Business Churn, Labor Intensity, and the Minimum Wage

Ekaterina Jardim[*] Amazon.com[†]

Emma van Inwegen[‡] MIT

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Abstract

We study the effects of a large increase in Seattle's minimum wage on business churn, hours, and revenue using Washington State administrative data. We find the minimum wage affected businesses both at the intensive and extensive margins. At the intensive margin, surviving businesses increased labor costs without decreasing hours and saw no reductions in revenue. At the extensive margin, businesses experienced higher rates of exit and newly opened businesses became less labor-intensive. We find the total effect of the minimum wage to low-wage employment, defined as jobs paying 130% of the minimum wage or less, came from the extensive margin.

JEL Classification: J38, J23, J63

minimum wage, extensive and intensive margin, channels of adjustment

[*]ekaterinajardim@gmail.com

[†]Ekaterina Jardim worked on this paper prior to joining Amazon.

[‡]Corresponding author, emmavani@mit.edu

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1 Introduction

We examine the magnitude of within-firm adjustment of incumbent firms, i.e., the intensive margin, versus the effects to business entry and exit, i.e., the extensive margin, for businesses faced with a higher local minimum wage. We study a large minimum wage hike in Seattle, when the minimum wage went from $9.47 to up to $13, using two unique confidential datasets from the State of Washington: payroll records from Unemployment Insurance (UI) program and sales records from the Department of Revenue. These data allow us to overcome the major limitations of previous studies: 1) restricting the analysis to restaurants and retail (Card and Krueger, 1994; Allegretto et al., 2013), and 2) focusing exclusively on intensive or extensive margin, without the ability to incorporate both (Harasztosi and Lindner, 2019; Luca and Luca, 2019).

We find that incumbent businesses that remained open (which we will call *surviving firms*) were largely able to sustain the minimum wage increase, with no significant effects to their hours worked. However, the minimum wage hike accelerated the exit of businesses with a high share of low-wage jobs and increased the rate of business exit by 13 percent in total ($p < 0.001$), from 5.08% to 5.77%. The revenue of exiting business was redistributed to the surviving businesses. Most importantly, the minimum wage hike shifted the composition of businesses in the market towards less labor intensive businesses. Compared to the prior cohorts, average exiting businesses had 4% more hours worked in low-wage jobs after the minimum wage hike, while average entering business had 20% fewer hours worked in low-wage jobs and 13% fewer hours worked in all jobs ($p < 0.001$).

These findings imply that the entirety of the effect of the minimum wage to employment in low-wage jobs, defined as jobs paying 130% of the minimum wage or less, came from the extensive margin. Our results suggest that the minimum wage pressures companies to adopt a business model with lower reliance on labor in the long-term.

We estimate these effects with a difference-in-differences approach, comparing Seattle businesses with lower costs of compliance with the law, i.e. those businesses which employed few minimum wage workers, to businesses with higher costs of compliance. We measure these costs of compliance by calculating how much a business would need to increase its total wagebill to comply with the new minimum wage, if it were to keep the same number of hours worked as before the passage of the law. The results are robust to different specifications and a placebo analysis.

Our paper contributes to the literature on who pays for the minimum wage, demonstrating that the local minimum wage in Seattle redistributed sales and payroll across businesses. To our knowledge, this is the first paper which shows direct evidence on 1) the shift towards

less labor-intensive firms as a result of the minimum wage hike and 2) the contribution of this compositional shift to the overall effect of the minimum wage. Previously, Hirsch, Kaufman and Zelenska (2015) and Harasztosi and Lindner (2019) examined channels of adjustment at the intensive margin in detail, but their data did not permit them to study the extensive margin. Similarly, Luca and Luca (2019) study business exit directly, but can neither measure employment and revenue in those businesses nor business entry. Finally, Aaronson, French, Sorkin and To (2018) suggest that existing businesses are locked into their business model, and find that employment effects to the minimum wage occur through business churn; however, their analysis cannot examine compositional effects to hours worked and payroll due to data limitations. In this paper, we are able to study both business exit and entry as well as the labor-intensity of those firms to give a complete view of the effects of the local minimum wage.

2 Data and Policy Change

In June 2014, the City of Seattle passed an ordinance which raised the minimum wage to $15 over the following seven years, in several phase-in stages.[1] We study the period from the second quarter of 2014 when the ordinance was passed through the third quarter of 2016, over which time the minimum wage increased by 37% in two phases. The first phase-in raised the minimum wage from $9.47 to up to $11 in April of 2015 and the second raised it to up to $13 in January of 2016.

We combine payroll data from Unemployment Insurance (UI) records collected by the Washington Employment Security Department with revenue data from the Business and Occupation tax records collected by the Washington Department of Revenue.

Our dataset spans from 2005 through 2016, allowing us to track businesses over time. For each business, we observe the industry code at the NAICS 6-digit level, address of the firm, opening and closing date, and quarterly revenue. We also observe quarterly payroll and total hours worked for each worker in the firm. Our sample consists of all single location businesses in Washington. We cannot separate employees of Seattle businesses, for whom the minimum wage applies, from employees at branches outside of of Seattle, for whom it does not.[2] Therefore, we focus our analysis on single-location businesses to avoid mixing

[1] The complete minimum wage schedule is presented in Appendix Table 1.

[2] Non-franchise businesses operating multiple stores are given the option to file a joint report for all their locations under one address. As a result, we cannot observe which employees in these businesses work in Seattle and are therefore covered by the wage ordinance and which work outside of Seattle. See (Jardim et al., 2017) for more details on ESD's coverage of firms.

treated and non-treated firms. On average, these businesses tend to be younger and smaller than multi-location businesses. They make up 89 percent of all firms in Washington State and hire about 62 percent of all workers. They also pay lower wages than multi-location businesses, and thus are more exposed to the minimum wage hike than an average business in Seattle. As such, our estimates can be interpreted as the minimum wage's effect on the most vulnerable firms. We also restrict our analysis to businesses that had five or more employees on average through their lifetime, and those which do not include a large share of reporting errors.[3] The firms that make up the final sample account for 70 percent of the workforce employed by single-location businesses in Seattle.

In order to study the impact of minimum wage on businesses longitudinally and to capture business entry and exit, we split the data into cohorts. We set the baseline period for a cohort in the second quarter of each calendar year and track firms for six subsequent quarters. This design allows us to take into account seasonal variation in business activity, as well as the annual increases in the state minimum wage. We choose short cohorts of six quarters 1) to detect the impact of each minimum wage phase-in period separately and 2) to avoid the bias towards large firms that arises in the longitudinal analysis if cohorts were longer. Six quarter cohorts are long enough to capture longitudinal effects to surviving firms and short enough to capture volatility in entry and exit. This design produces two "treated" cohorts which we analyze separately; one spanning the introduction of the $11 minimum wage, and one spanning the introduction of the $13 minimum wage, and seven "control" cohorts spanning 2005-2014, allowing us to capture pre-policy trends in Seattle.[4]

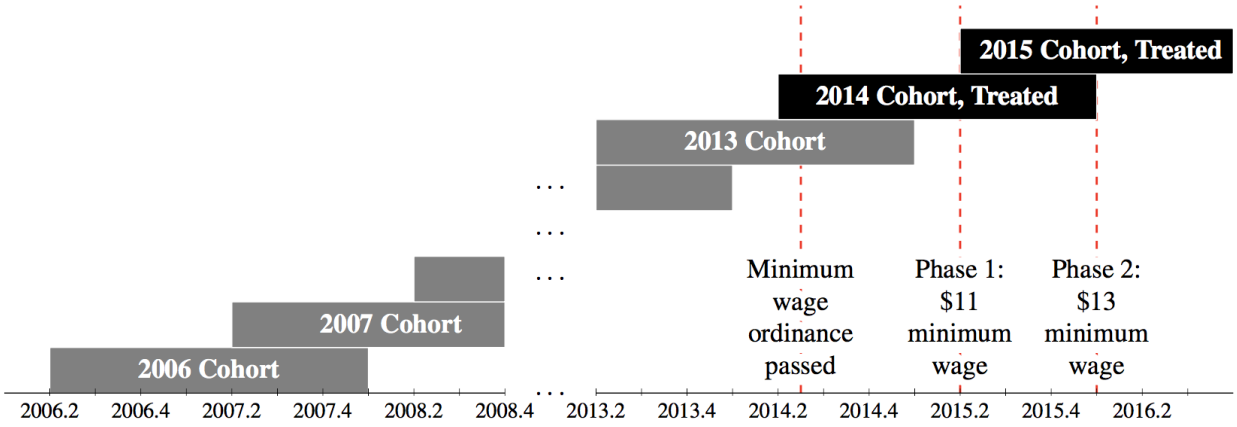
3 Variable Construction and Descriptive Evidence

One of the key advantages of our data is that it allows us to calculate each firm's cost of compliance with the new minimum wage, denoted by GAP. We define this as the percentage increase in total payroll required to meet the new minimum wage if a business keeps the

[3] A complete description of the data and data cleaning can be found in Appendix Section 1, with summary statistics in Appendix Table 2.

[4] The 2010 cohort has been removed from the analysis because of the incomplete revenue records for that year.

Figure 1. Cohort Strategy



Description of first difference in empirical strategy. We construct cohorts to be able to compare firms active after each minimum wage step up with firms active before.To be able to analyze the impact of each step-up separately, we set the baseline period in the second quarter of each calendar year and track firms for six subsequent quarters. As a result, the 2014 cohort starts in the second quarter of 2014, when the ordinance was passed, and ends in the fourth quarter of 2015, three quarters after the minimum wage increase to $11, and in the last quarter before the minimum wage hike to $13 per hour. Similarly, the 2015 cohort starts in the second quarter of 2015, the first period after the implementation of the $11 minimum wage, and ends in the third quarter of 2016, three periods after the implementation of the $13 minimum wage. We design control cohorts in a similar way, starting a new cohort in the second quarter of each calendar year.

number of jobs and hours at the pre-policy level[5].

$$GAP_{ic} = \frac{\sum_n h_{inc} \max\{MW - w_{inc}, 0\}}{\sum_n h_{inc} w_{inc}}, \tag{3.1}$$

where i denotes firms, c denotes a cohort, n denotes employees of firm i, h_{int} denotes hours worked by a worker n, w_{int} denotes hourly wage rate paid to worker n, and MW is the minimum wage. If $GAP = 0$ then the firm has no minimum wage workers, and needs to make no payroll changes to comply with the law. Firms with $GAP > 0$ are those for whom the minimum wage is binding. A GAP of 1 percent shows that a business needs to increase total labor costs by 1 percent to comply with the minimum wage.

The GAP metric reveals two stylized facts about firms' exposure to the new minimum wage. First, fewer than half of single-location businesses in Seattle had to increase labor costs to comply with the law. Only 39% and 51% of firms had positive GAP to comply with the $11 and $13 minimum wage respectively (see Appendix Table 3).[6] Second, the costs of

[5]This measure of the cost of compliance has been widely used in the literature (for example, Draca, Machin and Van Reenen, 2011; Hirsch, Kaufman and Zelenska, 2015), and was first introduced by Card and Krueger (1994).

[6]This fact holds even in heavily exposed industries, and cannot be explained by differences in pay between

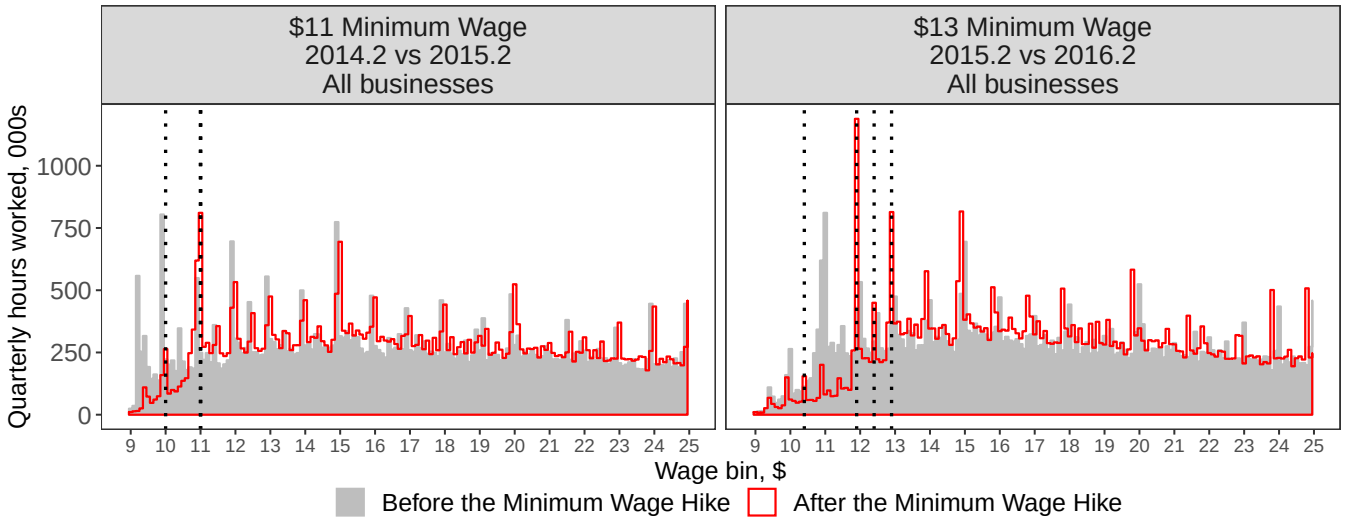
compliance on average were low, with the average firm having to increase total payroll 2.0% and 3.4% to comply with each phase-in, but these costs were very unequally distributed even among the exposed firms. In particular, half of the exposed firms needed to increase their labor costs by less than 1.5 percent to comply with both increases, while 25 percent of the exposed firms were required to raise their labor costs by 2.5 percent or more.

Despite the fact that only half of Seattle businesses were exposed to the effects of the minimum wages, the impact of the ordinance is clearly visible on the distribution of wages in Seattle, showing that the administrative data is able to capture the changes in wage distribution at a high granularity. Figure 2 shows the histogram of hours worked at jobs below $25 before and after the minimum wage hikes using 10-cent wage bins. The left panel compares the wage distribution in the second quarter of 2014, when the ordinance was passed, with the wage distribution one year later to demonstrate the effect of the $11 minimum wage, which went in effect on April 1, 2015. The right panel shows the same for the $13 minimum wage, which went into effect January 1, 2016.

Both panels show that hours worked in jobs paying below the new minimum wage declined dramatically, indicating employers' compliance with the minimum wage law. We see the large visible spikes in the wage distribution exactly at the level of the minimum wage schedules.

industries. Online Appendix Table 4 breaks down exposure by industry. It demonstrates that in the most affected industries – food and accommodation services, and retail trade – there were 27-40% and 10-20% businesses respectively which already paid their workers more than the new minimum wage before it was implemented. However, limited-service restaurants were by far the most affected industry, with fewer than 10% of employers having zero costs of compliance, and the average cost of compliance of 5-8% of payroll.

Figure 2. Histogram of hours worked in low-wage jobs in Seattle before and after the minimum wage hikes.



Source: UI records from WA. Sample: Single-location firms which had 5 and more workers on payroll on average during their lifetime and have data on revenue. Wages have been adjusted for inflation using CPI-W. Dotted lines show the minimum wage schedules. Jobs which pay less than the minimum wage likely correspond to trainees, teenage workers, and workers with disability who can be paid only 85 percent of the minimum wage. In addition, some of these observations occur due to measurement error in hours.

4 Empirical Strategy

We estimate the impact of the minimum wage hike on business outcomes by comparing Seattle businesses with lower costs of compliance to businesses with higher costs of compliance via a difference-in-differences approach. To avoid contaminating GAP with firms' response to the minimum wage, we calculate GAP at the baseline quarter for each cohort and hold it constant for the subsequent quarters, even if the workforce composition of the firm has changed.

Our identification strategy relies on the assumption that the difference between employers with zero costs of compliance and employers with positive costs of compliance in 2015–2016 would have been similar to their difference in prior years if the minimum wage ordinance had not been implemented. We argue that this assumption is reasonable based on two tests. First, we show that the wage increases in exposed firms start exactly in the quarter when the minimum wage hikes were implemented. Second, we do a falsification test by estimating the effect of a placebo ordinance passed in 2012, i.e., two years before the actual ordinance, and find no effect of the placebo ordinance on wages.[7]

We focus on the rates of growth in all outcomes, and examine effects to intensive and

[7]We also check that the samples of exposed and non-exposed employers are balanced in size, wages, and revenue relative to the prior years (Appendix Table's 5 and 6).

extensive margins separately. We decompose the growth rate in each outcome into the contributions from entering, exiting, and continuing businesses, and estimate the impact of the minimum wage to each component:

$$\frac{\Delta y}{y_{\text{All}}} = r_{\text{Entry}} \frac{\bar{y}^{\text{Entry}}}{\bar{y}^{\text{All}}} + r_{\text{Exit}} \frac{\bar{y}^{\text{Exit}}}{\bar{y}^{\text{All}}} + (1 - r_{\text{Exit}}) \frac{\bar{y}^{\text{Surviving}}}{\bar{y}^{\text{All}}} \frac{\Delta y^{\text{Surviving}}}{\bar{y}^{\text{Surviving}}}, \tag{4.1}$$

where $\Delta y/y$ is the growth rate in outcome y, r_{Entry} is the rate of business entry, r_{Exit} is the rate of business exit, $\bar{y}^{\text{All}}$ is the average outcome in all businesses in the baseline quarter, $\bar{y}^{\text{Entry}}$, $\bar{y}^{\text{Surviving}}$, and $\bar{y}^{\text{Exit}}$ are the average outcomes for entering, surviving, and existing businesses respectively, and $\Delta y^{\text{Surviving}}$ is the change in outcome for surviving businesses.

4.1 Intensive margin

To study the impact of the minimum wage at the intensive margin, we look at surviving businesses. We define surviving businesses as those active in the baseline quarter and remained open in the last quarter of each cohort.[8] For these businesses, we examine inflation-adjusted average hourly wage rate paid by each firm[9], total wagebill, revenue, hours worked in all jobs, and hours worked in low-wage and high-wage jobs. We measure the growth rate in each outcome using a bounded measure of growth, which reduces the impact of outliers on the estimates (Davis and Haltiwanger, 1992): $\Delta y_{ict} = \frac{y_{ict} - y_{ict_0}}{0.5 \left(y_{ict} + y_{ict_0}\right)}$, where y is an outcome of interest, i denotes firm, c denotes cohort, t denotes the number of quarters after the baseline and t_0 denotes the baseline quarter.

We implement a difference-in-differences approach that estimates the difference between firms with positive costs of compliance and firms with zero costs of compliance in 2015–2016, when the Seattle Minimum Wage Ordinance was enacted, using the 2006–2013 cohorts as a comparison:

$$\Delta y_{ict} = \alpha_t \, GAP_{ic} + \beta_t \, GAP_{ic} \, T_{ic} + \gamma_t X_{ic} + \theta_{jct} + \mu_i + \varepsilon_{ict}, \tag{4.2}$$

where i denotes the individual firm, c is cohort, t is quarter, and j denotes industry (at NAICS 4-digit level). We cluster standard errors in all regressions by cohort and by industry (at the NAICS 3 digit level) to allow for common shocks and autocorrelation (Bertrand, Duflo and Mullainathan, 2004).

Matrix X_{ic} contains firm characteristics (the number of employees in a firm at the baseline, i.e., indicators for 5–9, 10–49, 50–499, and 500+ workers at baseline, and for the age

[8] Cohorts used to study \$11 minimum wage span six quarters, and cohorts used to study \$13 minimum wage span five quarters.

[9] We express wage rates and earnings in constant prices of the second quarter of 2015 using the national CPI-W to match Washington's laws on inflation adjustment of the state minimum wage.

of the firm, i.e. indicators for less than 1 year, 1–10, and older than 10 years at baseline following the classification in Haltiwanger, Jarmin and Miranda (2013)), T_{ic} is the indicator for the treated cohort, θ_{jct} is the industry-cohort-quarter fixed effect, μ_i is the firm fixed effect, and ε_{ict} is the error term. Coefficient α_t captures the difference between low-paying and high-paying businesses in the pre-policy period, and coefficient γ_t captures the normal differential trends across small vs. large and young vs. old businesses.

Our main coefficient of interest is β_t which shows the impact of cost of compliance, measured by GAP, on business outcomes. For example, $\beta = 1$ indicates that a one percentage point (pp) increase in GAP leads to a one percentage point increase in the growth rate of outcome y.

4.2 Extensive margin

To investigate the extensive margin effects, we examine both 1) the impact of the minimum wage on business entry and exit rates, and 2) the impact of the minimum wage on the composition of exiting and entering businesses.

Effects to entry and exit are estimated with a similar difference-in-difference approach as the effect to surviving firms. We estimate the effect of the minimum wage on the probability of exit in the same way as we estimate the impact of the minimum wage on surviving firms, except that we cannot include firm fixed effects in these regressions:

$$Exit_{ijct} = \alpha_{1t}\ GAP_{ijc} + \beta_{1t}\ GAP_{ijc}\ T_{ct} + \theta_{1jct} + \varepsilon_{1ijct}, \tag{4.3}$$

Entering firms necessarily do not exist at baseline, therefore for these firms we cannot calculate GAP at the firm level. To trace the effects on business entry, we use the variation in exposure to the minimum wage across industries rather than across firms. For each NAICS 4-digit industry, we calculate the average costs of compliance GAP_{jc} the same way we calculated the costs of compliance for each firm. Then, we regress the entry rate in each industry on the industry's exposure to the minimum wage using the following difference-in-differences specification:

$$Entry_{jct} = \alpha_{2t}\ GAP_{jc} + \beta_{2t}\ GAP_{jc}\ T_{ct} + \theta_{2ct} + \varepsilon_{2jct}, \tag{4.4}$$

where $Entry_{jct} = N_{jct}^{\text{Entry}}/N_{0jc}$ is the ratio of the number of businesses in industry j which entered between the first and the last quarter of the cohort to the number of businesses in that industry in the baseline quarter.

Effects to the composition of exiting and entering businesses are estimated by studying the changes to the outcomes, e.g., hours worked, in entering (or exiting) firms relative to

average outcome in all businesses at the baseline quarter. For exits, we estimate whether the average hours worked, revenue, and wagebill in firms that exited following the minimum wage hike were higher or lower than the same outcomes in firms that exited in the years before the minimum wage hike. We repeat this exercise for the entering firms using the ratio of average hours worked, revenue, and wagebill in entering firms to the average hours worked, revenue, and wagebill of a typical firm at the baseline. Formally, we compare the ratio of average hours worked, revenue, and wagebill in exiting firms to the average hours worked, revenue, and wagebill of a typical firm at the baseline, and we evaluate if this ratio changed after the minimum wage hike:

$$\frac{y_{ic0}^{\text{Exit}}}{\bar{y}_{c0}} = \alpha_4 \; GAP_{ijc} + \beta_{4t} \; GAP_{ijc} \; T_c + \theta_{4jc} + \varepsilon_{4ijct}, \tag{4.5}$$

$$\frac{y_{ict}^{\text{Entry}}}{\bar{y}_{c0}} = \alpha_5 \; GAP_{jc} + \beta_{5t} \; GAP_{jc} \; T_c + \theta_{5jc} + \varepsilon_{5ijct}, \tag{4.6}$$

where y_{ic0}^{Exit} is the outcome of a business i at baseline quarter of the cohort, y_{ict}^{Entry} is the outcome of a business i at the last quarter of the cohort, and $\bar{y}_{c0}$ is the mean outcome among all businesses in the baseline quarter of the cohort. The analysis in equation (4.5) is limited to businesses that closed between the baseline and the last quarter of the cohort, while the analysis in equation (4.6) is limited to businesses that opened between the baseline and the last quarter of the cohort.

In this analysis, coefficients β_4 and β_5 show the impact of 1 pp increase in GAP on the difference in hours worked between the typical existing (or entering) business and the average business, compared to the control cohorts in 2006-2014.

5 Intensive margin effects: surviving firms' adjustment

In this section we look at the effects of GAP on firm wages, wagebill, revenue, and labor demand. As a first stage, we establish that GAP impacts wages (Panel A of Table 1). As expected, 1) the impact of GAP jumps exactly in the quarters when minimum wage increases, and 2) placebo tests two years earlier shows that GAP was not correlated with wage changes in 2012, ensuring that our main results are unlikely to be driven by the accelerated growth of Seattle economy.

Our main results, presented in Panel B of Table 1, indicate that firms' payroll rose in tandem with wage increases caused by the minimum wage hike. A 1 pp increases in GAP was associated with 0.79 pp increase in average wages and 0.96 pp increases in payroll.

Consistent with this finding, we find that the minimum wage hike had no impact either on total hours worked in surviving firms and on hours worked in low-wage jobs, defined as jobs paying up to 130% of the minimum wage.[10]

Our analysis shows that surviving firms saw a 0.2 pp increase to their revenue per each 1 pp increase in GAP after the minimum wage hike to $13, but no impact on revenue per hour. When we bring together the impact of the minimum wages to intensive and extensive margin, we find that the positive impact of the minimum wage on revenue of surviving businesses is likely driven by the redistribution of revenue from exiting businesses to surviving business. Though we do not observe prices, we would expect business revenue to fall if businesses passed the minimum wage increase to prices and they were facing demand with price elasticity below -1. Lack of the negative impact on revenue suggests that Seattle businesses did not raise prices in response to the minimum wage hike.

[10]We define low-wage jobs as those paying up to 130% of the minimum wage to allow for the spillover effect of the minimum wage on higher-paying jobs. In Appendix Section 3.1 we show that the minimum wage increased wages in jobs paying up to 130% of the minimum wage as employers sought to avoid wage compression between jobs with different skill requirements and encourage career progression. This effect is also found in Neumark, Schweitzer and Wascher (2004); Autor, Manning and Smith (2016); Phelan (2019).

Table 1. Effect of minimum wage on surviving businesses

	$11 Minimum Wage		$13 Minimum Wage	
	(1)	(2)	(3)	(4)
	Treatment	Placebo	Treatment	Placebo
Panel A: Timing of Effects of Minimum Wage to Firm Average Wage Rate				
$GAP \times t = -3$	-0.39	0.055		
	(0.057)	(0.069)		
$GAP \times t = -2$	-0.25	0.044	0.26	0.019
	(0.077)	(0.077)	(0.047)	(0.026)
$GAP \times t = -1$	-0.04	0.067	0.15	0.016
	(0.077)	(0.079)	(0.050)	(0.028)
$GAP \times t = 0$	0.69	0.099	0.72	0.034
	(0.094)	(0.083)	(0.056)	(0.03)
$GAP \times t = 1$	0.87	0.11	0.8	0.052
	(0.088)	(0.087)	(0.06)	(0.03)
$GAP \times t = 2$	0.93	0.17	0.85	0.073
	(0.090)	(0.095)	(0.06)	(0.032)
Panel B: Average Effects on Surviving Businesses				
% Δ Mean Wagerate	0.89	0.110	0.79	0.053
	(0.074)	(0.069)	(0.057)	(0.028)
% Δ Labor Costs	1.00	0.6	0.96	0.19
	(0.17)	(0.18)	(0.13)	(0.085)
% Δ Revenue	0.11	0.12	0.23	0.057
	(0.14)	(0.14)	(0.12)	(0.067)
% Δ Revenue per hour	-0.047	-0.41	-0.0072	-0.088
	(0.16)	(0.17)	(0.13)	(0.083)
% ΔTotal Hours	0.17	0.5	0.21	0.14
	(0.16)	(0.18)	(0.14)	(0.087)
Contribution to % Δ Total Hours of				
jobs paying <120% of MW	-0.61	0.12	-0.129	-0.039
	(0.19)	(0.18)	(0.14)	(0.084)
jobs paying <125% of MW	-0.49	0.11	-0.16	-0.029
	(0.18)	(0.18)	(0.14)	(0.084)
jobs paying <130% of MW	-0.34	0.15	-0.13	-0.033
	(0.18)	(0.18)	(0.14)	(0.084)
Obs	276,161	208,751	235,325	177,690
R^2	0.239	0.257	0.222	0.240
Year-Quarter Industry FE	X	X	X	X
Firm FE	X	X	X	X

No stars are used to designate bucketed p-values in accordance with the American Statistical Association's recommendations. Source: UI records from WA. Sample: Single-location firms that had 5 and more workers on payroll on average during their lifetime, had data on revenue, and opened on or before the second quarter of 2014 and were still open through the third quarter of 2016. Wages have been adjusted for inflation using CPI-W. GAP measures percentage increase in total wagebill required to comply with the new minimum wage, assuming jobs and hours remain the same.
Panel A describes the effects to wages in each of the quarters before or after the minimum wage went into effect, with 0 being the second quarter of 2015 for $11 and the first quarter of 2016 for $13. More specifications in Appendix Tables 7 and 8.
Panel B shows effects for all outcomes, averaged across the three quarters after the minimum wage went up.

6 Extensive margin effects: business entry and exit

We outline the results to entering and exiting firms in Table 2. We find the $11 minimum wage did not affect the rates of business entry and exit, whereas the $13 minimum wage increased the rate of business exit but had no effect on the rates of business entry. A 1 percent cost of compliance led to a 0.2 percentage point increase in the exit rate ($p < 0.001$). Considering that 51 percent of firms faced a positive cost of compliance in 2016, and that average cost of compliance was 3.44 percent, our estimates show that the minimum wage raised the exit rate of exposed firms from 5.08 to 5.77, or by 13 percent. Moreover, because exposed firms provide 84 percent of low-wage jobs, defined as those paying less than 130 percent of the minimum wage, an uptick in exit rates led to a 0.58 pp decline in hours worked in low-wage jobs ($p < 0.001$).

We find that $13 minimum wage had a substantial effect not only on the rate of exit, but also on the composition of firms in the market, while $11 minimum wage did not lead to any significant changes. Businesses that exited in 2016 paid lower average wages, had lower revenue per hour, and provided substantially more low-wage jobs than a typical business in their cohort, compared to exiting firms in 2005–2013. A 1 percent GAP raised the ratio of hours in low-wage jobs in exiting firms to hours in low-wage jobs in all active firms by 2.3% ($p < 0.001$). This increase translated into a 0.23 pp loss in employment in hours of jobs paying less than 130 percent of the minimum wage.

Following the minimum wage hike to $13, entering businesses became less labor intensive. We see that 1 percent increase in GAP reduced the labor costs of the average entering firm 6.2% relative to the labor costs of all active firms at the baseline ($p < 0.05$), and average hours of entering firms by 7.6% relative to hours of all active firms at baseline ($p < 0.001$). This shift resulted in a 0.30 pp decrease in hours of all jobs, and a 0.43 pp decrease in hours of low-wage jobs that pay up to 130% of the minimum wage. Our findings on the composition of entering and existing businesses demonstrate that the minimum wage increased the marginal costs of labor-intensive businesses and made a labor-intensive business model unsustainable.

Table 2. Effect of the minimum wage on the extensive margin

	$11 Minimum Wage				$13 Minimum Wage			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Timing of Effects of Minimum Wage to Exit and Entry Rate								
Outcomes:	Exit Rate Treatment	Exit Rate Placebo	Entry Rate Treatment	Entry Rate Placebo	Exit Rate Treatment	Exit Rate Placebo	Entry Rate Treatment	Entry Rate Placebo
$GAP \times t < 0$					0.22	0.052	-0.24	0.046
					(0.037)	(0.032)	(0.25)	(0.14)
$GAP \times t \geq 0$	0.16	0.033	-0.14	-0.1	0.20	0.052	-0.23	0.00
	(0.21)	(0.11)	(0.17)	(0.13)	(0.051)	(0.046)	(0.26)	(0.13)
Year Quarter Industry FE	X	X			X	X		
Panel B: Average Effect of the Minimum Wage on Composition of Exiting and Entering Firms								
Sample of Firms:	Exiting Treatment	Exiting Placebo	Entering Treatment	Entering Placebo	Exiting Treatment	Exiting Placebo	Entering Treatment	Entering Placebo
Average Wagerate	0.22	0.053	-1.3	-0.32	-1.7	-0.18	0.16	-0.55
	(0.085)	(0.25)	(1.1)	(0.55)	(0.18)	(0.075)	(1.4)	(0.37)
Average Labor Costs	0.43	-0.37	-1.1	-1.8	-0.23	-0.6	-6.2	-0.72
	(0.44)	(0.54)	(6.6)	(0.85)	(0.15)	(0.2)	(3.4)	(1.2)
Average Revenue	0.55	1.6	1.2	1.3	0.3	-0.34	-4.7	-0.71
	(0.44)	(1.8)	(4.9)	(3.4)	(0.32)	(0.32)	(3.7)	(1.00)
Average Revenue per hour	4.6	1.7	0.23	-1.00	-0.75	-0.59	-1.3	0.95
	(1.1)	(2.1)	(1.4)	(1.00)	(0.26)	(0.31)	(2.8)	(1.00)
Average Total hours	-0.42	-0.69	0.52	-1.7	0.18	-0.43	-7.6	-0.68
	(0.44)	(0.4)	(6.6)	(0.57)	(0.29)	(0.2)	(2.4)	(1.00)
Average Hours in:								
Jobs paying <120% of MW	-2.6	-2.3	9.5	-0.28	3.11	0.092	-9.6	1.2
	(2.00)	(1.7)	(6.9)	(1.7)	(0.069)	(0.79)	(3.5)	(1.8)
Jobs paying <125% of MW	-2.2	-2.0	8.8	0.43	2.7	0.003	–11.00	0.77
	(1.6)	(1.4)	(7.1)	(1.8)	(0.066)	(0.73)	(3.4)	(1.4)
Jobs paying <130% of MW	-2.00	-1.9	8.2	0.62	2.3	-0.08	-11.00	0.7
	(1.5)	(1.4)	(7.5)	(2.2)	(0.58)	(0.66)	(3.3)	(1.2)
Year Quarter Industry FE	X	X	X	X	X	X	X	X
Obs	313,367	237,965	50,806	41,128	262,345	198,305	28,383	22,413

No stars are used to designate bucketed p-values in accordance with the American Statistical Association's recommendations. Standard errors in regressions for exit are clustered by the industry (NAICS 3 digit Sector) and cohort. Source: UI records from WA state, 2005-2016. The instrument GAP measures percentage increase in total wagebill required to comply with the new minimum wage, assuming jobs and hours remain the same. In Panel A, the outcomes are entry rate and exit rate, where $t \geq 0$ means the effect averaged over the three quarters following the MW increase. Panel B includes all other outcomes, specified in first column, on only entering and exiting firms. Column headings clarify to which sample the analysis is referring.

7 Contribution of extensive vs. intensive margin effects to the total impact

After examining the impacts to intensive vs. extensive margin in detail, we provide a bird's eye view of the contribution of each margin to the total impact of the $13 minimum wage in Seattle (Table 3).[11]

To provide the contribution of each margin into the total effect of the minimum wage, we take the derivative of the decomposition (4.1) with respect to the cost of compliance GAP. We then calculate the total impact on the minimum wage on each outcome, reported in Column (1) of Table 3, by multiplying the point estimate for each outcome with $p < 0.05$ by the average GAP among exposed business, average outcome in these businesses, and by the contribution of exposed businesses to total outcome in that margin.

Our results show that the minimum wage redistributed revenue from exiting businesses to surviving businesses, while the share of new businesses in total revenue remained the same. However, these surviving businesses bore the entire increase in wagebill, with reductions in wagebill coming only from the exit of more labor intensive businesses and entry of less labor intensive businesses. Without additional data on prices and quantities sold, our analysis cannot discern whether the combined increase in revenue and wagebill was profit-neutral for surviving businesses, with the two increases canceling each other, or profit-reducing, with the wagebill effect dominating the revenue effect.[12]

The impact to hours worked clearly shows that the minimum wage added pressure to businesses with high reliance on low-wage jobs. The entirety of the impact to hours in all jobs came from the extensive margin adjustment, with 59% of the impact attributed to the accelerated exit and 41% of the impact attributed to reduced entry of businesses with high share of low-wage jobs. This pattern repeats itself for low-wage jobs paying up to 130% of the minimum wage. Higher rates of business exit generated 46% of the impact, shift in the composition of the exiting firms produced another 19%, and the shift of the entering businesses towards less labor-intensive business model produced the remaining 35% of the total impact.

Our findings highlight that the minimum wage adjustment in Seattle occurred through changes to competitive landscape for businesses. As payroll costs increase, newer businesses choose a leaner business model and push labor-intensive businesses off the market. In the

[11] We omit the results for the $11 minimum wage, because we find that it was largely absorbed by Seattle's labor market and had a negligible impact on employers.

[12] Additionally, the surviving businesses could have saved some hiring costs due to lower worker turnover, helping businesses to preserve profits (see Jardim et al., 2018, for the evidence on turnover reductions after the minimum wage hike in Seattle)

short-term, less exposed surviving businesses can sustain the minimum wage increase, but in the long-term, surviving businesses will need to adapt in order to scale without relying on labor.

Table 3. Contribution of extensive vs. intensive margin effects to the total impact of the $13 minimum wage.

	(1) Total impact of MW	(2) Surviving businesses	(3) Exit rate	(4) Composition of exiting businesses	(5) Entry rate	(6) Composition of entering businesses	(7) Total
Average wagerate	0.86 pp	109%	-29%	20%	-	-	100%
Labor costs	0.65 pp	177%	-39%	-	-	-38%	100%
Revenue	0.02 pp	1,296%	-1,196%	-	-	-	100%
Revenue per hour	-0.13 pp	-	158%	-58%	-	-	100%
Hours in All Jobs	-0.74 pp	-	59%	-	-	41%	100%
Hours in Jobs paying <130% of MW	-1.25 pp	-	46%	19%	-	35%	100%

"-" indicates that the minimum wage had zero impact through this channel.

Source: UI records from WA. Column (1) is the total impact on the minimum wage on each outcome, calculated by multiplying the point estimate for each outcome where $p < 0.05$ by the average GAP among all businesses and by the average outcome in that margin (see Online Appendix Table 3 for the detailed break-down). Column's (2) through (6) show the percentage of the total impact that come from the margin in the heading.

8 Conclusion

With the renewed popularity of minimum wage policies among state and local governments in the US, the academic, policy, and business literature have been debating on whom those costs will fall (Aaronson and French, 2007; Draca et al., 2011; MaCurdy, 2015; Allegretto and Reich, 2018). Recent evidence from a large increase in national minimum wage in Hungary suggests that the minimum wage increase can be absorbed by consumers in the form of higher prices (Harasztosi and Lindner, 2019). In this paper we show that for a local minimum wage increase in Seattle, the policy redistributed sales and payroll across businesses rather than from consumers to workers. Businesses that could sustain the higher minimum wage saw increases both to their revenue share and payroll costs, and their employees' hourly wages increased. Businesses reliant on low-wage jobs were pushed off the market, taking those jobs with them. New businesses created fewer jobs compared to prior years, choosing to optimize their payroll costs. Overall, these findings suggest that a higher local minimum wage likely

leads to firm adoption of a less labor intensive business model, as conjectured in the prior literature (Lordan and Neumark, 2018; Aaronson, French, Sorkin and To, 2018; Aaronson and Phelan, 2019).

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