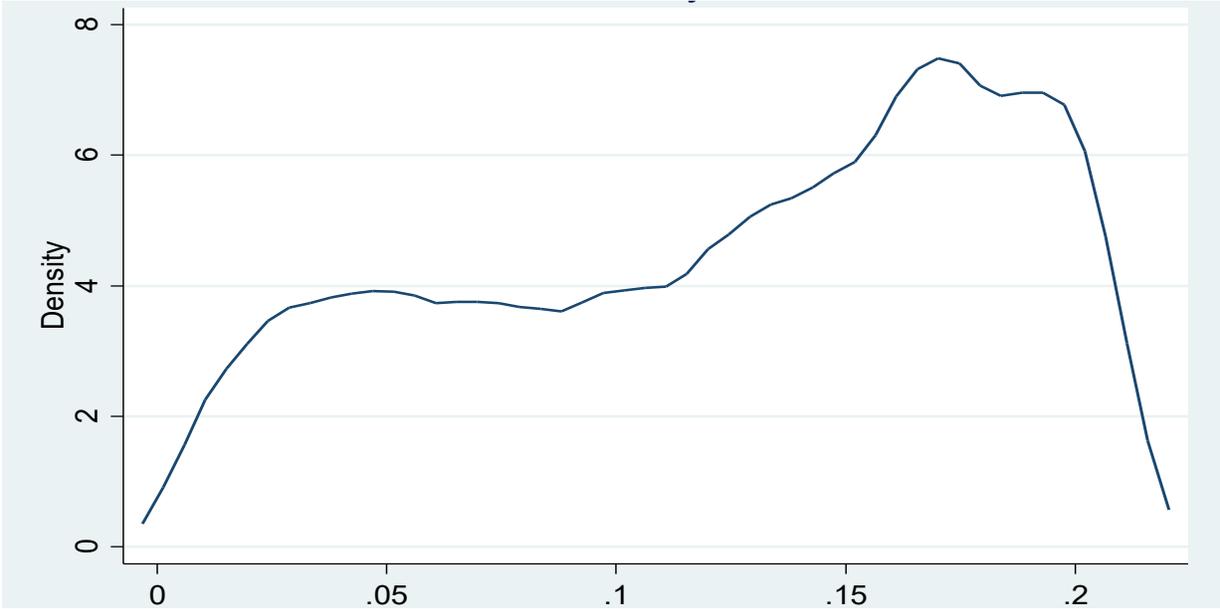
Source: Turkish Enterprise Information System.

**Figure 5: Annual Nominal Wage Growth, Formal Firms**



Source: Turkish Enterprise Information System.

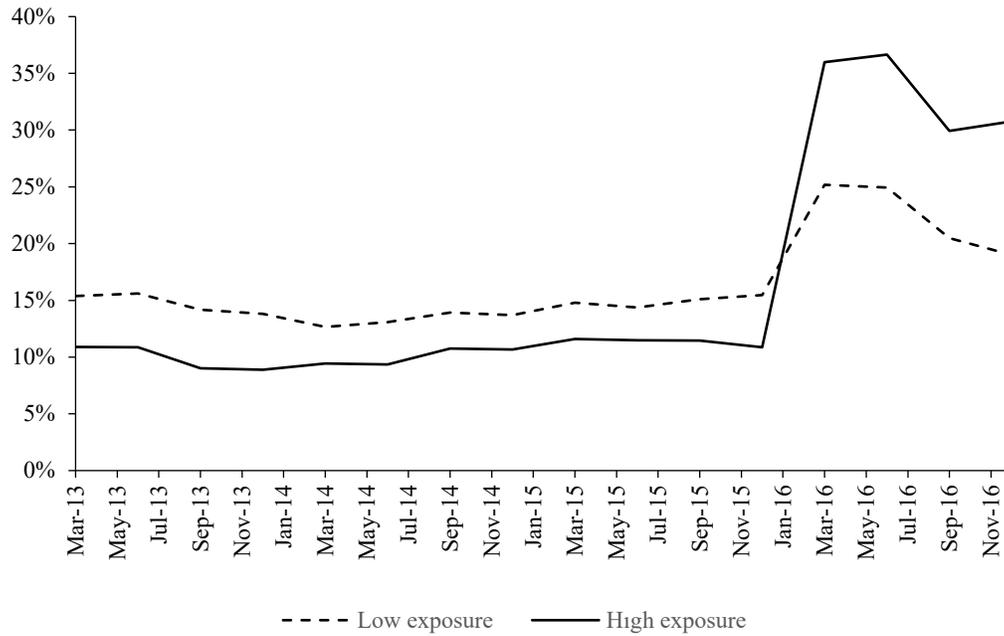
**Figure 6: The Distribution of Cell-level Exposure to the Increase in the Minimum Wage**



Source: Turkish Enterprise Information System.

Note: Exposure to the minimum-wage increase is measured in the fourth quarter of 2015 as the proportional rise in the wage bill required to bring all workers in the cell up to the new 2016 minimum wage. Cells are defined as a given NACE 2-digit industry in a given district of Turkey.

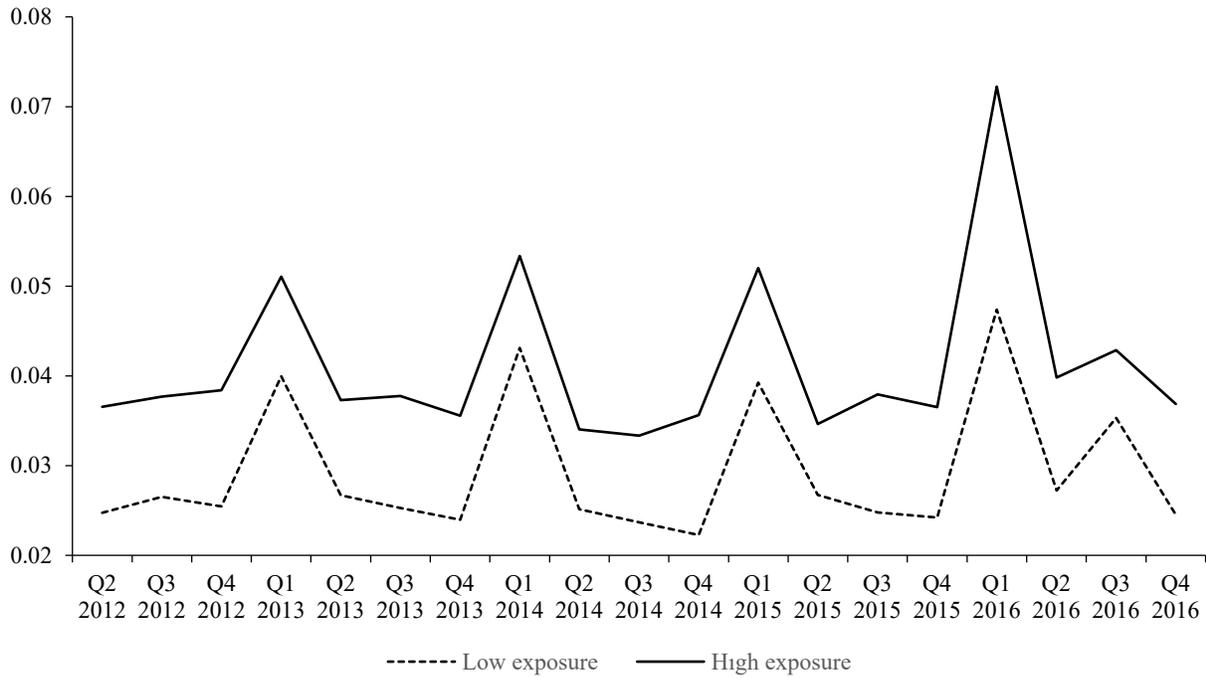
**Figure 7: Nominal Annual Wage Growth, by Cell Exposure to the Increase in the Minimum Wage**



Source: Turkish Enterprise Information System.

Note: Exposure to the minimum wage increase is measured in the fourth quarter of 2015 as the proportional rise in the wage bill required to bring all workers in the cell up to the new 2016 minimum wage. Cells are considered high exposure if the cell-level measure of exposure to the minimum wage is above the sample median, but low exposure otherwise.

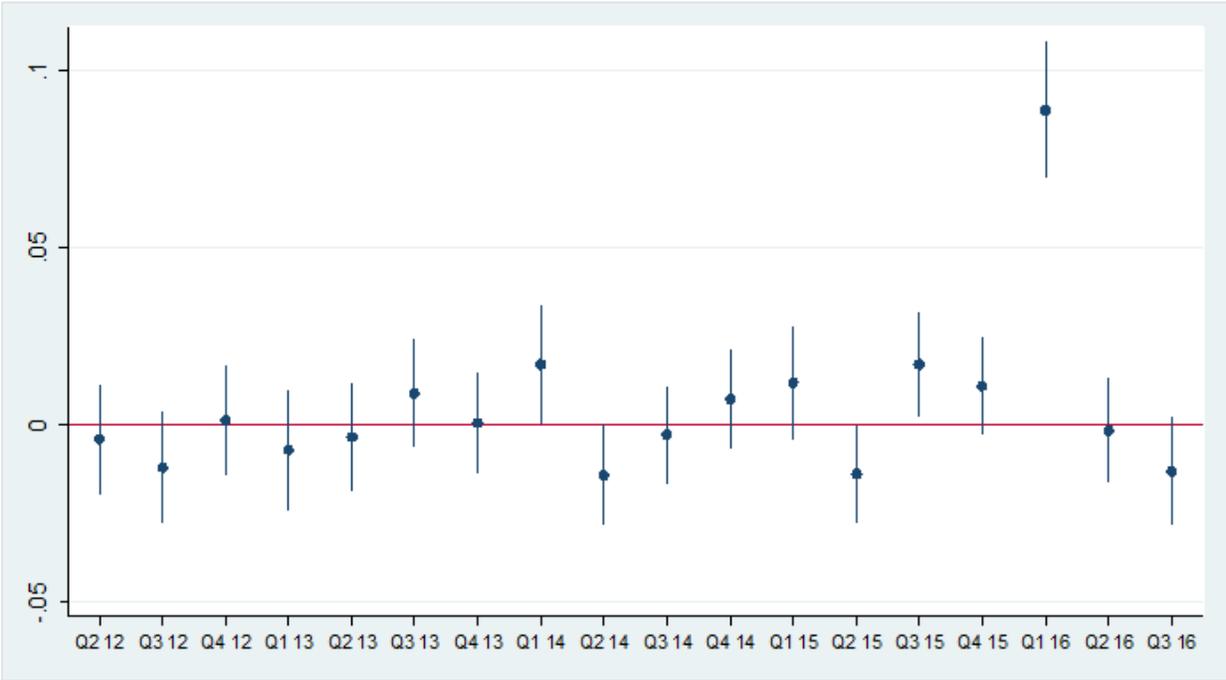
**Figure 8: Cell Exit Rates Relative to the Increase in the Minimum Wage, Registered Firms by Quarter and Treatment Status**



*Source:* Turkish Enterprise Information System.

*Note:* Exposure to the minimum-wage increase is measured in the fourth quarter of 2015 as the proportional rise in the wage bill required to bring all workers in the cell up to the new 2016 minimum wage. Cells are considered high exposure if the cell-level measure of exposure to the minimum wage is above the sample median, but low exposure otherwise.

**Figure 9: Testing the Common Trend Assumption, Quarter before the Increase in the Minimum Wage**



*Note:* Following Autor (2003), the estimated coefficients of the interaction between treatment and year-quarter dummies are plotted together with the 95 percent confidence intervals. Standard errors are clustered at the cell level.

## Tables

**Table 1: Descriptive Statistics before the Increase in the Minimum Wage, Formal Firms, December 2015**

*by firm size in number of registered employees*

<i>Indicator</i>	<i>Micro, 1–2 (1)</i>	<i>Small, 3–9 (2)</i>	<i>Medium, 10–49 (3)</i>	<i>Large, 50+ (4)</i>	<i>Total (5)</i>
<i>Registered firms</i>					
Number	582,306	384,818	156,137	32,357	1,155,618
% of total	50.4	33.3	13.5	2.8	100
Mean firm age	7.1	7.5	7.4	7.9	7.3
<i>Employees</i>					
Number	741,420	1,779,933	2,932,961	6,064,014	11,518,328
% of total	6.4	15.5	25.5	52.6	100
Mean number	1.4	4.9	20.1	210.6	10.9
Mean daily wage	46	49	57	81	68
Workers paid less than 1.02 MW, %	93	87	69	32	54
<i>Distribution of firms, by sector, %</i>					
Agriculture	0.9	1.0	1.4	1.7	1.0
Manufacturing	14.0	19.5	24.7	35.3	17.9
Other industry (nonmanufacturing)	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
<i>Distribution of firms, by sector, number</i>					
Agriculture	4,962	3,797	2,210	536	11,505
Manufacturing	81,797	75,187	38,513	11,410	206,907
Other industry (nonmanufacturing)	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
<i>Total employment, by sector</i>					
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 (nonmanufacturing)	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

*Note:* MW = minimum wage.

**Table 2: Wage Effects of the Minimum Wage, Difference-in-differences Estimates, Continuous Treatment, 2012–16**

<i>Continuous treatment, dependent variable: % change in average daily wage</i>	<i>All cells</i>	
	<i>(1)</i>	<i>(2)</i>
Difference in differences coefficient	0.429 *** (0.0127)	0.432 *** (0.0126)
Cell-level control variables	No	Yes
Number of observations (cells-quarter)	66,347	66,347

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 3: Difference-in-differences Estimates, Baseline Results, Continuous Treatment, 2012–16**

<i>Continuous treatment, dependent variable: firm exit rate in the cell</i>	<i>All cells</i>		<i>Excluding top and bottom 5 percent exposure</i>		<i>Excluding top and bottom 25 percent exposure</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>	<i>(6)</i>
Difference in differences coefficient	0.021*** (0.004)	0.026*** (0.004)	0.024*** (0.004)	0.028*** (0.004)	0.027*** (0.010)	0.032*** (0.010)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	71,754	71,754	64,621	64,621	35,863	35,863

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 4: Difference-in-differences Estimates, Effect of the Increase in the Minimum Wage, 2012–16**

<i>Continuous treatment, dependent variable: quarterly % change</i>	<i>Firms, number</i>	<i>Microenterprises, number</i>	<i>Nonmicroenterprise firms, number</i>
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>
Difference in differences Coefficient	-0.123*** (0.032)	-0.216*** (0.046)	-0.091** (0.039)
Cell-level control variables	Yes	Yes	Yes
Number of observations (cells-quarter)	66,347	66,347	66,347

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. The dependent variable is the percent change in the corresponding variable in the column header. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 5: Difference-in-differences Estimates, Pretreatment Placebo Effects on Firm Exit Rates**

<i>Continuous treatment, dependent variable: firm exit rate in the cell</i>	<i>2012–13</i>		<i>2013–14</i>		<i>2014–15</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>	<i>(6)</i>
Difference in differences	0.0003	-0.002	0.002	0.003	0.002	0.003
Coefficient	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	26,723	26,723	28,763	28,763	29,977	29,977

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for the second year of the corresponding two-year period. It measures the effect of a placebo minimum-wage increase in the second year on firm destruction. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 6: Difference-in-differences Estimates, Effect of the Increase of the Minimum Wage on Exit Rates, by Cell Labor Productivity, 2012–16**

<i>Continuous treatment, dependent variable: firm exit rate in the cell</i>	<i>Quintile 1</i> <i>(1)</i>	<i>Quintile 2</i> <i>(2)</i>	<i>Quintile 3</i> <i>(3)</i>	<i>Quintile 4</i> <i>(4)</i>	<i>Quintile 5</i> <i>(5)</i>
Difference in differences	0.048***	0.036***	0.023**	0.021**	0.012
Coefficient	(0.012)	(0.011)	(0.011)	(0.010)	(0.011)
Cell-level control variables	Yes	Yes	Yes	Yes	Yes
Number of observations (cells-quarter)	14,351	14,351	14,351	14,351	14,351

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Quintiles 1–5 refer to the productivity quintiles to which the cells belong as measured by the labor productivity of firms in the cells over 2012–15, that is, prior to the minimum wage increase. Quintile 1 refers to the bottom productivity quintile, while quintile 5 refers to the top productivity quintile. The number of cells on which productivity measures are available is lower than the number for the full sample used for other estimations because productivity can only be calculated on the subset of firms that are legally required to report their balance sheets. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 7: Difference-in-differences Estimates, Heterogenous Effects of the Increase in the Minimum Wage on Exit Rates, 2012–16**

<i>Continuous treatment, dependent variable: firm exit rate in the cell: variable interacted with difference in differences coefficient</i>	(1)	(2)	(3)	(4)
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 (cells-quarter)	71,754	71,755	71,756	71,757

*Note:* Each column reports the coefficient of the corresponding cell-level characteristic interacted with Exposure\*post. The interaction coefficients reported in columns 1–5 are estimated in separate regressions. A higher value in the Lerner index indicates lower market competition in the cell. The cell-level characteristics are calculated as the average of the yearly cell-level outcomes over 2012–15, that is, prior to the 2016 minimum wage increase. All regressions include a vector of cell-level control variables that 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 8: Difference-in-differences Estimates, Effect of the Increase in the Minimum Wage on Employment, 2012–16**

*% change*

<i>Continuous treatment, dependent variable</i>	<i>Total registered employment</i>	<i>Registered employment in surviving firms</i>	<i>Formal job destruction due to exits</i>
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>
Difference in differences Coefficient	−0.176*** (0.058)	−0.0961 (0.074)	−0.500** (0.225)
Cell-level control variables	Yes	Yes	Yes
Number of observations (cells-quarter)	66,348	66,348	66,348

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. The dependent variable is the percent change in the corresponding variable in the column header. Cell-level control variables 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table 9: Workers in Exiting Firms, Status the Year Following the Increase in the Minimum Wage**

*percent*

		<i>Firm size in 2016</i>				<i>Not in formal employment</i>	<i>Total</i>
		<i>Micro</i>	<i>Small</i>	<i>Medium</i>	<i>Large</i>		
<i>a. All workers from exiting firms</i>							
	<i>Micro</i>	2.6	2.1	1.8	1.8	91.7	100
	<i>Small</i>	1.2	4.5	3.6	2.8	87.9	100
<i>Firm size in 2015</i>	<i>Medium</i>	0.5	2	7	5.4	84.9	100
	<i>Large</i>	0.3	0.7	2.1	16	80.9	100
	<i>Total</i>	0.9	2.1	2.7	8	85.3	100
<i>b. Workers from exiting firms in formal employment by the end of 2016</i>							
	<i>Micro</i>	31.0	25.5	22.0	21.5	n.a.	100
	<i>Small</i>	10.0	37.2	29.8	23.0	n.a.	100
<i>Firm size in 2015</i>	<i>Medium</i>	3.5	13.7	46.8	36.0	n.a.	100
	<i>Large</i>	1.4	3.8	11.0	83.9	n.a.	100
	<i>Total</i>	6.3	14.6	25.0	54.1	n.a.	100

*Note:* Each cell reports the percent share of workers by firm size in 2015 (in rows) that transitioned into a given firm size in 2016 (in columns). For example, the cell in the first row and first column of panel b indicates that 31 percent of workers who were employed in exiting microenterprises in 2015 had found employment in other microenterprises by the end of 2016. n.a. = not applicable.

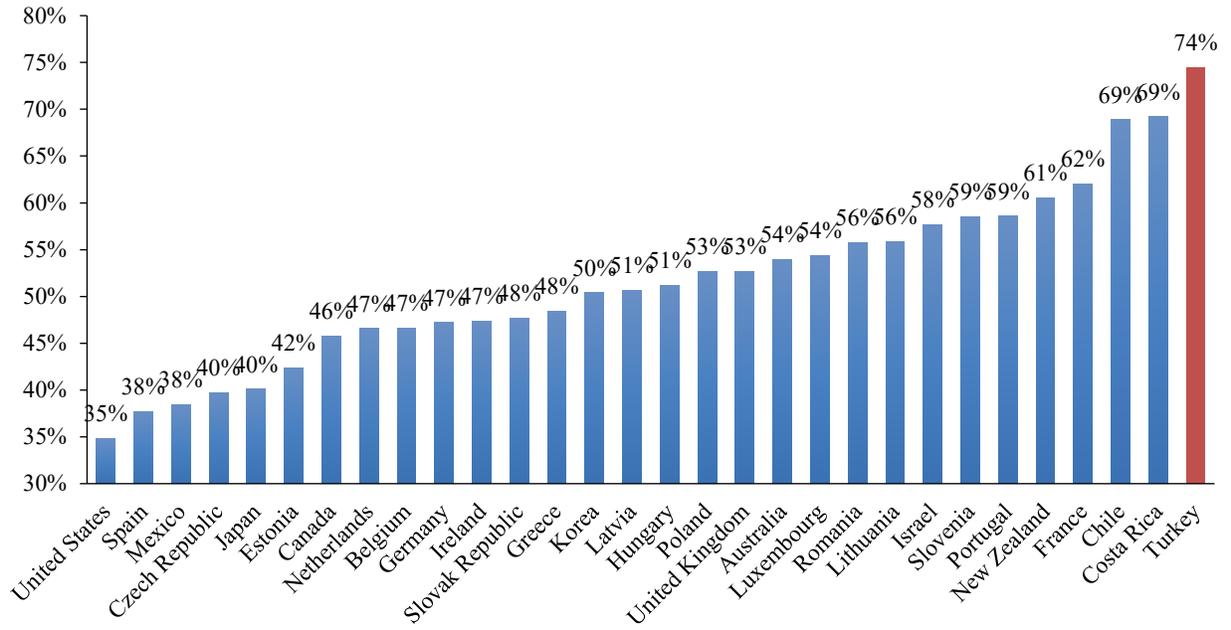
**Table 10: Grouping Estimates of the Minimum Wage using National Household Surveys (2010-2016)**

Dependent variable (in annual percentage change)	Total employment	Formal employment	Informal employment	Out of the labor force	Unemployed	Monthly wage (all)	Monthly wage (informal)	Monthly wage (formal)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Difference-in-difference coefficient	-0.102* (0.057)	-0.195*** (0.071)	-0.188 (0.122)	0.123** (0.056)	0.237 (0.158)	0.1194** (0.053)	0.1025 (0.097)	0.141*** (0.052)
Observations (group-years)	2853	2853	2853	2853	2853	2853	2853	2853
R-squared	0.204	0.213	0.135	0.133	0.132	0.235	0.118	0.258

Note: Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent. Robust standard errors clustered at the group level are reported in parentheses. The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum wage exposure on the corresponding outcome of interest. Groups are defined as a unique combination of gender, age group, educational level and region within Turkey. All regressions control for gender, age group, educational level, region and year dummies, as well as the interactions between year and region dummies and year and educational dummies, to account for region-specific and education specific labor market shocks in a given year. Regressions are for years 2010-2016, with 2010-2015 as the pre-treatment period and 2016 as the post-treatment period.

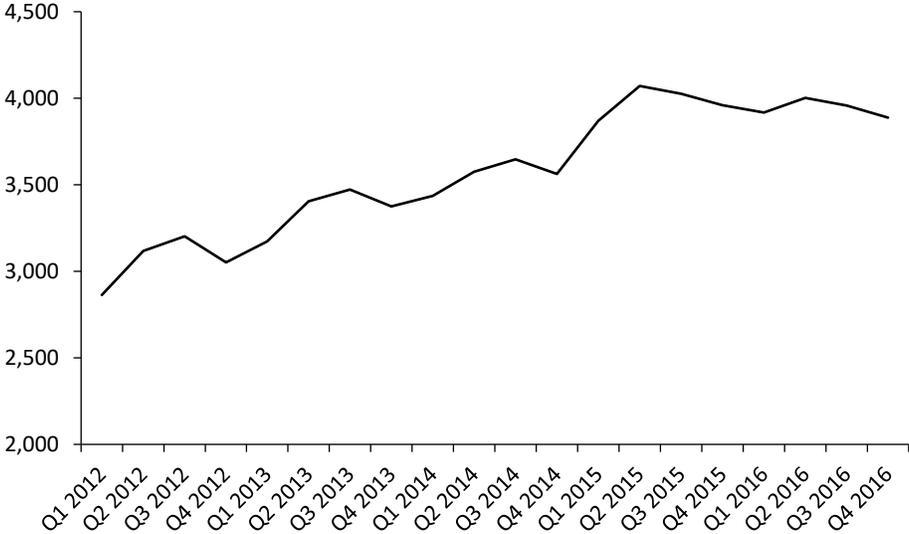
## Appendix A

**Figure A.1: The Minimum Wage Relative to the Median Wage of Full-Time Workers, 2016**



Source: Data of the Organisation for Economic Co-operation and Development.

**Figure A.2. Number of Large, Registered Firms (with More than 100 Employees) in Turkey**



Source: Turkish Enterprise Information System.

**Table A.1: Difference-in-differences Estimates: Increase in the Minimum Wage, Binary Treatment Measure**

<i>Discrete treatment, dependent variable: firm exit rate in the cell</i>	<i>All cells</i>		<i>Excluding bottom and top 5 percent exposure</i>		<i>Excluding bottom and top 25 percent exposure</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>	<i>(6)</i>
<i>2015–16</i>						
Difference in differences	0.0018***	0.0019***	0.0017***	0.0018***	0.0023***	0.0023***
Coefficient	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0007)	(0.0007)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	30,938	30,938	28,475	28,475	28,645	28,645
<i>2012–16</i>						
Difference in differences	0.0026***	0.0030***	0.0026***	0.0030***	0.0022***	0.0025***
coefficient	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0006)	(0.0006)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	73,409	73,409	67,540	67,540	68,288	68,288

*Note.* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.2: Difference-in-differences Estimates of the Increase in the Minimum Wage, Continuous Treatment Measure, 2015–16**

<i>Continuous treatment, dependent variable: firm exit rate in the cell</i>	<i>All cells</i>		<i>Excluding top and bottom 5 percent of exposure</i>		<i>Excluding top and bottom 25 percent of exposure</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>	<i>(6)</i>
Difference in differences	0.014***	0.016***	0.015***	0.016***	0.019*	0.020*
Coefficient	(0.004)	(0.004)	(0.005)	(0.005)	(0.012)	(0.011)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	30,451	30,451	27,397	27,397	15,129	15,129

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.3: Difference-in-differences Estimates, Effect of the Increase in the Minimum Wage on Exit Rates, by Alternative Cell Size Cutoff**

<i>Continuous treatment, dependent variable: firm exit rate in the cell</i>	<i>Minimum number of firms in the cell</i>				
	$\geq 40$ (1)	$\geq 60$ (2)	$\geq 70$ (3)	$\geq 80$ (4)	$\geq 90$ (5)
Difference in differences Coefficient	0.023*** (0.004)	0.023*** (0.004)	0.024*** (0.004)	0.025*** (0.004)	0.025*** (0.004)
Cell-level control variables	Yes	Yes	Yes	Yes	Yes
Number of observations (cells-quarter)	84,897	62,376	54,945	49,050	44,240

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.4: Difference-in-differences Estimates, Effect of the Increase in the Minimum Wage on Exit Rates, Including Nonpermanent Exits, 2012–16**

<i>Continuous treatment, dependent variable: exit rate of firms in the cell</i>	<i>Permanent exists only</i>		<i>All exits</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>
Difference in differences Coefficient	0.021*** (0.004)	0.026*** (0.004)	0.027*** (0.004)	0.034*** (0.004)
Cell-level control variables	No	Yes	No	Yes
Number of observations (cells-quarter)	71,754	71,754	71,754	71,754

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. All regressions include a vector of cell-level control variables that 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.5: Placebo Effects of the Increase in the Minimum Wage, Discrete Treatment Measure, 2012–15**

<i>Discrete treatment, dependent variable: exit rate of firms in the cell</i>	<i>2012–13</i>		<i>2013–14</i>		<i>2014–15</i>	
	<i>(1)</i>	<i>(2)</i>	<i>(3)</i>	<i>(4)</i>	<i>(5)</i>	<i>(6)</i>
Difference in differences	0.0005	0.0004	0.0001	0.0006	0.0001	0.0003
Coefficient	(0.0005)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0004)
Cell-level control variables	No	Yes	No	Yes	No	Yes
Number of observations (cells-quarter)	26,723	26,723	28,763	28,763	29,977	29,977

*Note:* 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.6: Difference-in-differences Estimates, Effect of the Increase in the Minimum Wage on Firm Profits, 2012–16**

<i>Continuous treatment, dependent variable: profit-to-sale ratio</i>	<i>(1)</i>	<i>(2)</i>
Difference in differences	-0.026	-0.027
Coefficient	(0.020)	(0.020)
Cell-level control variables	No	Yes
Number of observations (cells-quarter)	70,523	70,523

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum-wage exposure and a dummy for after 2015. It measures the effect of minimum-wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

**Table A.7: Effect of the Minimum Wage Increase on Exit Rates, by Sector of Activity, 2012–16**

<i>Continuous treatment, dependent variable: exit rate of firms in the cell</i>	<i>Manufacturing (1)</i>	<i>Other industry (2)</i>	<i>Wholesale and retail (3)</i>	<i>Other services (4)</i>
Difference in differences	0.017**	0.014	0.024***	0.009
Coefficient	(0.008)	(0.014)	(0.007)	(0.006)
Cell-level control variables	Yes	Yes	Yes	Yes
Number of observations (cells-quarter)	16,586	7,710	17,855	29,286

*Note:* The difference-in-difference coefficient is the coefficient on the interaction between minimum wage exposure and a dummy for after 2015. It measures the effect of minimum wage exposure on the corresponding outcome of interest. 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. Robust standard errors clustered at the cell level are reported in parentheses. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.