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The Impact of Minimum Wage Introduction on Characteristics of New Establishments: Evidence from South Korea

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Abstract

This paper examines whether imposing minimum wage alters the characteristics of new businesses. Applying a difference-in-differences framework to repeated cross-sectional data of new plants, we explore the impact of minimum wage introduction on characteristics of new plants in South Korea. We first confirm that the minimum wage introduction induced new plants to have higher remuneration to workers. Due to the imposed minimum wage, the new plants tend to start with fewer employees and to equip their employees with more capital. Finally, we find that the minimum wage introduction led to higher labor productivity among entering plants.

JEL classification: J24, J38, K31, L25, L60

Keywords: Minimum Wage Introduction; Employment; Capital Intensity; Labor Productivity; Entering Plants; Establishment-Level Data

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1 Introduction

Minimum wage system is a specific form of labor regulation in which a state or a local government set and regulate the lowest amount of remuneration that employers must pay to workers. As the minimum wage is a regulation on the labor use for employers, a group of literature employs firm/establishment-based data to properly understand the impact of minimum wage (Bossler and Gerner, 1999; Card and Krueger, 1994; Neumark and Wascher, 2000; Dube, Naidu, and Reich. 2007; Skedinger, 2006; Haepf and Lin, 2017; Gan, Hernandez and Ma 2016; Luca and Luca, 2018; Fan, Lin, and Tang, 2018). Specifically, the impact of minimum wage on employment could depend on the margin in which employers adjust to the minimum wage. Majorities of the existing studies using employer-based data explore the effect of minimum wage on firms which have been operating before the change in minimum wage policy. That is, the previous literature focused on how or whether incumbent firms would exit from the market or adjust their employment, working hours, profitability or prices in response to the change in minimum wage (Aaronson, French and MacDonald. 2008; Harasztosi and Lindner. 2018; Huang, Loungani, and Wang. 2014; Stewart and Swaffield. 2006; Draca, Machin, and Reenen. 2011; Riley and Bondibene. 2017).

Given this strand of literature, the purpose of this paper is to extend our understanding on minimum wage by focusing on new firms and their characteristics. The investigation on the effect of minimum wage on new plants is warranted for two reasons. First, relatively little attention has been given in the literature although it could provide important implications regarding the long-run effect of the minimum wage (Aaronson et al., 2018). Moreover, the aspect of the impact of minimum wage on new firms could differ from what incumbent firms would experience. Due to the employment protection law and other adjustment costs stemming

from putty-clay nature of technology, incumbent firms are less likely to swiftly adjust their characteristics such as employment or capital intensity in response to the change in the minimum wage (Sorkin. 2015; Johansen. 1959). However, a minimum wage could have a more immediate impact on the characteristics of entering firms not only because entering firms are more flexible in terms of choice of labor and capital inputs, but also because minimum wage could affect the decision of potential entrepreneurs on whether or not to enter the market in the first place (Williamson, 1968; Bachmann, Bauer, and Frings, 2014).

We exploit the introduction of minimum wage in South Korea in 1988 to identify the impact of minimum wage on new plants. In particular, we compare the changes in the characteristics of new firms in more affected sectors with those in less affected sectors. Since the minimum wage regulates the lowest amount of remuneration that an employer must pay to workers, it would have more ‘bite’ on low-paying sectors. The idea is to use the pre-policy remuneration to workers before the minimum wage introduction to capture the heterogeneous degrees of exposure to the minimum wage across sectors.¹ To be more specific, we define the intensity of treatment at the sector-level using the fraction of firms in which the average wage to workers was below the initial minimum wage, and apply a generalized difference-in-differences framework to repeated cross-sectional data of new firms to explore the causal effect of minimum wage introduction on various characteristics of new firms.

We first confirm that the minimum wage introduction in Korea in 1988 was a binding regulation for entering firms. Specifically, we document that the average remuneration to workers at new plants increased as a result of the minimum wage introduction. We also show

¹ This methodology was first proposed by Card and Krueger (1994) and subsequently adopted by papers such as Draca, Machin, and Reenen (2011) and Riley and Bondibene (2017).

that new firms in sectors with a high proportion of plants paying low wages start the business with fewer employees due to the minimum wage introduction. Therefore, although the minimum wage introduction did not negatively affect the employment of existing firms (Baek and Park, 2016), it reduced the employment size of entering firms. Moreover, we document that new firms choose to adopt capital intensive technology—i.e. higher capital-to-labor ratio—due to the minimum wage introduction. We then find empirical evidence supporting that the minimum wage introduction has a positive impact on the labor productivity of new firms. Specifically, our empirical evidence implies only the entrepreneurs who could make more out of the workers choose to enter the market after the minimum wage introduction. Our findings regarding the productivity of new firms are consistent with recent literature suggesting that minimum wage could enhance overall efficiency of economy by improving the productivity of incumbent firms and forcing less productive firms to exit the market. (Riley and Bondibene, 2017; Luca and Luca, 2018).²

We are able to contribute to the literature which uses firm/establishment-level data to examine how employers respond to the minimum wage, in two important ways. First, we take advantage of the data that cover all the firms which have been subject to the minimum wage introduction. As it will be explained in detail in the following sections, the minimum wage in Korea was initially applied to establishments with ten or more employees in manufacturing sector, and our dataset covers the population of establishments meeting the criteria. Thus, our estimates based on the population of firms being subject to the introduction would be more

² Riley and Bondibene (2017) exploits the minimum wage introduction and increase in minimum wage in the U.K. to examine its impact on productivity. They find that the productivity of firms employing low-wage workers, increased with the minimum wage. Luca and Luca (2018) finds that restaurants with lower ratings are more likely to go out of businesses by minimum wage increase.

representative than those in other studies based on a sample of firms that are affected by the minimum wage. In particular, firm-level analyses regarding the effect of minimum wage mostly exploit firm-level surveys underrepresent the firms being affected by the minimum wage due to the nature of the firm-level surveys. To be specific, firm-level data with detailed information such as revenue, wage, and employment is usually collected for sufficiently large firms.³ Therefore, compared to the previous works employing firm-level data, our work is less likely to suffer from the bias stemming from the underrepresentation of the firms being affected by the minimum wage.

Second, to the best of our knowledge, our paper is the first to examine the impact of minimum wage on the characteristics—i.e. employment, capital intensity and labor productivity—new firms entering the market. There are a few papers that examine the impact on the entry of businesses. For instance, Rohlin (2011) finds that non-trivial negative impact of minimum wage on entry of new establishments, whereas Aaronson et al. (2018) shows that the entry rate increases due to the minimum wage. However, such papers did not examine the impact of minimum wage on the characteristics of new firms which have chosen to enter the market. Exploring the characteristics of new firms is important as it allows us to draw implications regarding the long-term consequence of the minimum wage introduction. In particular, by documenting the capital-deepening as a possible channel for productivity improvement of entering firms, we are able shed light on the long-term impact of minimum wage on employment adjustment. Since the characteristics of new firms shape the

³ For instance, Mayneris, Poncet, and Zhang (2018) uses Chinese data that surveys firms with at least 5 million Yuan sales. As a result, the data covers only 20% of all industrial firms and it is likely to leave out small firms that are severely affected by the increase in the minimum wage. Similarly, the previous studies using FAME (Financial Analysis Made Easy) database in the U.K. are likely to exclude small companies from their analysis (Draca, Machin, and Reenen, 2011; Riley and Bondibene, 2017).

characteristics of an industry and the economy, our results suggest that the minimum wage introduction would eventually increase per-worker output at the cost of employment reduction.

The rest of the paper is organized as follows. Section 2 provides detailed description of minimum wage introduction in South Korea. Section 3 provides a description of the data used in the analysis, followed by the discussion on the empirical model. Section 4 presents the main result along with various robustness checks. Section 5 concludes.

2 Background

The introduction of the minimum wage in Korea has many unique features that provide a useful analytic framework. Although the Labor Standards Act was enacted in 1953 to secure and improve the living standards of workers, there was no explicit minimum wage law in Korea until 1986. After considerable debate and discussion on the details of the law, the National Assembly of Korea promulgated the Minimum Wage Act in December 1986 to reduce the low-wage labor and improve workers' life.

In particular, the law stipulated the first minimum wage to be determined in 1987 by the Minimum Wage Council and the initial minimum wage to be applied starting in January 1, 1988. As it is not hard to imagine, there were oppositions about the introduction of minimum wages from businesses and entrepreneurs. In particular, there was a concern that the minimum wage introduction would hurt the small businesses at the margin to exit the market. Reflecting their concerns, the Article 3 of Minimum Wage Act stated that the minimum wage could be gradually introduced by the sizes and industries of establishments. On July 1, 1987, the Presidential Decree No. 12207 was announced and limited the establishments being affected by the minimum wage to those in the manufacturing sector with ten or more workers.

Although the minimum wage introduction was limited to the specific sector, it was not expected to be revoked. Specifically, the revised Constitution which was amended on October 29, 1987 clearly states the requirement of a minimum wage system in Article 32. Therefore, despite the fierce oppositions, the minimum wage introduction had been perceived as irreversible policy for both employers and workers since it was stipulated in the Constitution.

The inaugural minimum wage level was supposed to be decided by the Minimum Wage Council no later than December 15, 1987. However due to a large disagreement among the council members representing employers and workers, the first minimum wage was finally decided on December 24, 1987. The initial minimum wage was decided separately for two groups of industries within manufacturing sector although the difference was minimal. For the low-paying manufacturing industries denoted as “Group 1” the minimum wage was determined to be 111,000 KRW per month or 462.50 KRW per hour.⁴ The initial minimum wage for the rest of the manufacturing sector, “Group 2”, was decided to be 117,000 KRW per month or 487.50 KRW per hour. The initial minimum wage was approximately 33% of the median wage of full-time workers in 1988 (OECD, 2019).⁵ About 4.2% of the workers employed in manufacturing plants with ten or more employees were estimated to be paid below than the initial minimum wage level in 1988.

The Korean context provides two advantages to explore the aspect of minimum wage in which the previous literature has paid less attention despite its importance. First, it enables us to observe how the developing economy adapts to a newly established labor market

⁴ The Group 1 consists of 12 low-paying industries such as manufacture of food and textiles, based on the three digit code of Korean Standard Industry Classification (KSIC) revision 5.

⁵ The minimum wage level relative to the median wage of full-time workers was similar to countries such as Japan and the United States in 1988. For instance, the federal minimum wage level in the United States was 35% of the median wage of the full-time workers in 1988.

institution regulating the minimum wage level. Most empirical studies in the literature analyze the employer's adjustment to the increase in minimum wage level given that there was a minimum wage system previously introduced to the economy. In contrast, the minimum wage introduced in 1988 in Korea provides an opportunity to examine how the characteristics of new businesses alter in response to a discrete change in labor market institution which did not seem to be revoked or reversed. In particular, the impact of the imposition of a new labor market regulation could be different from the impact of the change in the level of regulation which is already established. Moreover, unlike the recent minimum wage introduction in Germany and U.K. where it was introduced to well-developed countries, minimum wage in South Korea was implemented when it was a developing country. Specifically, most of the previous studies on the introduction of minimum wage focus on the experience of the U.K. and Germany that introduced the national level minimum wage in 1999 and 2015, respectively (Machin, Manning, and Rahman, 2003; Machin and Wilson 2004; Stewart. 2002, 2004b; Dickens and Manning, 2004; Ahlfeldt, Roth, and Seidel, 2018; Bossler and Brosziet. 2017; Caliendo et al., 2018). In particular, the impact of the minimum wage introduction could be different along the course of the economic development. Therefore, documenting the impact of minimum wage introduction on developing countries could extend our understanding on the impact and leads to the second point.

The second advantage comes from the fact that the minimum wage legislation initially targeted the manufacturing sector of a developing country. The existing literature, especially the ones exploiting the empirical setting of the U.S., has mainly focused on selected service sector which are heavily dependent on low-wage labor such as restaurant and fast-food industries (Aaronson, 2001; Aaronson and French, 2007; Card and Krueger 1994; Dube,

Lester, and Reich, 2010, 2016; Luca and Luca, 2018; Kim and Taylor, 1995; Wang, Phillips, and Su, 2019; Rohlin, 2011). The high attention to these industries reflects the importance of services industry in developed countries. In many developing countries, however, low-wage manufacturing still serves as the driving force of growth and also suffers from the “sweatshop” working conditions. Specifically, it is well known that main feature of the rapid economic growth in Korea was an increase in international trade of manufacturing goods (Connolly and Yi, 2015). Therefore, documenting the impact of minimum wage on manufacturing sector is particularly important in developing countries as it would have a direct implication on the economic development and growth. Moreover, it should also be noted that measuring the output, and therefore the labor productivity, and observing production technology represented by capital-labor ratio is more straightforward in manufacturing than in service sector. In particular, the possibility of price pass-through which complicates the interpretation of the result regarding the labor productivity is less likely to occur in manufacturing sector exposed in the fierce global competition (Harasztosi and Lindner, 2018). This allows the paper to have reliable implications on the impact of minimum wage introduction on various characteristics of new plants which are not limited to the employment size of the establishments.

3 Data and Empirical Strategy

To examine the impact of minimum wage introduction on characteristics of entering establishments, we use the Mining and Manufacturing Survey from 1984 to 1990. The data is collected by Statistics Korea and covers all the establishments with ten or more workers in manufacturing sector in which the minimum wage in Korea was initially applied to. Therefore, we are able to reliably examine the impact of the minimum wage introduction by utilizing all

establishments that were directly subject to the introduction.⁶ In particular, our empirical results are based on a large and representative sample from the survey which does not systematically omit the information of small firms.

The data has detailed information on plant's characteristics such as the number of workers, output, amount of physical capital, total wage to workers and its industry classification. The information allows us to examine the effect of the minimum wage introduction on plant's characteristics—labor productivity and capital intensity—other than traditionally examined employment size. In particular, output observed in the dataset measures the monetary value of goods produced by a given plant in a given year. The amount of physical capital is a monetary value of the depreciable tangible assets such as machinery, equipment, tools, vehicles, and buildings, and we use the average values of capital stock at the beginning of the year and at the end of the year to adjust for the possible investment and depreciation. The average monthly wage at a plant is defined as the total wage paid to workers divided by 12 months and by the number of workers at a plant in a given year. We use this information to define the heterogeneous impact of minimum wage introduction across sectors. To be specific, we define the treatment intensity as the proportion of plants in each sector at which the average monthly wage in year 1987—prior to the minimum wage implementation—was lower than the minimum wage (referred to as “low-wage plants”).⁷ That is, a sector with a large proportion of low-wage plants (referred to as “low-paying sector”) would have been affected by the minimum wage introduction more than sectors with a small proportion of low-wage plants

⁶ The manufacturing sector in our sample is defined by Korean Standard Industrial Classification (KSIC) revision 5 which is mainly based on International Standard Industrial Classification (ISIC) revision 2 published by United Nations.

⁷ The sector is defined at the 4-digit level of KSIC revision 5, and there are 104 sectors in our sample.

(referred to as “high-paying sector”). Figure 1, depicts the distribution the treatment intensity across the sectors.

To analyze the impact of minimum wage introduction on the characteristics of entering plants by employing the aforementioned measure on the impact, we use repeated cross-sectional data of new plants which were established in each year of survey. Specifically, our analysis regarding the impact of the minimum wage introduction is based on 51,706 new plants with more than ten workers in manufacturing sector. Table 1 presents the summary statistics for our main sample described above. Specifically, Panel A summaries key variables in the entire data whereas Panels B and C describe those variables among the plants that entered prior to the minimum wage introduction and after the introduction, respectively. The number of workers denotes the average number of employees of a given plant during the year. The annual output per worker in each establishment, which reflects the labor productivity, is annual output divided by the number of workers,⁸ Finally, capital per worker, measuring capital intensity, is capital-to-labor ratio which is defined as the amount of capital stock divided by the number of employees in a given plant. Compared to the numbers observed during the periods prior to the minimum wage introduction, monthly wage per worker, capital stock per worker and annual output per worker increased and the number of workers decreased during the periods after the policy implementation.

We use the aforementioned sample to examine the effect of minimum wage introduction on the characteristics of entering plants by implementing a difference-in-differences framework. In particular, we analyze how the minimum wage affected the

⁸ The annual output at a plant in a year is a real value which was normalized by the industry specific deflator for the value-added.

characteristics of new plants differentially across industries by the heterogeneous degree of the minimum wage impact. Our empirical strategy is similar to the one adopted in recent literature such as Draca, Machin, and Reenen (2011) and Riley and Bondend. Specifically, the changes observed among new plants in low-paying sectors relative to those among plants in high-paying sectors can be attributed to the introduction of minimum wage. Unlike in a conventional difference-in-differences, in which the sample is divided into a treatment group and a control group, we employ a continuous treatment intensity, which takes a larger value for low-paying (more affected) sectors and a smaller value for high-paying (less affected) sectors.

To be concrete, we estimate the following equation to examine the causal effect of minimum wage introduction on the characteristics of new plants:

$$Y_{ijt} = \beta Treat_j \cdot After_t + \gamma_j + \tau_t + \delta_j \cdot t + \phi G_t \cdot Treat_j + \varepsilon_{ijt} \quad (1)$$

where Y_{ijt} indicates a characteristic of new plant i , in sector j , at year t such as the number of workers, labor productivity, and capital intensity. $Treat_j$ denotes the treatment intensity, which is defined using the average monthly wage to workers prior to the minimum wage introduction as above. As a sector with a large proportion of plants with the average monthly wage to workers below the minimum wage tends to be highly affected by the minimum wage introduction, the treatment intensity represents the heterogeneity in actual ‘bite’ of the minimum wage across sectors. In the following section, we also provide results using alternative treatment intensities such as a negative log of average wage of workers following Draca, Machin, and Reenen (2011).⁹

⁹ As additional robustness checks, we provide results employing various alternative treatment intensity in

$After_t$ is a dummy variable indicating the periods after the minimum wage introduction. That is, $After_t$ takes value equal to one for new plants that entered the market after the introduction of minimum wage in 1988. The coefficient of the interaction term between $After_t$ and $Treat_j$, β , is the coefficient of interest; it summarizes how the minimum wage introduction alters the characteristics of new plants. γ_j and τ_t indicate sector-fixed and year-fixed effects, respectively. In addition, we control for the possibility of heterogeneous trends across different sectors by including the sector-specific linear time trend, $\delta_j t$. Furthermore, we control for the possibility of the macro-economic shocks which could affect differentially low-paying sectors and high-paying sectors. To explicitly address this issue, we include the interaction terms between the real GDP growth rate and the treatment intensity of each sector, following the approach used in Kugler and Pica (2008). Finally, the error term, ε_{ijt} is clustered at the sector level to address the potential serial correlation within a sector.

4 Results

4.1 Main Result

In this section, we document how the minimum wage introduction shaped the characteristics of new establishments. Specifically, the introduction of minimum wage could induce firms with higher labor productivity to enter the market, and deter the entries of less productive firms. Moreover, new plants could choose labor saving technology in response to the minimum wage when entering the market. They could also adopt better management practice to improve labor productivity and compensate for the increase in labor cost induced by the minimum wage. We

Table 3 of Section 4.2.

examine the plausibility of these based on the results from estimating the equation (1).

Table 2 presents the regression results from the equation (1) using various dependent variables, summarizing the impact of minimum wage introduction on new plants' characteristics. All regressions include industry-fixed effects at 4 digit level and year-fixed effects, industry specific linear trends and the interaction term between real GDP growth rate and the treatment intensity.

Column (1) of Table 2 shows the impact of minimum wage introduction on the average monthly wage of workers of entering plants. If the imposition of the minimum wage was a binding regulation and our treatment intensity appropriately captures the impact, we would expect to observe a positive and statistically significant estimate of β in equation (1). The estimated coefficient is 0.612 and statistically significant. That is, the monthly wage per worker at new plants in the sector that consists of only low-wage plants, increased by 61% as a result of minimum wage introduction than that in a sector without any plants paying below the minimum wage.

This result shows that the minimum wage introduction indeed had a positive impact on the average remuneration of new firms. Furthermore, the positive coefficient also confirms that our treatment intensity adequately captures the degree of effect of minimum wage introduction. Therefore, one can safely rule out the possibility that our remaining results on employment, capital intensity and labor productivity are due to non-compliance of the minimum wage.

The result in column (2) of Table 2 summarizes the effect of the minimum wage introduction on the employment size of new plants. The negative coefficient implies that new firms entering the market after the minimum wage imposition tend to start with fewer

employees than new firms entering the market prior to the policy. To be specific, entering firms in a sector with 1 percentage point higher proportion of low-wage plants, launched their business with approximately 1% fewer employees because of the minimum wage introduction. This result suggests that the minimum wage introduction could have a negative impact on the number of jobs because of the reduced number of jobs created by newly entering firms.

Column (3) documents the impact of the minimum wage on the capital intensity of entering plants measured by the capital to labor ratio. The estimated coefficient capturing the effect of the minimum wage on the capital intensity is positive and statistically significant, which indicates that the minimum wage induces new firms to adopt more capital intensive technology when starting their business. Overall, the results from columns (2) and (3) suggest that new firms substitute capital for labor and choose more capital intensive and more labor-saving technology when entering the market as the minimum wage introduction permanently affects the labor costs.

We also examine how the minimum wage introduction affects the labor productivity of new plants. The positive and statistically significant coefficient in column (4) of Table 2 shows that the minimum wage introduction leads to higher labor productivity among entering plants. That is, the change of the labor productivity among new plants in a more affected sector, is greater than that in a less affected sector. This result suggests that a modest minimum wage could spur productivity improvement by the entries of “better” plants. Although we cannot pin down the exact mechanism for the improvement of the labor productivity, there are several possible explanations as the increase in the labor productivity can be led by various sources such as technology and/or management skills. This finding, the minimum wage introduction causing higher labor productivity, could be explained by new plants’ choice of technology

and/or their management skills. Besides, new plants could hire higher quality of labor inputs and/or they could choose to produce products with a higher value. Compared to the situation before the minimum wage introduction, better prepared entrepreneurs could have entered to the market in the first place.

4.2 Robustness Checks

In this subsection, we perform various robustness checks for our main results. We perform three different sets of robustness checks. First, we try various measures of treatment intensity to show whether our main results are robust to the definitions of treatment intensity. Second, we impose an imaginary introduction of minimum wage to examine whether our results are simply driven by the pre-existing trend. Furthermore, we restrict the sample to the plants in industries with positive values of treatment intensity to see whether industries without any low wage plants drive our main findings.

To begin with, we use four alternative measures for the treatment intensity of the minimum wage introduction, and the results are reported in Panels A through D of Table 3. First, Panel A of Table 3 uses the proportion of workers working at low-wage plants in each sector instead of the proportion of low-wage plants. When using the proportion of low-wage plants in each sector for the treatment intensity, we weight each plant in a sector equally. Instead, we weight each plant by the size of its employment to construct the alternative measure of treatment intensity, assuming the wages of workers within each plant are same. This alternative measure allows large firms to influence more in determining the ‘bite’ of the minimum wage introduction in each sector. The empirical result using this alternatively constructed treatment intensity is both qualitatively and quantitatively consistent with our

main result documented in Table 2.

We adopt another alternative measure for the treatment intensity by taking a natural log of the average wage of workers in each sector. The average wage of each sector is calculated by dividing the sum of total wage in each sector with the sum of employees in the sector. Following the Draca et al. (2011), we use a negative of the logarithm of the average wage in a sector so that the sign of the estimated coefficient is consistent with our main treatment intensity. The estimated coefficients from using this treatment intensity, summarized in Panel B of Table 3, are also qualitatively similar to our main result.

In addition, we take the average of the proportion of low-wage plants in each sector over the time periods prior to the introduction of the minimum wage—years from 1984 through 1987—to construct an alternative measure for the treatment intensity. In particular, we normalize the wages in each year to the year 1987 and identify the share of plants paying below the initial minimum wage determined in 1987. We then average the share for each industry over the period from year 1984 to 1987 and use it as an alternative treatment intensity. From the results based on this treatment intensity, we show that our main result is not driven by the wage distribution specific to the year of 1987. Panel C of Table 3 summarizes the impact of the minimum wage introduction on various outcome variables using the treatment intensity defined based on the wage distribution from entire periods prior to the policy.

Finally, we also use a different minimum wage cutoff to determine the proportion of plants below the minimum wage in each sector to show that our results are robust to the minor change in wage cutoff which determines the treatment intensity. Specifically, we use a minimum wage cutoff, 1.2 times higher than the actual minimum wage and determine the

treatment intensity based on the higher cutoff. The result reported in Panel D of Table 3 is consistent with our main result, and thus confirms that our main results are robust to small change in minimum wage cutoff.

Moreover, we use the pseudo year of minimum wage introduction to examine whether our result simply reflects the pre-existing trend in terms of technology adoption and the increase of wage and labor productivity of workers. Since South Korea was growing rapidly during this period, it is possible that the result could have been observed without the minimum wage introduction. To formally examine this possibility, we use the data periods only prior to the minimum wage introduction—from 1981 through 1987—and impose an imaginary minimum wage introduction in year 1985 instead of 1988. We also adjust the treatment intensity to reflect the timing of the imaginary minimum wage introduction. Using the wage distribution in 1984, we calculate the proportion of low-wage plants in each sector in 1984 for the pseudo-impact of minimum wage introduction. The results using the imaginary introduction of minimum wage are presented in Panel E of Table 3. The impact of the imaginary introduction of minimum wage in 1985 on the same set of outcome variables employed in our main analysis helps us to refute the argument that our main results would have been observed in the absence of the minimum wage introduction. Column (1) shows that the monthly wage of workers is not affected by the pseudo treatment. The estimates shown in columns (2) and (3) have opposite signs of those in the main result, and they are statistically insignificant. The estimate for labor productivity in column (4) is positive, but much smaller than that in the main result and it is also statistically insignificant. From these results, we can be assured that our main results are neither identifying a spurious relation between the increase in the wage and productivity nor simply capturing simple trends in the

course of economic development.

Finally, we limit the sample to sectors with at least some proportion of plants paying below the minimum wage level. In particular, sectors without any plants paying below the minimum wage may be different from sectors with many low wage plants in many aspects. From this exercise, we could examine, conditional on being affected by the minimum wage in some degree, whether entering plants in high-paying sectors would change their characteristics more substantially because of the minimum wage introduction. The results reported in Panel F of Table 3 are qualitatively and quantitatively similar to our main results, implying that our findings are valid when sectors without any low wage plants are excluded.

5 Conclusions

In this paper, we try to extend our understanding on minimum wage by examining its impact on various characteristics of new plants. Despite the important implications regarding the long-run impact, the studies documenting the impact of minimum wage on newly entering firms are limited. To explore the causal impact of the minimum wage introduction, we exploit the introduction of minimum wage in Korea. To be specific, we apply a generalized difference-in-differences framework to the data covering the universe of the new plants subject to the minimum wage introduction in Korea, utilizing heterogeneous degrees of exposure to the minimum wage introduction across sectors. Our estimation results show that the minimum wage introduction reduced low-wage labor by increasing wages of workers. Moreover, we find that new firms tend to adopt more capital-intensive technology and employ fewer workers due the minimum wage. We also find that labor productivity of new firms which chose to enter the

market increased with the introduction of minimum wage. Our main results are confirmed by various robustness checks which include a falsification test and alternative definitions of degree of exposure to the minimum wage. Our results suggest that minimum wage in developing countries could induce its manufacturing sector to utilize the labor force in a more efficient way and to be equipped with more capital at the cost of reduced employment.

References

- Aaronson, Daniel. 2001. "Price pass-through and the minimum wage." *Review of Economics and statistics* 83 (1):158–169.
- Aaronson, Daniel, and Eric French. 2007. "Product market evidence on the employment effects of the minimum wage." *Journal of Labor Economics* 25(1):167–200.
- Aaronson, Daniel, Eric French, and James MacDonald. 2008. "The minimum wage, restaurant prices, and labor market structure." *Journal of Human Resources* 43 (3):688–720.
- Aaronson, Daniel, Eric French, Issac Sorkin, and Ted To. 2018. "Industry Dynamics and the Minimum Wage: A Putty-Clay Approach" *International Economic Review* 59(1): 51-84.
- Ahlfeldt, Gabriel M., Duncan Roth, and Tobias Seidel. 2018. "The regional effects of Germany's national minimum wage." *Economics Letters* 172:127–130.
- Bachmann, Ronald, Thomas K. Bauer, and Hanna Frings, 2014. "Minimum Wages as a Barrier to Entry: Evidence from Germany," *Labour* vol. 28(3), pages 338-357.
- Baek, Jisun and WooRam Park. 2016. "Minimum wage introduction and employment: Evidence from South Korea." *Economics Letters* 139 (C):18–21.
- Belman, Dale and Paul J. Wolfson. 2014. *What Does the Minimum Wage Do?* W.E. Upjohn Institute for Employment Research.
- Bosler, Mario, and Hans-Dieter Gerner. 2016. *Employment effects of the new German minimum wage: Evidence from establishment-level micro data*. No. 10/2016. IAB-Discussion paper
- Bosler, Mario, and Sandra Broszeit. 2017. "Do minimum wages increase job satisfaction?"

- Micro-data evidence from the new German minimum wage.” *Labour* 31 (4):480–493.
- Card, David and Alan B Krueger. 1994. “Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania.” *American Economic Review* 84 (4):772–793.
- Card, David, and Alan B. Krueger. *Myth and Measurement: The New Economics of the Minimum Wage*. PRINCETON; OXFORD: Princeton University Press, 1995.
- Caliendo, Marco, et al. 2018. “The short-run employment effects of the German minimum wage reform.” *Labour Economics* 53: 46–62.
- Connolly, Michelle, and Kei-Mu Yi. 2015. "How Much of South Korea's Growth Miracle Can Be Explained by Trade Policy?" *American Economic Journal: Macroeconomics*, 7 (4): 188-221.
- Dickens, Richard, and Alan Manning. 2004. “Spikes and spill-overs: the impact of the national minimum wage on the wage distribution in a low-wage sector.” *The Economic Journal* 114 (March): C95–C101.
- Draca, Mirko, Stephen Machin, and John Van Reenen. 2011. “Minimum Wages and Firm Profitability.” *American Economic Journal: Applied Economics* 3 (1):129–51.
- Dube, Arindrajit, Suresh Naidu, and Michael Reich. 2007. “The economic effects of a citywide minimum wage.” *ILR Review* 60 (4): 522–543.
- Dube, Arindrajit, T. William Lester, and Michael Reich. 2010. “Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties.” *The Review of Economics and Statistics* 92 (4):945–964.
- Dube, Arindrajit, T. William Lester, and Michael Reich. 2016. “Minimum Wage Shocks, Employment Flows, and Labor Market Frictions.” *Journal of Labor Economics* 34

(3):663–704.

- Fan, Haichao, Faqin Lin and Lixin Tang. 2018. “Minimum Wage and Outward FDI from China” *Journal of Development Economics* 135(C):1–19
- Gan, Li, Manuel A. Hernandez, and Shuang Ma. 2016. “The higher costs of doing business in China: Minimum wages and firms' export behavior.” *Journal of International Economics* 100:81–94.
- Haepf, Tobias, and Carl Lin. 2017. “How Does the Minimum Wage Affect Firm Investments in Fixed and Human Capital? Evidence from China.” *Review of Development Economics* 21 (4):1057–1080.
- Harasztosi, Péter and Attila Lindner. 2018. “Who Pays for the Minimum Wage?” Accepted at American Economic Review
- Huang, Yi, Prakash Loungani, and Gewei Wang. 2014. *Minimum wages and firm employment: Evidence from China*. IMF Working Paper No. 14-184.
- Johansen, Leif. 1959. “Substitution versus Fixed Production Coefficients in the Theory of Economic Growth: A Synthesis.” *Econometrica* 27 (2):157–176.
- Kim, Taeil, and Lowell J. Taylor. 1995. “The Employment Effect in Retail Trade of California’s 1988 Minimum Wage Increase.” *Journal of Business and Economic Statistics* 13 (2):175–182.
- Luca, Dara Lee, and Michael Luca. 2018. “Survival of the fittest: The impact of the minimum wage on firm exit.” *Harvard Business School NOM Unit Working Paper* 17-088.
- Machin, Stephen, Alan Manning, and Lupin Rahman. 2003. “Where the Minimum Wage Bites Hard: Introduction of Minimum Wages to a Low Wage Sector.” *Journal of the European Economic Association* 1 (1):154–180.

- Machin, Stephen, and Joan Wilson. 2004. "Minimum Wages in a Low-Wage Labour Market: Care Homes in the UK." *Economic Journal* 114 (March):C102–109.
- Mayneris, Florian, Sandra Poncet, and Tao Zhang. 2018. "Improving or disappearing: Firm-level adjustments to minimum wages in China." *Journal of Development Economics* 135:20–42.
- Metcalf, David. 2008. "Why has the British national minimum wage had little or no impact on employment?" *Journal of Industrial Relations* 50 (3):489–512.
- Neumark, David, and William Wascher. 2000. "Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania: Comment." *American Economic Review* 90 (5):1362–1396.
- Neumark, David and William L. Wascher. 2008. *Minimum Wages*, MIT Press Books, vol. 1. The MIT Press.
- OECD. 2019. "Earnings: Minimum wages relative to median wages." *OECD Employment and Labour Market Statistics* (database), <https://doi.org/10.1787/data-00313-en> (accessed on 12 June 2019).
- Riley, Rebecca and Chiara Rosazza Bondibene. 2017. "Raising the standard: Minimum wages and firm productivity." *Labour Economics* 44:27 – 50.
- Rohlin, Shawn M. 2011. "State minimum wages and business location: Evidence from a refined border approach." *Journal of Urban Economics* 69 (1):103–117.
- Schmitt, John. 2013. "Why Does the Minimum Wage Have No Discernible Effect on Employment?" CEPR Reports and Issue Briefs 2013-04, Center for Economic and Policy Research.

- Skedinger, Per. 2006. "Minimum Wages and Employment in Swedish Hotels and Restaurants." *Labour Economics* 13 (2):259–290.
- Sorkin, Isaac. 2015. "Are there long-run effects of the minimum wage?" *Review of Economic Dynamics* 18 (2):306 – 333.
- Stewart, Mark B. 2002. "Estimating the Impact of the Minimum Wage Using Geographical Wage Variation." *Oxford Bulletin of Economics & Statistics* 64 (Supplement):583–605.
- Stewart, Mark B. 2004a. "The employment effects of the national minimum wage." *Economic Journal* 114(494):110–116.
- Stewart, Mark B. 2004b. "The Impact of the Introduction of the U.K. Minimum Wage on the Employment Probabilities of Low-Wage Workers." *Journal of the European Economic Association* 2 (1):67–97.
- Stewart, Mark B., and Joanna K. Swaffield. 2006. "The Other Margin: Do Minimum Wages Cause Working Hours Adjustments for Low-Wage Workers?" Unpublished paper, University of Warwick.
- Wang, Wuyi, Peter CB Phillips, and Liangjun Su. 2019. "The heterogeneous effects of the minimum wage on employment across states." *Economics Letters* 174:179–185.
- Williamson, Oliver E. 1968 "Wage Rates as a Barrier to Entry: The Pennington Case in Perspective." *The Quarterly Journal of Economics* 82(1): 85-116.

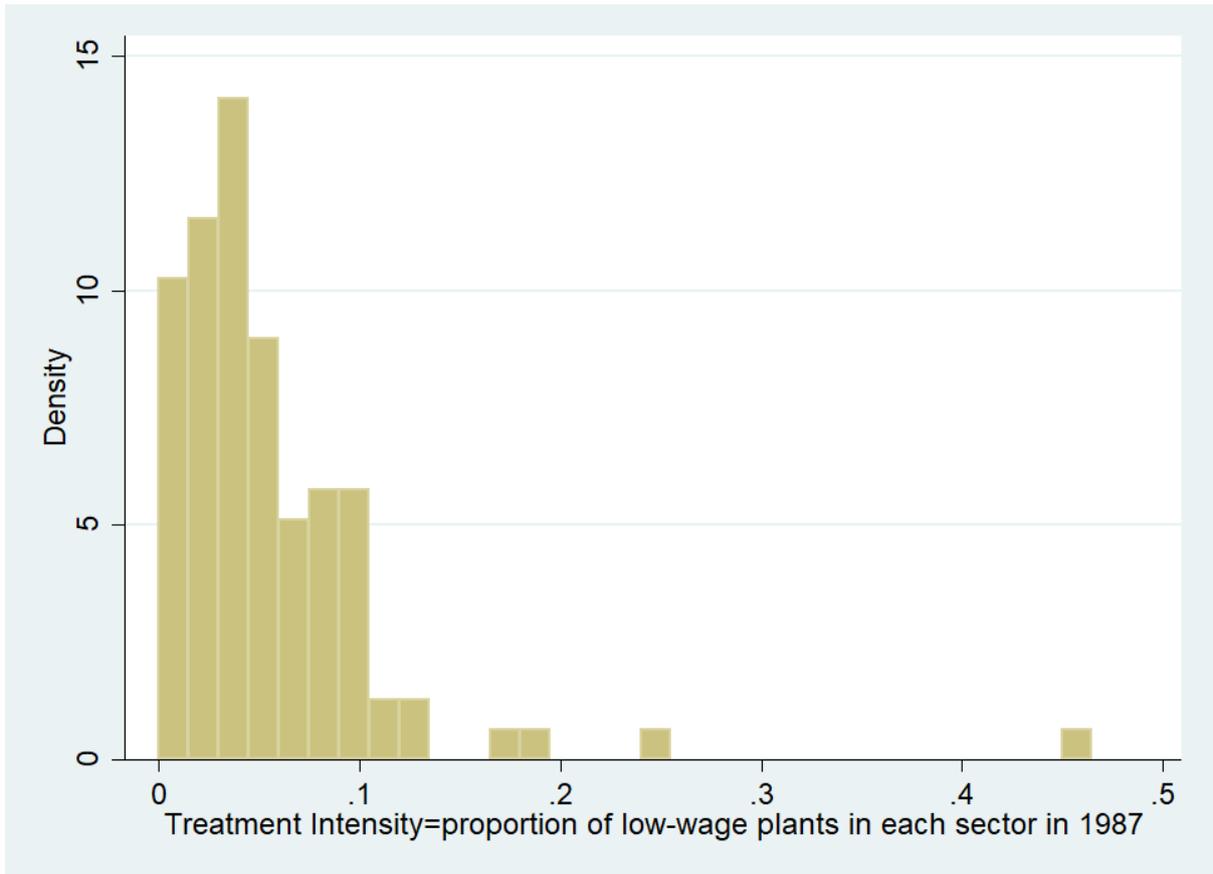


Figure 1 Distribution of Treatment Intensity across Sectors

Table 1 Summary Statistics

Variable	N (1)	Mean (2)	SD (3)
Panel A: New Plants with 10+ Workers, 1984-1990			
monthly wage per worker	51706	0.24	0.14
number of workers	51706	32.8	75.3
capital stock per worker	51706	4.2	9.6
annual output per worker	51706	28.8	50.4
capital stock	51706	206.7	3458.6
annual output	51706	1114.2	7076.8
Panel B: New Plants with 10+ Workers, 1984-1987			
monthly wage per worker	25003	0.18	0.09
number of workers	25003	35.5	81.5
capital stock per worker	25003	2.7	5.9
annual output per worker	25003	22.3	35.6
capital stock	25003	148.9	3777.5
annual output	25003	965.4	7852.9
Panel C: New Plants with 10+ Workers, 1988-1990			
monthly wage per worker	26703	0.30	0.15
number of workers	26703	30.3	68.8
capital stock per worker	26703	5.7	11.8
annual output per worker	26703	34.9	60.4
capital stock	26703	260.9	3129.7
annual output	26703	1253.4	6260.5

1. Panel A reports the statistics for the full sample, and Panels B and C report, respectively, the statistics of the subsamples containing plants that entered prior to the minimum wage introduction and plants that entered after it, respectively. The numbers in column (1) show the number of observations in each variable. The numbers in column (2) and (3) indicate the average and the standard deviation, respectively.

2. All monetary values are in million KRW.

3. Output per worker and total output are real, and the remaining variables in monetary values are nominal. Labor input indicates the number of employees at each plant.

Table 2 Effect of Minimum Wage Introduction on Characteristics of Entering Plants

Dependent Var.	Wage/L (1)	L (2)	K/L (3)	Y/L (4)
Treat=Share of affected plants in each industry in 1987				
Treat*After	0.612*** -0.1421	-0.968*** -0.1333	1.237*** -0.3806	1.170*** -0.2229
adj. R-sq	0.237	0.075	0.289	0.169
N	51706	51706	51706	51706

1. The numbers in the main entry indicate the coefficient of Treat*After in equation (1). Treat is the intensity of treatment defined as the proportion of low-wage plants of which the average wage per worker in each sector in 1987 is less than the initial minimum wage, and After is a dummy variable indicating periods after the minimum wage introduction 1988.
2. All dependent variables are in logarithm.
3. For all dependent variables, we include 4 digit industry-fixed effects, year-fixed effects, industry specific linear trends, and the interaction term between real GDP growth rate and Treat.
4. Standard errors in parentheses are clustered at 4 digit industry level.
5. *Statistically significant at the 10% level; ** at the 5% level; *** at the 1 % level.

Table 3 Robustness Checks

Dependent Var.	Wage/L (1)	L (2)	K/L (3)	Y/L (4)
Panel A: Treat=Share of employees hired by the affected plants in each industry in 1987				
Treat*After	0.681*** (.16)	-1.161*** (.2115)	1.625*** (.5094)	1.262*** (.2309)
adj. R-sq	0.237	0.075	0.289	0.169
N	51706	51706	51706	51706
Panel B: Treat=(-1)*ln(industry average wage in 1987)				
Treat*After	0.134** (.0539)	-0.215** (.0865)	0.0979 (.1731)	0.178 (.1115)
adj. R-sq	0.237	0.075	0.288	0.169
N	51706	51706	51706	51706
Panel C: Treat=Average of share of affected plants in each industry during 1984-1987				
Treat*After	0.471*** (.107)	-0.923*** (.1425)	0.791 (.5493)	0.934*** (.1806)
adj. R-sq	0.237	0.075	0.288	0.169
N	51706	51706	51706	51706
Panel D: Treat=Share of affected plants in each industry in 1987, using 1.2*actual MW cutoff				
Treat*After	0.492*** (.1061)	-0.796*** (.1437)	0.845* (.43)	0.979*** (.1761)
adj. R-sq	0.237	0.075	0.289	0.169
N	51706	51706	51706	51706
Panel E: Imaginary year of MW introduction in 1985, using data during 1981-1987				
Treat*After	-0.273 (.3625)	0.751 (.5239)	-0.575 (.4557)	0.130 (.4609)
adj. R-sq	0.119	0.085	0.228	0.145
N	28917	28917	28917	28917
Panel F: Using plants in industries with positive values of Treat				
Treat*After	0.587*** (.1348)	-0.938*** (.134)	1.282*** (.3639)	1.157*** (.2196)
adj. R-sq	0.237	0.075	0.287	0.168
N	51317	51317	51317	51317

-
1. Treat in Panel A is the proportion of workers at low-wage plants, paying below the minimum wage on average, in each sector in 1987. Treat in Panel B is a negative log of the average wage in each sector in 1987. Treat in Panel C is the average of the proportion of low-wage plants, paying below the minimum wage on average, in each sector during the periods prior to MW introduction, i.e. 1984-1987. Treat in Panel D is the proportion of low-wage plants, paying below 1.2 times initial minimum wage on average, in each sector in 1987. Treat in Panel E is the proportion of plants, paying below the minimum wage on average, in each sector in 1984. Treat in Panel F is identical to Treat used in the main analysis in Table 2. After in all panels but Panel E is an indicator variable taking one for periods after the minimum wage introduction in 1988. After in Panel E is an indicator variable taking one for periods after the imaginary introduction of minimum wage, 1985.
 2. The sample used in Panels A through D are identical to the sample used in our main analysis. The sample used in Panel E contains new plants with 10 or more employees from 1981 through 1987. The sample used in Panel F contains plants with 10 or more employees in industries with positive values of Treat, excluding industries without any low-wage plants from the main sample.
 3. For all dependent variables, we include 4 digit industry-fixed effects, year-fixed effects, industry specific linear trends, and the interaction term between real GDP growth rate and Treat.
 4. Standard errors in parentheses are clustered at the 4 digit industry level.
 5. *Statistically significant at the 10% level; ** at the 5% level; *** at the 1 % level.