How Do Restaurants Pay For the Minimum Wage?*

Peter Brummund†

October 13, 2017

Abstract

Policies that increase minimum wages do not specify how the increased wages should be paid for. However, they need to be paid for somehow. Using confidential data from a national restaurant chain, I analyze the minimum wage incidence of all potential payees. I find employees help pay for increased minimum wages through changes in the wage distribution and the composition of workers, but not through lower employment. I also find customers help cover costs by paying higher prices, but reduce the amount spent on each transaction. I do not find evidence that restaurant owners help pay by accepting lower profits.

Keywords: Minimum Wage, Profits, Restaurant Adjustments.
JEL Classifications: J31, J38, L23

*I thank the studied employer for generously providing the data, and I thank Francine Blau, Brian Dillon, Laura Giuliano, Daniel Henderson, Barry Hirsch, David Phillips, and Le Wang, for helpful comments and discussion. All errors are my own responsibility.

†University of Alabama; Department of Economics, Finance and Legal Studies; Box 870224; Tuscaloosa, AL, 35401. Telephone +1(205) 348-8967. Email: pbrummund@cba.ua.edu

1 Introduction

When any government passes legislation to increase the minimum wage that must be paid to workers under their jurisdiction, the legislators do not need to specify how they are going to fund the increased wages for private sector workers. It is the responsibility of each firm affected by the increased minimum wage to determine how best to pay for the higher wages due its workers. Standard economic theory suggests there are four possible channels to pay for the higher wages. Broadly speaking, employees could pay for the higher minimum wage through lower employment levels or through more compressed wage distributions. Secondly, customers could pay for higher minimum wages by paying higher prices for the final product. Third, owners could pay for higher minimum wages by receiving lower profits from their business. Finally, the firm could absorb the higher wage costs by changing its production function or adjusting its use of other inputs.

Most of the literature analyzing the impact of increased minimum wages has focused on the first channel of adjustment, that of firms reducing employment (see Card and Krueger (1995), Brown (1999), and Neumark and Wascher (2008) for excellent surveys). There have been other studies analyzing other channels of adjustment (for example, Giuliano (2013) on workforce composition, Katz and Krueger (1992) on employment benefits, Dube, Naidu and Reich (2007) on wage distribution, Aaronson (2001) and Lemos (2008) on output prices, Draca, Machin and van Reenen (2011) on firm profits, and Gittings and Schmutte (2016) on employment turnover), but to the best of my knowledge, this is the first study to have access to data by which all four channels can be studied simultaneously.

This study uses a confidential restaurant-level dataset with quarterly financial data on over 500 restaurants in 13 states for the years 2006-2010. During this time, about half of the states implemented minimum wages that were above the national minimum wage, and the other half of the states saw their minimum wage increase as the federal minimum increased from \$5.15 to \$7.25.

I use both variation in minimum wages at the state level and restaurant-level variation

in the cost of compliance with new minimum wages to measure exposure to changes in the minimum wage. I then employ standard difference-in-differences methods to measure the extent to which restaurants use the four channels of adjustment to respond to minimum wage changes. After analyzing how firms respond in specific ways, I then analyze how much of the cost of increased minimum wages is paid for by the various channels. In order to do this, I need to make assumptions about what is the true cost of the minimum wage to each restaurant. The total cost of the minimum wage depends upon the internal wage distribution within a particular restaurant, and how that distribution should adjust to the new minimum wage. For example, how much of a raise should workers already making $7.25 receive when the minimum wage is raised to $7.25? While the data shows how wages change at each restaurant, I do not know the optimal adjustment. Therefore, I consider four possible adjustments to the wage distribution at each restaurant, a lower bound, an upper bound, and two adjustments observed in other contexts (Neumark, Schweitzer and Wascher, 2004; Dube, Giuliano and Leonard, 2015).

Depending on the assumption about the true cost of the minimum wage, I find that employees pay between 50% and 87% of the total cost of the minimum wage increase. I find that employees help pay for the minimum wage through more compressed wage distributions and a change in the composition of the workforce, and not through a lower level of employment. In three of the four scenarios considered, customers pay for over 100% of the total cost of the minimum wage by paying higher prices. However, I do find evidence that customers work to offset their burden by reducing how much they spend on each transaction. For the third channel, I do not find any evidence that restaurant owners help pay for the minimum wage through lower profits. For the fourth channel, I find mixed evidence that restaurants adjust their production function to help cover the costs of increased minimum wages.

This study makes two primary contributions to the literature. First, I am able to directly analyze the impact of minimum wage increases on restaurant profits. Second, due to the comprehensive nature of the data, I am able to simultaneously analyze multiple channels of

adjustment for each restaurant.

The paper proceeds as follows. The next section discusses the previous literature related to this study. The third section describes the data and the minimum wage changes being studied. The fourth section then describes the empirical methodology. The fifth section presents the results for the impact of minimum wages on employment, customers, owners, and the production function. The next section then estimates for the relative shares of minimum wage costs borne by each channel of adjustment. The last section concludes.

2 Related Literature

The two papers that are most closely related to this one also use confidential store level data to analyze the impact of minimum wage increases (Hirsch, Kaufman and Zelenska, 2015; Giuliano, 2013). Hirsch, Kaufman, and Zelenska (2015) use confidential payroll data from over 80 quick-service restaurants across Georgia and Alabama. They have data for the years 2007-2009, during which the US minimum wage increased by 70 cents in July of each of the three years. Using detailed payroll data, the authors are able to measure how much each restaurant would have to raise their wages to bring all of their employees into compliance with the new minimum wages. These restaurant level measures of compliance costs provide the variation across restaurants used to identify the impact of the minimum wage. Hirsch, Kaufman, and Zelenska find that restaurants with higher compliance costs do not experience a significant decrease in employment or hours after the minimum wage increases. Their result is consistent with the findings of this paper. Hirsch, Kaufman, and Zelenska go on to examine other channels of adjustment on the part of the restaurants, primarily through a survey of restaurant managers, which I will discuss in more detail below.[1]

Giuliano (2013) used confidential payroll data from over 700 retail stores nationwide

[1]Harasztosi and Lindner (2017) have a new paper using matched-employer-employee data from Hungary to examine a large increase in the minimum wage in 2001. They find large effects on workers' wages, but small effects on employment. They also show that customers pay for most of the increased costs through higher output prices.

to examine the impact of the 1996 increase in the federal minimum wage. She also finds that stores more impacted by minimum wage increases did not have significant decreases in employment. However, she does find that stores substituted away from older workers towards younger workers. My results below are consistent with these findings. Giuliano also finds some evidence that higher minimum wages increased teenage labor force participation, and this effect occurred mostly in wealthier neighborhoods.

While these two papers are most closely related to mine, other papers have examined the various other responses that firms could have to increased minimum wages. The channel of adjustment which has been most studied in the literature is the employment channel. Good summaries of this literature can be found in Card and Krueger (1995), Brown (1999), and Neumark and Wascher (2008).

In addition to firms directly adjusting the level of employment, firms could offset the cost of increased minimum wages through the employment channel by reducing the level of benefits provided to workers or by compressing the wage distribution. While most work environments for minimum wage workers do not provide a lot of benefits for their workers in the form of health or retirement benefits, many restaurants do provide free or reduced meals and uniforms for their workers. Restaurant owners could change the value of these in-kind benefits to help offset the increased wage costs. Hirsch, Kaufman, and Zelenska did not analyze fringe benefits as the hourly workers in their sample did not receive any (2015). In two studies that directly analyzed whether firms reduced benefits, Card and Krueger (1994) and Katz and Krueger (1992) do not find that firms changed the amount of benefits given to workers after minimum wages increased.

With regards to the wage distribution of workers, standard theories do not provide a clear explanation for what is observed in the literature. If the labor market is perfectly competitive, than all workers performing the same job would receive the same pay. However, this is not the case both within restaurants and across restaurants (Card and Krueger, 1995). Not only is there evidence of workers receiving different wages for doing the same job, there

is also evidence that workers of different productivity levels receiving the same wage. So, if there is a distribution of wages paid to similar workers, how does the minimum wage impact that distribution? Stigler (1946) argued the minimum wage takes a bite out of the wage distribution, with firms dismissing workers who had marginal revenue productivities below the minimum wage. However, Card and Krueger (1995) find that firms have substantial spikes of workers exactly at the minimum wage.

Some studies have been able to investigate how changes in the minimum wage impact the wage distribution. Hirsch, Kaufman, and Zelenska, in their survey of restaurant managers, found that 40% of managers indicated they would delay bonuses and raises for more experienced workers, thus compressing the wage distribution within a restaurant in the short-run (2015). In their empirical analysis, Hirsch, Kaufman, and Zelenska do not find any evidence that workers above the new minimum wage received raises. Grossman (1983) found that minimum wage increases compressed the wage distribution in the short-run, but not the long-run. Katz and Krueger (1992) found that managers would provide raises for workers earning above the minimum wage, but the percent of managers willing to do so decreased as the minimum wage increased further. Neumark, Schweitzer, and Wascher (2004) examined the effects nationally, and find significant increases in wages for workers earning up to 3 times the new minimum wage. Phelan (2016) finds evidence of spillovers across occupations whereas Gindling and Terrell (2007) find no evidence of spillovers to the uncovered sector in Costa Rica. Finally, Dube, Naidu, and Reich (2007) found that San Francisco's minimum wage policy worked to compress wage inequality at both fast-food and table-service restaurants.

The second major channel of adjustment is for firms to pass on the higher labor costs to consumers. Firms could do this directly through higher output prices, or indirectly through lower product quality or customer service. Lemos (2008) provides a survey of the literature on the effects of minimum wages on prices, and finds that a 10% increase in the minimum wage would result in a 4% increase in food prices. One of the more notable studies on this

topic is Aaronson's (2001). He uses multiple data sources on restaurant prices from Canada and the United States, and finds that stores raise prices about the same time as the minimum wage change, with a 10% increase in the minimum wage leading to a 0.7% increase in prices. Card and Krueger's (1994) study of restaurants in New Jersey and Pennsylvania found the price of a basic combo meal increased 4% faster in New Jersey after the minimum wage change than it did in Pennsylvania. While most of the evidence indicates that companies are able to offset at least some of the increased labor costs by raising output prices, some studies have not found statistically significant evidence that they do (Katz and Krueger, 1992; Machin, Manning and Rahman, 2003; Draca, Machin and van Reenen, 2011).

MaCurdy takes a different approach to measuring how customers might pay for minimum wage increases by examining the distributional impacts of minimum wages (2015). He finds that as firms increase output prices in response to minimum wage increases, this has a larger impact on low-income families. He also finds that the higher earnings resulting from higher minimum wages are distributed relatively evenly across the income distribution. So, while some low-income families are net winners, with their earnings increasing more than their costs, most low-income families are net losers.

The other way customers could pay for higher minimum wages would be through lower product quality. This could occur along any number of dimensions. Restaurant owners could reduce the number of times they clean the bathrooms, provide fewer condiments with each order, or reduce the amount of energy used to heat/cool the dining room. In this study, the actual product is highly regulated by the national corporation, but individual restaurants could reduce food costs by not throwing away food as quickly as regulated. There could also be confounding effects of changes to the labor force that could impact product quality. For example, if a restaurant reduces its level of employment, each remaining worker would have to be more productive, potentially leading them to be more hurried, smile less often, and make more mistakes. In this paper, I will be able to analyze many of these dimensions of product quality through the use of customer satisfaction surveys. Product quality is also

impacted through production decisions, such as how much to spend on cleaning supplies, and these aspects of product quality will be analyzed as a part of the production function channel of adjustment.

The third major channel of adjustment is on the part of firm owners. If the firm is in a competitive output market and unable to increase its output price, then increased costs would lead to lower profits for the firm. However, if the cost shock is an industry wide shock, then the market price could adjust upwards, allowing firms to offset the labor cost shock. The higher price could influence customers to reduce their demand for the final product, working to lower revenue for the firm. While basic theory does not provide a clear prediction for how minimum wages would impact profits, a few papers in the literature have developed arguments for why profits would not be affected by minimum wage increases. Card and Krueger (1995) develop an efficiency wage model to show that minimum wage increases do not reduce profits for firm owners. Rebitzer and Taylor (1995) show that in an employment matching model with many employers, minimum wage increases also do not reduce profits. MaCurdy (2015) argues that firm owners of large, publicly traded firms will not face lower profits due to the efficient nature of capital markets.

Empirically, a few papers have analyzed the effect of minimum wage increases on profits. Card and Krueger (1995) take an event study approach using firm stock prices and identify various news events which could have provided information about the federal minimum wage changes in 1991 and 1992. They do not find large negative impacts on firm stock prices, though they admit it is hard to identify exactly which pieces of information caused investors to change their expectations about future firm profitability. Bell and Machin (2016) address that concern by analyzing a unexpected change in United Kingdom's minimum wage, and its impact on firm stock prices. They find that stock prices of firms who hire low-wage workers fell by 2 to 3% within five days after the announcement, which is roughly equal to the expected decrease in profitability associated with the announcement. Draca, Machin, and Van Reenen (2011) use publicly available annual accounting information for

both private and public firms in the United Kingdom to analyze the impact of the 1999 national minimum wage. They find a small negative effect on profits. In Aaronson, French, Sorkin, and To's (2017) study on industry dynamics, they find the elasticity of accounting profit with respect to minimum wages to be -0.01. Hirsch, Kaufman, and Zelenska (2015) find suggestive evidence of a negative effect on profits, but are unable to disentangle the effect of minimum wages from other cost increases. However, their survey of restaurant managers reports the higher minimum wage contributed to a difficult business environment in the medium to long-run. The study in this paper is the first to be able to directly analyze the impact of minimum wage increases on profits using restaurant level data.

The last channel of adjustment for firms is through the production function. It is possible that firms could absorb higher labor costs by tightening work schedules, reducing food waste, cleaning less often, or by expecting employees to be more productive. The survey of restaurant managers conducted by Hirsch, Kaufman, and Zelenska (2015) provides a lot of insight into this channel. They report that 90% of respondents indicated they would increase performance standards for their workers, and that this channel was a "very important" way for them to offset minimum wage costs. They also report that 92% of respondents wanted to boost team morale so the workers would be more productive. Hirsch, Kaufman, and Zelenska also argue that while standard theory assumes firms are constantly cost minimizing, it may be that the minimum wage increase provides a shock to managers causing them to look for more ways to minimize costs.

Another way firms could minimize costs is through lower employment turnover. For many firms that pay low-wages, there are high levels of turnover. Turnover is costly to firms, as they regularly need to recruit and train new workers. Hirsch, Kaufman, and Zelenska (2015) report that two owners estimated turnover costs of $300 to $400 per employee. Higher minimum wages could work to reduce turnover as workers earning higher wages are less likely to quit.

A number of recent studies have directly examined the impact of minimum wages on

employee turnover. Gittings and Schmutte (2016) provide a useful overview. In Hirsch, Kaufman, and Zelenska's (2015) detailed restaurant data, they find weak evidence of higher minimum wages leading to lower turnover. Dube, Lester, and Reich (2016) examine turnover both for teenagers and the restaurant sector and find that higher minimum wages lead to both lower separations and lower hires. Gittings and Schmutte (2016) find evidence of higher minimum wages leading to lower turnover, and go on to show that reduced employment turnover helps mitigate the costs of higher minimum wages. There is not much literature analyzing the impact of minimum wages on other production decisions as the data is difficult to come by. This paper is able to address some of those gaps.

3 Data and Setting

The data made available for this project is from a national restaurant chain for the years 2006-2010. For confidentiality reasons, restaurants were randomly selected to be included in the dataset if the restaurant was located in a state with at least 30 restaurants in 2010. For example, if Nebraska had 30 restaurants in 2010, 15 restaurants were chosen at random from Nebraska to be included in the dataset. Given this constraint, the dataset contains 8,975 restaurant-quarter observations, covering 515 restaurants in 13 states. The data is extensive and includes information on basic restaurant characteristics, income and expenses for each restaurant, payroll by age category, customer satisfaction reports, information on price changes, and some productivity measures.

For basic restaurant characteristics, the data identifies which state the restaurant was located in, but no more detailed information about its location. The data also indicates whether the restaurant was located in a mall or if it was a stand-alone restaurant, when the restaurant opened, a unique identifier for the restaurant owner, and when the restaurant owner took control of each restaurant.

The data also contains information on each restaurant's income and expenses. This

includes both sales that were generated from within the restaurant, and from catering. The data includes many separate expense categories, such as food costs, packaging costs, labor costs, utilities, linen, pest control, kitchen supplies, cleaning supplies, etc. However, for confidentiality reasons, some expense categories were suppressed so that each owner's profit level could not be calculated exactly. The categories that were suppressed were for occupancy costs, credit card fees, and franchise fees. The omission of this information should not affect the results of this study as owners are not able to manipulate these expenses in response to changes in the minimum wage.

The payroll information was grouped into age categories for each restaurant. The age categories are <18, 18-22, 23-29, 30-39, 40-49, 50-59, 60-64, and 65+. For each category, the data provides the number of workers, number of male workers, total hours worked, average tenure, gross earnings, and the standard deviation for both the earnings and hourly wage rate.

The results of customer satisfaction surveys are reported for five categories, "Overall", "Taste", "Speed", "Service", and "Cleanliness". For each category, the results are reported as the percent of respondents who provided a rating of "Excellent". The data also provides information on the total number of transactions each restaurant processed and a measure of employee turnover. The company would not disclose the exact formula used to calculate turnover, only that the number provided is a twelve month rolling average.

Summary statistics are reported in Table 1. The statistics are reported separately for restaurants located in malls and stand-alone restaurants, as stand-alone restaurants are twice as big as mall restaurants both in terms of overall sales and in number of employees hired [2]. Even though the two types of restaurants are different sizes, the cost structures are relatively similar. Both types of restaurants have total costs equal to about 65% of total sales. Wages comprise about 31% of total costs and food costs are about 44% of total costs. Mall restaurants are 14 years older than stand-alone restaurants on average. Owners

[2]For confidentiality reasons, average total sales are not reported.

of stand-alone restaurants have been been in charge for 5.5 years on average, whereas mall restaurant owners have been in charge for 6.8 years. Stand-alone restaurants have 60.8 employees on their payroll in any given quarter, and those employees work about 20.1 hours per week on average. Mall restaurants have 36.8 employees, who work about 17.2 hours per week on average. Both types of restaurants employ more females than males, with females comprising almost 60% of the workforce. The average employee has been at the restaurant for 6 quarters, and earns a hourly wage rate of $8.93 in stand-alone restaurants and $8.59 in mall restaurants (the difference is statistically significant, with a t-stat of 13.7).

There are a number of minimum wage changes which occurred during the years 2006-2010. In May of 2007, the US government passed the *Fair Minimum Wage Act* that would raise the federal minimum wage from $5.15 to $7.25. This change occurred in $0.70 increments in July of years 2007, 2008, and 2009. At the time when this law was passed, seven of the states in this study had minimum wages above the federal minimum's first increase. That is to say that California, Colorado, Florida, Maryland, North Carolina, Ohio, and Pennsylvania all had state minimum wages above $5.85 in 2007, so the first increase in the federal minimum wage did not impact them.

Four of these "High Minimum Wage States" (CO, NC, OH, and PA) did not have a state minimum wage higher than the federal level at the start of 2006, but then raised their state minimum wages above the federal level in January of 2007. California and Florida both had state minimum wages above the federal level in 2006, but then also increased their minimum wage even higher in January of 2007. Maryland had a minimum wage of $6.15 in 2006, and did not raise their minimum wage until the second federal increase of the minimum wage in July of 2008.

By the time the federal minimum increased in July of 2009 to $7.25, only California, Colorado, and Ohio had state minimum wages above $7.25. And even so, Colorado's minimum wage was only $7.28 and Ohio's was $7.30. This variation in the timing and impact of changes in the minimum wage across states provides one source of variation used to identify

the impact of the minimum wage on restaurants. These changes in the minimum wage are summarized in Table 2.

Figure 1 shows the trends for a few primary outcome variables over time. Each figure has a vertical line whenever some restaurants faced an increase in the minimum wage. The top-left figure shows the trends in average hourly wages, and shows a consistent increase across the time periods. The top-right figure shows the trends in employment levels. The figure shows some seasonality in employment, but no secular trend. The bottom-left panel shows the trends for average total hours worked at each restaurant, and the pattern exhibits marked seasonality, with peaks in the first and third quarters of each year. The bottom-right panel shows the trends in employment turnover. This trend is much smoother as the measure is calculated as a 12-month rolling average. The figure shows an increase in turnover in the last two years of data.

Another source of variation that has been used in the literature to identify the impact of changes in the minimum wage is the "Wage Gap" for each restaurant. This measure captures how much each restaurant would have to raise their wages to meet the new minimum wage. We construct the wage gap in a similar manner as Hirsch, Kaufman, and Zelenska (2015). The wage gap for restaurant j in period t is:

$$Gap_{jt} = 1 + \frac{\sum_{i<MW}(MW_{jt} - W_{ijt-1})H_{ijt-1}}{\sum_i W_{ijt-1}H_{ijt-1}}, \tag{1}$$

where MW_{jt} is minimum wage at restaurant j in period t, W_{ijt-1} is the wage earned by employee i at restaurant j in period $t-1$, and H_{ijt-1} is the number of hours worked by employee i at restaurant j in period $t-1$.

The numerator in the Gap_{jt} formula captures how much wages would have to increase to bring all employees up to the new minimum wage, assuming the number of hours each employee works does not change. The denominator is the total wage bill in the previous period. Adding 1 to the term converts the proportion to a wage ratio, and then using the

natural log of $Gap_{jt}+1$ in a regression with log employment as the dependent variable results in estimates of the wage gap elasticity (Hirsch, Kaufman and Zelenska, 2015).

For example, if a restaurant had one employee that was being paid \$6.75 per hour in the second quarter of 2009. Then, in Q3 of 2009, the restaurant would have to raise that employee's hourly wage \$0.50 in order to comply with the new minimum wage. The next step in calculating the Gap_{jt} is to multiply that employee's \$0.50 wage increase with the number of hours that employee worked in Q2 2009. This step assumes the hours worked by each employee stays constant across periods. The final step is to sum over each employee in a restaurant and divide by the restaurant's total wage bill to determine how much the restaurant would have to raise wages to comply with the new minimum wage.

While the Gap_{jt} measure provides another way to measure the impact of minimum wages on restaurants, the data used in this study do not allow the construction of the wage gap exactly as defined above. That is because the data used here is grouped by age categories, and is not at the individual level. With only knowing the mean and standard deviation of wages for various groups of workers, I need to back out a distribution of wages in order to determine how many workers had wages below the new minimum wage. To do this, I assume that wages at each restaurant follow a gamma distribution, and then calculate the parameters of the gamma distribution using the mean (μ) and standard deviation (σ) of wages for each restaurant. The gamma distribution's shape (k) and scale (θ) parameters were calculated as follows for each restaurant-quarter observation (Casella and Berger, 2002):

$$k = \mu^2/\sigma^2 \tag{2}$$

$$\theta = \sigma^2/\mu \tag{3}$$

To test the validity of this assumption, the company provided the actual distribution of wages for four random restaurants. Using this data, I calculated the restaurant mean and standard deviation in order to construct a gamma distribution from the summary statistics.

I then compare the observed wage density to the calculated gamma distribution. Kernel-density plots for both the observed and calculated wage distributions are shown in Figure 2. While the calculated gamma distributions do not exactly match the observed wage distributions, they match pretty well, and do not show a systematic bias in how it represents low wages. The actual wage distributions did not contain the ages of the workers, so I am unable to test whether the gamma distribution matches the distribution of wages within each age bracket. So, in the analysis presented below, I calculate the wage gap by applying the gamma distribution to the entire workforce at each restaurant, and not within each age bracket. The results do not change significantly when applying the gamma distribution within each age bracket, and those results are shown in the appendix.

Using the assumption that wages for the whole restaurant follow a gamma distribution, I am able to calculate what percent of each restaurant's workforce earns below the new minimum wage. Then, to calculate the wage gap measure, I need to assume that the distribution of hours worked is evenly spread across the wage distribution and does not change in response to the change in the minimum wage. The formula I use to calculate the wage gap is:

$$Gap_{jt} = 1 + \frac{\int_{MW_{jt-1}}^{MW_{jt}} \Big[(MW_{jt} - x) * H_{jt-1} * f(x)\Big] dx}{E_{jt-1}} \tag{4}$$

where H_{jt-1} is the total hours worked at restaurant j in period $t-1$, $f(x)$ is the PDF of the gamma distribution, and E_{jt-1} is the total wage bill. I can then calculate two measures of how much each restaurant is impacted by changes in the minimum wage. The first measure is the Gap_{jt} as described above, equal to the percentage change in wages that would have to occur to bring each employee's hourly wage up to the new minimum wage. The second measure of impact is the percentage of worker-hours that were worked by employees with hourly wages below the new minimum wage. The results of these measures are reported in Table 3.

Since these two measures of impact can only be calculated when there are changes in the minimum wage, Table 3 only shows results for the 6 quarters where minimum wage changes

were observed in the data. The first two columns report the measures of impact on the restaurant overall. Column 3 then reports the number of restaurants that were impacted by changes in minimum wages in each period.

The first number reported in Table 3 indicates that the 163 restaurants who were impacted by the minimum wage change in January of 2007 would have to raise their wages by 2.9% on average to comply with the new minimum wage. Column 2 reports that on average, 45.1% of the hours worked at those restaurants in the previous quarter were worked by employees whose hourly wage was below the new minimum wage.

Overall, Table 3 shows that the first change in the minimum wage, in January of 2007 had the largest impact on restaurants' wages. Each of the federal minimum wage changes, in July of 2007, 2008, and 2009, also had significant impacts on restaurant wages, and that more restaurants were impacted by those changes as the years progressed. These estimates are in line with, though smaller than those reported by Hirsch, Kaufman, and Zelenska (2015). They have actual pay data for about 80 restaurants in Alabama and Georgia from 2007-2009, and report an average wage gap of 2.6 in 2007, but 6.8 in 2009, and share of workers affected of 49.2% in 2007 and 82.2% in 2009.

Gap_{jt} provides a second source of variation to examine the impact of minimum wage changes on restaurants. The analysis below will use both the state-level variation in minimum wages, and the restaurant-level variation in Gap_{jt}.

4 Empirical Methods

The standard approach for measuring the impact of minimum wages is the difference-in-differences strategy popularized by Card and Krueger (1994) as they analyzed the impact of a change in the minimum wage in New Jersey in 1992. Formally, this method is represented by the following specification:

$$y_{jst} = \alpha + \beta ln(MW_{st}) + \delta Z_{st} + \gamma X_{jst} + \phi_j + \tau_t + \epsilon_{jst} \tag{5}$$

where y_{jst} is the outcome of interest for restaurant j in state s in quarter t. The independent variable of interest is the log of the relevant minimum wage in that state at time t. Z_{st} is a set of state level controls, which here include population in quarter t and the unemployment rate at time t. X_{jst} is for restaurant level control variables, which here is just the tenure of the owner of restaurant j. All models include restaurant fixed effects ϕ_j and period fixed effects τ_t[3].

In much of the minimum wage literature, the outcomes are the natural log of wages and employment, so β estimates the relevant wage and employment elasticities. This paper estimates those specifications, but then also analyzes many other outcomes for each restaurant, such as profits, prices, costs, and customer satisfaction. Most of these outcomes will also be logged, so the estimated coefficients will be elasticities, but some outcomes, such as customer satisfaction ratings and whether a restaurant changed their prices, are not.

As discussed above, this paper also uses Gap_{jt} to measure the impact of minimum wage changes at the restaurant level. That specification is very similar to the standard specification, replacing MW_{st} with Gap_{jt}.

$$y_{jst} = \alpha + \beta ln(Gap_{jt}) + \delta Z_{st} + \gamma X_{jst} + \phi_j + \tau_t + \epsilon_{jst} \tag{6}$$

Following the construction of Gap_{jt} used in Hirsch, Kaufman, and Zelenska (2015), the estimates of β in this specification are elasticities with respect to the wage gap.

The summary statistics in Table 1 showed that mall restaurants are much smaller than stand-alone restaurants. To investigate whether minimum wage changes impact these two types of restaurants differently, I include an interaction term into the above specifications for whether the restaurant is located within a shopping mall or not.

$$y_{jst} = \alpha + \beta ln(MW_{st}) + \eta[ln(MW_{st}) * Mall_j] + \theta Mall_j + \delta Z_{st} + \gamma X_{jst} + \phi_j + \tau_t + \epsilon_{jst} \tag{7}$$

[3]No restaurants change states, so state fixed effects are collinear with restaurant effects and therefore excluded.

In this specification, β captures the impact of minimum wages on restaurants which are not mall restaurants, and η captures the additional effect of minimum wages on mall restaurants. For almost all of the specifications performed for this study, the interaction term is not significant, and therefore the results are not included with the main results, but are shown in the appendix.

A few other econometric concerns need to be addressed. First, standard errors are clustered at the state level in all specifications because minimum wages are determined at the state level, and so the error term is likely to be correlated for restaurants in the same state over time (Bertrand, Duflo and Mullainathan, 2004). Donald and Lang (2007) have an important paper identifying issues with inference when using difference-in-differences methods on samples that have small numbers of groups. This paper addresses those concerns by first noting that the sample used here has 13 states, which is more than the analyses used in their paper which had 2 and 4 groups. Robust standard errors with 10 groups perform well in Hansen's (2007) simulations. Second, the owners of the restaurants for which data was used in this paper have individual control over wages, employment, and most other aspects of their business, working to mitigate the concerns about common effects within a state or across the chain which would overstate the precision of the estimates.

In order to interpret the estimated coefficients as the causal impact of minimum wages on the outcome variable, the difference-in-differences technique assumes the treatment and control groups are on parallel trends. This assumption is more difficult to test when there are multiple treatment events of varying magnitudes, but I follow Angrist and Pischke (2009) and Dinardo and Lee (2011) as they adapt a Granger causality test. The intuition of this test is the effects shouldn't happen before the causes. I estimate:

$$ln(y_{jst}) = \alpha + \sum_{k=-3}^{3} [\beta_{-k} ln(MW_{i,t-k})] + \delta Z_{st} + \gamma X_{jst} + \phi_j + \tau_t + \epsilon_{jst} \tag{8}$$

This specification includes leads and lags of the minimum wage treatment spanning 7 quar-

ters, ranging from 3 quarters before the minimum wage change to 3 quarters after the quarter in which the minimum wage changed. The rest of the specification is the same as the previous models. The choice of 3 quarters before and after the quarter when the minimum wage changed is determined by the pattern of minimum wage changes observed in the data. Most of the states in this data changed the minimum wage every year, and so limiting the leads and lags to 3 quarters avoids the effect of the previous or next minimum change.

Tables 4 and 5 report the results for a few key outcome variables from each channel of adjustment. The results for the other outcome variables can be found in the appendix. Table 4 shows the results from equation 8 applied to wages, employment, and hours. The top panel indicates restaurants did adjust wages ahead of the actual change in the minimum wage, especially for workers less than 18 years old who are most likely to be affected by the changes in the minimum wage. In the second panel, there are some weak and mixed effects on employment prior to the actual change in the minimum wage using the state level variation in the minimum wage. However, there is no such pre-treatment effects found when using the restaurant level wage gap measure. The bottom panel shows some pre-treatment effects on hours for workers less than 18 years old, in column (2). However, none of the other specifications show any evidence of pre-treatment effects. Overall, Table 4 does not present strong evidence to reject causal interpretations of the impact of minimum wages on wages, employment, or hours. At most, the results in column 2 suggest that maybe something else is affecting employment and hours of workers less than 18 years old, but only when using the state level variation in minimum wages.

Table 5 reports the Granger test results for restaurant profits, total revenue, and employment turnover. For each of these outcomes, there is not strong evidence against a causal interpretation for the impact of minimum wages. The appendix reports the Granger test results for all of the other outcomes considered in this analysis. Across the seven tables of results, there are a few significant pre-treatment effects, but there is not consistent evidence against a causal interpretations for the impact of minimum wages on these outcomes.

5 Results

In the following sub-sections, I present the results for estimating the impact of changes in the minimum wage on the four channels of adjustment. The first sub-section considers how minimum wages impact employees. The next two sub-sections examine how minimum wages impact customers and owners, respectively. The last sub-section then examines how minimum wages affect each restaurant's production decisions.

5.1 Employees

The employment channel is the one most commonly studied in the literature. The results presented in this section therefore serve as both a replication of those results, and a calibration of this analysis. Table 6 presents those results. The first panel of the table presents the results using the natural log of the average hourly wage at each restaurant as the dependent variable. The second panel uses the natural log of the number of workers at each restaurant as the dependent variable and the last panel uses the natural log of the total hours worked at each restaurant. For each panel, columns 1-4 present the results using state level minimum wage variation to identify the treatment, and columns 5-8 use the restaurant level wage gap variable to identify the treatment effect. The various columns of Table 6 then consider the impact of minimum wages on different age groups of workers.

Column 1 of Table 6 presents the base specification, showing the impact of the minimum wage on all workers. It shows that minimum wages increase the average hourly wage at each restaurant, have no significant impact on overall employment, and have no significant impact on total hours worked. While there is debate in the literature about whether and how much minimum wages negatively impact employment levels, the results in Column 1 of Table 6 are consistent with many papers that find no negative impact (Card and Krueger, 1994; Dube, Lester and Reich, 2010; Allegretto, Dube and Reich, 2011). More importantly, the two papers which use data similar to the one used in this analysis also find no negative

impact on overall employment, Giuliano (2013) and Hirsch, Kaufman and Zelenska (2015).

The results in Column 5 of Table 6 show the similar results on all workers, but now using wage gap as the treatment. The first result in Column 5 indicates that minimum wages decreased the average wage paid by restaurants. This could be due to restaurants changing the composition of the workforce, as found in Giuliano (2013). If restaurants systematically responded to changes in the minimum wage by using fewer high wage workers, and using low wage workers more, than the average wage paid at that restaurant could decrease, even as the hourly wage of the low wage workers increased.

The results in the other columns of Table 6 support this interpretation. Columns 2, 3, and 4 show the impact of minimum wages on workers less than 18 years old, between the ages of 18 and 22, and between the ages of 23-29, respectively. Columns 6, 7, and 8 show the results for the same age categories using the restaurant-specific wage gap to measure the impact of minimum wages. The data provided information on workers older than 29, but there are not many workers in those categories, so those analyses were neither economically nor statistically significant. Columns 2 and 6 of Table 6 show that high school aged workers were most impacted by changes in the minimum wage. Those workers saw their average wage increase the most, which is to be expected as those workers had the lowest average wages to start with. Column 3 shows that wages of workers between the ages of 18-22 increased whereas Column 7 indicates that wages for those workers decreased. The difference between the two results is explained by the different treatment variable. Column 3 uses the state level minimum wage changes whereas Column 7 uses the restaurant level wage gap variable. Restaurants with larger wage gaps would have lower wages by definition, and it could be that these owners respond to minimum wage increases by not using as many workers that could command high wages, and instead use more high school aged workers. This result parallels the negative coefficient seen in Column 5, and could be driven by a similar composition effect.

The results shown in the second and third panels for these columns do not reject the

changing composition story, as most of the results are not statistically significant. In the second panel, the coefficients are positive for high school aged workers, and negative for older workers. This is consistent with restaurants changing the composition of the workforce, but none of the results are statistically significant. In the third panel, Columns 5, 6, and 7 show a positive impact of minimum wages on total hours worked. If restaurants are substituting towards high school aged workers, but these workers are not as productive as the older workers, then the younger workers would have to work more hours to maintain output. Hirsch, Kaufman and Zelenska (2015) also find a positive effect of wage gap on hours. Also, the coefficient on hours in Column 6 is larger than the coefficient in Column 7, suggesting that restaurants are using relatively more high school aged workers. More results on the impact of minimum wages on worker productivity are presented below.

Overall, the results of Table 6 show evidence of wage compression in response to minimum wage increases, and suggests that restaurants also change the composition of workers. Giuliano (2013) finds stronger evidence of this changing composition effect in her data of retail stores, with stores substituting away from older workers towards younger workers. Another way to examine whether restaurants are changing the composition of its workforce is to look at the average age of its workforce. Using the midpoint for each age range provided in the data, I construct the average age for each restaurant's workforce. The impact of changes in the minimum wage on the average age are shown in columns 1 and 2 of Table 7. The estimates are both negative, though only statistically significant when using wage gap to measure exposure to minimum wage changes.

Table 7 also shows the results of specifications examining the impact of minimum wages on other labor costs, namely wage taxes, benefits, and total labor costs. Wage taxes are a fixed percentage of each worker's hourly wage, and so we should expect the impact of minimum wages on wage taxes to be similar to that on hourly wages. Columns 3 and 4 show estimates that are consistent with the results reported for wages in Table 6, but only the coefficient in Column 3 is statistically significant. Columns 5 and 6 then show the the effect

of minimum wages on employee benefits. This variable consists of any health insurance or retirement benefits provided by the employer. It could be the case that store owners offset higher minimum wages by providing lower benefits, but the results do not find any evidence of this response. This is most likely due to most workers not receiving these kinds of benefits. Any changes to the amount of discounted food provided to workers is captured in total discounts provided at each store. Table 14 below shows no significant impact of minimum wages on the amount of total discounts provided at each store.

The last two columns of Table 7 show the impact of minimum wages on total labor costs, which includes both total wages paid and all employee benefits provided. This measure is the total for each store in that quarter. The results in columns 7 and 8 indicate that minimum wages do cause total labor costs to increase, but with an elasticity of 0.146 with respect to the minimum wage, and an elasticity with respect to wage gap of 0.654. So, employees do benefit from increased minimum wages, but at a rate less than the increase in the minimum wage. In Section 6 below, I discuss how these estimates are useful for determining how much employees help pay for the increased minimum wage.

Overall, the results discussed in this section are consistent with the literature, that minimum wages increase wages for the workers most impacted, have no impact on overall employment, but there is some effect on the composition of workers used at each store. Total labor costs do increase in response to minimum wage increases, but at a rate much less than 1.

5.2 Customers

The next potential payee of minimum wage increases are the customers. Customers could pay for higher minimum wages through higher prices, lower product quality, or lower customer service. The data does not provide a direct measure of product quality, but should be captured in the various measures of customer satisfaction provided in the data. Table 8 shows the results for prices and Table 10 shows the results for various measures of customer

satisfaction.

It is important to note that individual store owners do not have complete control over product prices. Product prices are jointly determined by the owners within a particular market and the corporate headquarters. It is also the case that the headquarters monitors minimum wage increases and determines whether or not the minimum wage increase was large enough to merit an increase in product prices. Headquarters does not have a strict rule which determines when prices can or can not be raised in response to minimum wage increases. Instead, the minimum wage increase acts like a shock for both the store owners and headquarters to re-evaluate all the factors which influence output prices, and then determine whether prices should be raised.

The first two columns of Table 8 show the impact of minimum wages on whether stores increase their output prices. The dependent variable for these regressions is a dummy variable equal to 1 for each quarter in which stores raised their output prices. The results in column 1 show no significant impact of state minimum wage changes on whether stores raise their prices. However, column 2 shows the wage gap does increase the probability that stores change output prices. The coefficient in column 2 indicates that a 10% increase in the wage gap would raise the probability stores raise output prices by 4.6 percentage points. In the data, about half of the stores which experienced a change in the minimum wage raised their output prices.

Columns 3 and 4 of Table 8 show the impact of minimum wages on how much prices changed. Here, the dependent variable is the percent change in the output price index. In the sample, when stores change their output prices, the price index increases by 3% on average. The result in column 4 shows that stores with larger wage gaps increase their prices more in response to increases in the minimum wage.

The results in Table 8 show that stores with larger wage gaps raise their output prices in response to minimum wage changes. This indicates that customers help pay for higher minimum wages by paying more for their meals. However, if customers follow the law of

demand, they would reduce their demand for the output in response to the higher prices. The first two columns of Table 9 investigate the intensive margin of this response on the part of the customers by analyzing whether minimum wages affect the average transaction price at each store. The average transaction price is calculated by dividing total revenue by the number of transactions at each store. The result column 2 indicates that customers do spend less on each visit at stores with larger wage gaps. The result in column 2 suggests that a 10% increase in the wage gap would cause customers to reduce their spending per visit by 1.8%. The average transaction price over the whole sample is $6.95.

The results in columns 3 and 4 of Table 9 show the cumulative effect of price changes on customers. These results are discussed more in Section 6 below, but indicate that customers do help pay for increased minimum wages at stores with larger wage gaps.

Table 10 shows the results for whether minimum wages affect customer satisfaction. There are five measures of customer satisfaction, which are collected from consumer surveys. The five measures are "Overall", "Taste", "Speed", "Service", and "Cleanliness". The values reported are the percent of respondents who reported a score of "Excellent" on the survey in each quarter. The "Overall" value is the percent of customers who reported a score of "Excellent" for all four of the other categories. The results on customer satisfaction do not show any significant effects of minimum wages on product quality or customer service.

5.3 Owners

This sub-section analyzes to what extent profits of store owners are affected by changes in the minimum wage. Table 11 shows the results of specifications analyzing the impact of minimum wage changes on store profits, both for all stores and separately by store type. The results indicate there is no significant impact of minimum wage changes on profits in any of the four specifications examined. The results on the control variables follow standard intuition, that more experienced owners are able to generate more profit and that stores in states with high unemployment rates have lower profits. The results also suggest that stores

in states with higher population levels have lower profits, but the results are weak.

To the best of my knowledge, this is the first time restaurant level profit data has been used to examine the impact of minimum wages on profits, and I find no evidence of a negative effect.

5.4 Production Function

The last category of ways companies can respond to increases in the minimum wage relate to the production function. Stores could offset some of the increased costs due to minimum wages by increasing their productivity or by reducing other input costs. The results examining these possible responses are presented in this section.

Table 12 reports the results for the impact of minimum wages on the employment structure. The top panel uses the state variation in the minimum wage and the bottom panel uses the wage gap. Column 1 indicates that minimum wage increases lead to a decrease in employment turnover. The result is only significant at the 10% level, but suggests that a 10% increase in the minimum wage leads to a 1.2% decline in employment turnover. The wage gap result on turnover shown in bottom panel of column 1 is similar, but is not statistically significant. The results on employment turnover shown here are consistent with other findings in the literature (Dube, Lester and Reich, 2016; Gittings and Schmutte, 2016; Hirsch, Kaufman and Zelenska, 2015).

Table 12 also shows the results for how minimum wages may impact other characteristics of the labor force. Column 2 shows no impact of minimum wages on the share of males in the workforce in either panel. Column 3 shows no effect of minimum wages on the average tenure of workers. If turnover is reduced as found in column 1, we would expect to see a positive effect on the average tenure or workers. Both results in column 3 are positive, but are not statistically significant. Column 4 of Table 12 shows a positive impact of minimum wages on the average number of hours each employee worked, and the result in the bottom panel is statistically significant. Overall, the negative impact of minimum wage on employee

turnover would help restaurants offset the cost of minimum wages, whereas the positive effect on average hours has no clear effect on costs.

These restaurants do some catering business and the first two columns of Table 13 show no evidence that minimum wages significantly impact how much stores generate revenue from catering. Columns 3 and 4 of Table 13 presents results for whether minimum wages affect the number of transactions each store handles each quarter. Column 4 shows that an increase in the wage gap leads to an increase in the number of transactions. Recalling from Table 6 that minimum wages did not effect the overall number of employees, this suggest that minimum wage increases work to make workers more productive. This is indeed what is shown in Column 6 of Table 13, that the wage gap leads to increased productivity in terms of the average number of transactions per employee.

The last two columns of Table 13 analyze the impact on the revenue generated for each hour worked. Column 8 shows wage gap to negatively impact the revenue generated per hour worked, suggesting minimum wages negatively impact productivity. However, this effect could be driven by consumers reducing how much they spend on each transaction combined with store owners not changing the number of hours employees work. The negative productivity result may also reflect the changing composition of the workforce. If restaurants substitute towards high school aged workers, and these workers are less productive on average, than average productivity would fall.

Another way stores could offset increased labor costs is through reducing the costs of other inputs into the production function. The impact of minimum wages on other input costs are shown in Table 14. Paper costs measure how much stores spend on paper products, such as cups, napkins, etc. Discounts measure the food and paper costs of transactions discounted at the point-of-sale. The last three categories are cleaning, utility, and kitchen expenses.

If restaurants are cutting corners on other inputs into their production function in response to minimum wage increases, we should see negative results reported in Table 14. However, the significant coefficients found are all positive. That is, the wage gap works

to increase the amount of money restaurants spend on paper products, and also increases utility expenses. The state variation in the minimum wage is also found to have a positive effect on utility expenses in column 7. The positive effect on paper expenses is consistent with the positive effect on the total number of transactions found in Table 13. Overall, the results reported in Table 14 show no evidence of stores cutting corners on other inputs to help offset increased labor costs.

Another way stores could increase productivity, and thus help offset increased labor costs, is by "running a tighter ship". The headquarters of this restaurant chain provides two operating targets to each restaurant, one for labor hours and one for food costs. The details for how these targets were set for each restaurant were not provided to me. I used these targets to create a measure of tightness by subtracting the target from the actual value, and then taking the absolute value of the difference. The results of these analyses on tightness are presented in Table 15, and show no significant impact of minimum wages on how closely store owners track operational targets.

6 Incidence of the Minimum Wage

One of the contributions of this paper is its ability to compare multiple channels of adjustment by each store in attempt to answer the question, "How do restaurants pay for the minimum wage?". The first step in answering this question is determining how much minimum wages cost. This is harder then it seems at first glance as its not clear how much wages should increase for workers already earning above the minimum wage. Legally, workers who have been earning more then the new minimum wage are not required to receive a raise. However, those workers may have more seniority or be more productive then their co-workers who just received a government mandated pay raise. If the high wage workers don't receive a raise, they may become disgruntled and not work as hard as before. Restaurant owners know this, and often provide pay raises to workers earning above the new minimum wage in

order to maintain an optimal wage distribution within each restaurant. Unfortunately, the optimal wage distribution is restaurant specific, may change along with the minimum wage change, and is unknown to outside researchers. In this section I propose bounds for the true cost of a minimum wage change, and also consider evidence from previous research on how minimum wages affect the wage distribution. I then calculate how much each adjustment channel helps pay for the minimum wage based on these various hypothetical changes in the wage distribution for each restaurant.

For the lower bound, the smallest possible cost of the minimum wage is the least amount stores would have to increase their wages to comply with the new minimum wage law. This is exactly what "Wage Gap" measures. In this sample, the average wage gap for stores facing an increase in the minimum wage is 1.94%. For the upper bound, the most that stores could raise their wages in response to an increase in the minimum wage is if they raised every workers' wage by the same percentage as the increase in the minimum wage, thereby preserving the same wage distribution as existed previously. In this sample, the average increase in the minimum wage is 9.9%, implying that stores would increase their total wage bill by 9.9%. Recent research provides some insight for how minimum wages affect the wage distribution (Neumark, Schweitzer and Wascher, 2004; Dube, Giuliano and Leonard, 2015; Hirsch, Kaufman and Zelenska, 2015; Phelan, 2016).

Even though Dube, Giuliano, and Leonard (DGL) (2015) study the effect of unequal raises on quit behavior, which is not directly related to this paper, they provide the actual formula used by the company in their study to provide raises to workers in response to changes in the minimum wage. While that formula was designed for the specific changes in the minimum wage the company was responding to, I adopt the same goal of raising wages for workers earning up to 15% above the new minimum wage. In DGL, the raise schedule was a stair-step pattern with the biggest raise going to workers earning the old minimum wage, all the way up to workers earning 15% above the new minimum wage. I apply that same strategy to all minimum wage changes observed in the data used for this study, and

also linearize the formula for computational ease. My adaptation of the DGL formula is calculated as:

$$DGL_{jt} = \frac{\int_{MW_{jt-1}}^{1.15*MW_{jt}} \Big[Max[MW_{jt} - x + \psi(x - MW_{jt-1}), 0] * H_{jt} * f(x)\Big] dx}{E_{jt}}, \qquad (9)$$

where $\psi = \frac{1.15*MW_{jt} - MW_{jt}}{1.15*MW_{jt} - MW_{jt-1}}$, the slope of the line going from the bottom step of the raise ladder to the top. When applying this adapted raise formula to my data, I find the average total cost of the minimum wage to be 2.64%.

Hirsch, Kaufman, and Zelenska (2015) also examine the extent of spillovers found in their data. They found positive but insignificant effects of the wage gap on wages of workers above the new minimum wage. Therefore I do not use their findings in this analysis.

Neumark, Schweitzer, and Wascher (NSW) (2004) study how minimum wages effect the overall wage distribution nationally. They find significant and positive effects for workers earning up to 3 times greater than the new minimum wage. I apply their findings to these restaurants according to the following table:

Wage	% Raise
w < MW - \$0.10	1.39
MW - \$0.10 ≤ w ≤ MW + \$0.10	0.79
MW + \$0.10 < w ≤ 1.1 * MW	0.78
1.1 < w/MW ≤ 1.2	0.41
1.2 < w/MW ≤ 1.3	0.36
1.3 < w/MW ≤ 1.5	0.26
1.5 < w/MW ≤ 2	0.16
2 < w/MW ≤ 3	0.06

Applying these spillover results to my data, I find the average total cost of the minimum wage to be 3.07%.

Phelan (2016) also analyzes the extent to which minimum wages cause spillovers. However, he examines spillovers across occupations and therefore does not provide a good estimate for the true cost of the minimum wage in the restaurants considered here.

Using both the bounds for the true cost of the minimum wage and the estimates found

in DGL and NSW, I next use the estimates reported above to determine how much each channel of adjustment helps pay for. I start with the employment channel. If employees see their total wage bill increase by the full cost of the minimum wage increase, then employees have not paid for any of the increase. Instead, they have received the full benefit of the minimum wage increase. On the other hand, if employees see their total wage bill increase by less than the full cost of the minimum wage, they are helping pay for the minimum wage. So, the extent by which the total labor costs increase less than the full cost of the minimum wage is the employee's share in paying for the minimum wage.

Gap_{jt} measures the minimum stores would have to increase their total labor costs to comply with the new minimum wage, but it assumes that workers do not change the number of hours they work. Stores could obviously reduce the number of hours worked by employees and thereby deflect some of the increases in total labor costs. However, the results above show a positive impact of minimum wages on total hours worked. Second, stores could make employees pay for the minimum wage increase by changing the composition of the workforce. Stores could substitute away from these high-wage workers and use more low wage workers, even though the low-wage workers wages increased. The results reported above, and the work of Giuliano (2013), support this mechanism.

The lower bound for the true cost of the minimum wage says that total labor costs should increase by 1.94%. However, Table 7 reports an elasticity for total labor costs with respect to the minimum wage of 0.146 in column 7. With the average minimum wage change in this sample being 9.9%, the estimated increase in total labor costs is 1.45%. This increase is smaller than the full cost of the minimum wage, indicating that workers do help pay for the minimum wage. The first row of column 1 Table 16 reports this result. The bottom panel of Table 16 use the estimate for the elasticity of total labor costs with respect to the wage gap to calculate the incidence of the minimum wage for employees. The point estimate is larger than that reported in row 1, however both estimates are not statistically significant.

Both of the estimates for the true cost of the minimum wage based on DGL and NSW's

findings are larger than the lower bound. Therefore, when considering these scenarios, the estimates for how much employees pay for the minimum wage will be larger. These results are reported in columns 2 and 3 of Table 16. Again, the top panel reports estimates based on minimum wage elasticities, whereas the bottom panel reports estimates using wage gap elasticities. All four estimates are near 50%, and three of the four are statistically different from 0. These estimates suggest that in the restaurants studied here, employees total earnings do not increases as much as predicted by the findings of DGL and NSW, and therefore employees help pay for about 50% of the minimum wage increase.

The result for the upper bound scenario are reported in column 4 of Table 16. If the minimum wage increased by 9.9%, then total labor costs should also have increased by 9.9%. Instead, the results from Table 7 indicate that total labor costs only increased by 1.45% when using the minimum wage treatment. This suggests that employees pay for $(1 - 1.45/9.9) = 85.4\%$ of the cost of the minimum wage. The bottom panel finds a similar estimate when using the wage gap treatment. Both estimates are statistically significant.

The second channel of adjustment is the customers. If the customers paid for the full cost of the minimum wage increase, total revenue at each store should increase by an amount equal to the increase in labor costs multiplied by labor's share in total costs. Again, labor's share in total costs is 36% in this sample. So, using the lower bound, total revenue would have had to increase by $1.94 * 0.36 = 0.70\%$ if customers paid for the full cost of the minimum wage. Based on the total revenue elasticties reported in Table 9, the estimates for how much customers helped pay for the minimum wage are reported in the second row of both panels in Table 16. The top panel reports positive incidences for customers, but the estimates are all less than 20% and are not statistically different from 0. The bottom panel reports both large and significant incidences for customers. The first three columns suggest that customers pay more than their fair share, with incidences greater than 1. These results suggest the company raises prices more than what was necessary to pay for the minimum wage.

The third channel is the store owner. If store owners paid for the full cost of the minimum

wage, they would see their profits fall by an amount equal to the increase in labor costs multiplied by labor's share in total costs. In this sample, labor costs are 36% of total costs. So, using the lower bound, owners should see a fall in profit by $1.94 * 0.36 = 0.70\%$ if they paid for the full cost of the minimum wage. Instead, the results in Table 11 find no statistical impact of minimum wages on profits. The estimates for how much owners helped pay for the minimum wage are reported in the third row of each panel in Table 16. In both panels, the results are not significantly different from 0. The negative estimates shown in the bottom panel suggest that the owners might benefit from the increased minimum wages, which makes sense given the results reported for the employee and customer channels. However, the results are not statistically significant.

The remaining channel of adjustment is the production function. While the results presented above showed that minimum wages did impact the production function, it is more difficult to then determine the value of these impacts. For example, Table 12 showed that minimum wages reduced employee turnover. We know that employee turnover is costly to stores, but it is harder to calculate how much money was saved by a 1.2% reduction in turnover. Therefore, I assign any cost of the minimum wage that wasn't paid for by the first three channels to be paid for by the production function. Then, the lower bound for the costs of the minimum wage indicates the production function paid for -37%, whereas the upper bound indicates the production function was able to pay for -5% of the costs. However, none of the estimates are statistically significant.

Overall, this section shows that in order to determine the incidence of the minimum wage, the true total cost of the minimum wage needs to be determined. This section considered four scenarios, a lower bound, an upper bound, and two results found in the literature (Neumark, Schweitzer and Wascher, 2004; Dube, Giuliano and Leonard, 2015). The results using the two scenarios found in the literature show that employees help pay for about 50% of the total cost of the minimum wage increase while customers help pay for over 100% of the increased costs. Both restaurant owners and the production function were not found to help pay for

the increased costs.

7 Conclusion

This project analyzed how stores in a national restaurant chain are impacted by changes in the minimum wage. The study makes use of a unique dataset with quarterly financial data on over 500 restaurants in 13 states for the years 2006-2010. During this time, about half of the states implemented minimum wages that were above the national minimum wage, and the other half of the states saw their minimum wage increase as the federal minimum increased from $5.15 in 2006 to $7.25 in 2010.

The empirical analysis used both state level variation in minimum wages and store level variation in the wage gap to identify the impact of minimum wage changes on four main channels of adjustment, employees, customers, owners, and the production function. The results found that overall average hourly wages increased in response to changes in the minimum wage using the state treatment. However, when using the wage gap treatment, the overall average hourly wage was shown to decrease. The decrease was shown to be partially due to a change in the composition of the workforce at stores with high wage gaps. The results on levels of employment support this interpretation as the overall level of employment was not impacted by minimum wages in either treatment, but there was suggestive evidence that stores with high wage gaps used more high school aged workers in response to the minimum wage. The evidence on employment structure also supports this story as there was evidence that stores used younger workers in response to minimum wage changes.

The next section showed that customers are negatively impacted by minimum wage increases as they both face higher prices for food and spend less on each transaction at the store. However, the analysis did not find strong evidence that customer satisfaction was negatively impacted by minimum wages. The analysis then found no evidence that minimum

wages negatively impacted profits using either treatment. It is important to remember that this is a null result, and not evidence of no effect. Secondly, it should be noted that the experiences of this restaurant chain may or may not generalize to other restaurants, or to larger increases in the minimum wage.

The last section of the analysis considered how components of the production function could be adjusted to help pay for the minimum wage. The results showed that employee turnover was reduced in response to minimum wage changes. The results found mixed results on productivity, with the average number of transactions per employee increasing whereas the average revenue per hour worked decreased. There was also no evidence of restaurants cutting back on other inputs or increasing their operational efficiency.

A benefit of having such comprehensive data for each store was the ability to explore many avenues of adjustment. However, as seen in the results presented above, many of those avenues of adjustment were not found to be statistically significant. This is not surprising for two reasons. First, it could be that each store was running efficiently before the minimum wage change, and there was no more room to reduce costs along these other dimensions after the minimum wage change. Second, the results above also showed that profits were not negatively impacted. This suggests that store owners were able to accommodate the increased labor costs by changing the composition of their workforce, increasing the output price, and reducing labor turnover. If the owners still felt profit pressure after adjusting along these dimensions, then they might have had to pay more attention to the other channels of adjustment.

Many of the significant results above were found by using the wage gap treatment. That treatment has extra power because the treatment varies at the store level, and not just the restaurant level. However, the restaurant level variation in wage gap could be due to two different situations. One, it could be that restaurants with high wage gaps have owners who are very stringent, and work hard to minimize costs as much as possible. However, it could also be that restaurants with high wage gaps are located in communities with low wages.

The data just identifies the state each restaurant is located in, so the above specifications are able to control for state-specific factors, but not the local wage level. It would be useful to know more about local wage levels in order to analyze the various mechanisms by which wage gaps impact restaurants.

References

Aaronson, Daniel. 2001. "Price Pass-Through and the Minimum Wage." *Review of Economics and Statistics*, 83: 158–69.

Aaronson, Daniel, Eric French, Isaac Sorkin, and Ted To. 2017. "Industry Dynamics and the Minimum Wage: A Putty-Clay Approach." *International Economic Review*, forthcoming.

Allegretto, Sylvia A., Arindrajit Dube, and Michael Reich. 2011. "Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data." *Industrial Relations*, 50(2): 205–40.

Angrist, Joshua D., and Jorn-Steffen Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton University Press.

Bell, Brian, and Stephen Machin. 2016. "Minimum Wages and Firm Value." *CEP Discussion Paper*, , (1404).

Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan. 2004. "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics*, 119(1): 249–275.

Brown, Charles. 1999. "Minimum Wages, Employment, and the Distribution of Income." In *Handbook of Labor Economics.* , ed. Orley Ashenfelter and David Card. New York:Elsevier.

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: 772–793.

Card, David, and Alan B. Krueger. 1995. *Myth and Measurement: The New Economics of the Minimum Wage.* Princeton, NJ:Princeton University Press.

Casella, George, and Roger L. Berger. 2002. *Statistical Inference.* . 2nd ed., Pacific Grove, CA: Duxbury Press.

DiNardo, John, and David S. Lee. 2011. "Program Evaluation and Research Designs." In *Handbook of Labor Economics*. Vol. 4, 463–536. Elsevier.

Donald, Stephen G., and Kevin Lang. 2007. "Interfence With Difference-in-Differences and Other Panel Data." *Review of Economics and Statistics*, 89(2): 221–233.

Draca, Mirko, Stephen Machin, and John van Reenen. 2011. "Minimum Wages and Firm Profitability." *American Economic Journal: Applied Economics*, 3(1): 129–151.

Dube, Arindrajit, Laura Giuliano, and Jonathan Leonard. 2015. "Fairness and Frictions: Impact of Unequal Raises on Quit Behavior." *IZA Discussion Paper*, , (9149).

Dube, Arindrajit, S Naidu, and Michael Reich. 2007. "The Economic Effects of a Citywide Minimum Wage." *Industrial and Labor Relations Review*, 60: 522–543.

Dube, Arindrajit, T. William Lester, and Michael Reich. 2010. "Minimum Wage Effects Across State Borders: Estimates Using Contiguous Counties." *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.

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

Gittings, R. Kaj, and Ian M. Schmutte. 2016. "Getting Handcuffs on an Octopus: Minimum Wages, Turnover, and Employment." *Industrial and Labor Relations Review*, 69(5): 1133–70.

Giuliano, Laura. 2013. "Minimum Wage Effects on Employment, Substitution, and the Teenage Labor Supply: Evidence from personnel data." *Journal of Labor Economics*, 31(1): 155–94.

Grossman, Jean B. 1983. "The Impact of the Minimum Wage on Other Wages." *Journal of Human Resources*, 18: 359–78.

Hansen, Christian B. 2007. "Asymptotic Properties of a Robust Variance Matrix Estimator for Panel Data when T is Large." *Journal of Econometrics*, 141(2): 597–620.

Harasztosi, Peter, and Attila Lindner. 2017. "Who Pays for the Minimum Wage?" *mimeo.*

Hirsch, Barry T., Bruce E. Kaufman, and Tetyana Zelenska. 2015. "Minimum Wage Channels of Adjustment." *Industrial Relations*, 54(2): 199–239.

Katz, Lawrence F., and Alan B. Krueger. 1992. "The Effect of the Minimum Wage on the Fast-Food Industry." *Industrial and Labor Relations Review*, 46: 6–21.

Lemos, Sara. 2008. "A Survey of the Effects of the MInimum Wage on Prices." *Journal of Economic Surveys*, 22(1): 187–212.

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 European Economic Association*, 1(1): 154–180.

MaCurdy, Thomas. 2015. "How Effective is the Minimum Wage at Supporting the Poor?" *Journal of Political Economy*, 123(2): 497–545.

Neumark, David, and William Wascher. 2008. *Minimum Wages.* Cambridge, MA:MIT Press.

Neumark, David, Mark Schweitzer, and William Wascher. 2004. "Minimum Wage Effects throughout the Wage Distribution." *Journal of Human Resources*, 39(2): 425–450.

Phelan, Brian J. 2016. "Hedonic-Based Labor Supply Substitution and the Ripple Effect of Minimum Wages." *mimeo.*

Rebitzer, James B., and Lowell J. Taylor. 1995. "The Consequences of Minimum Wage Laws: Some New Theoretical Ideas." *Journal of Public Economics*, 56: 245–255.

Stigler, George J. 1946. "The Economics of Minimum Wage Legislation." *American Economic Review*, 36: 358–65.

Figure 1: Trends in Outcomes by Restaurant Type, 2006-2010

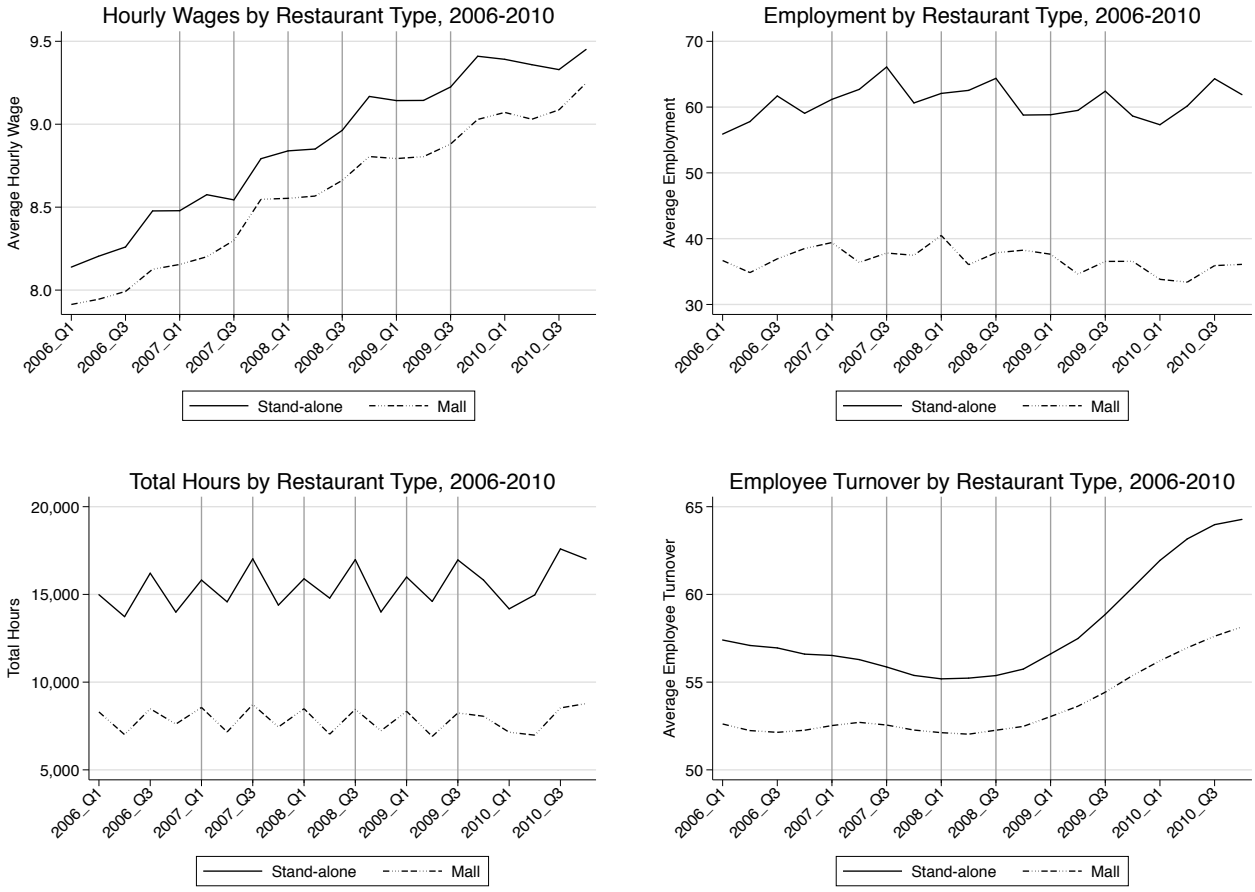

Figure 2: Comparison of Observed Wage Distribution to Calculated Gamma Distribution

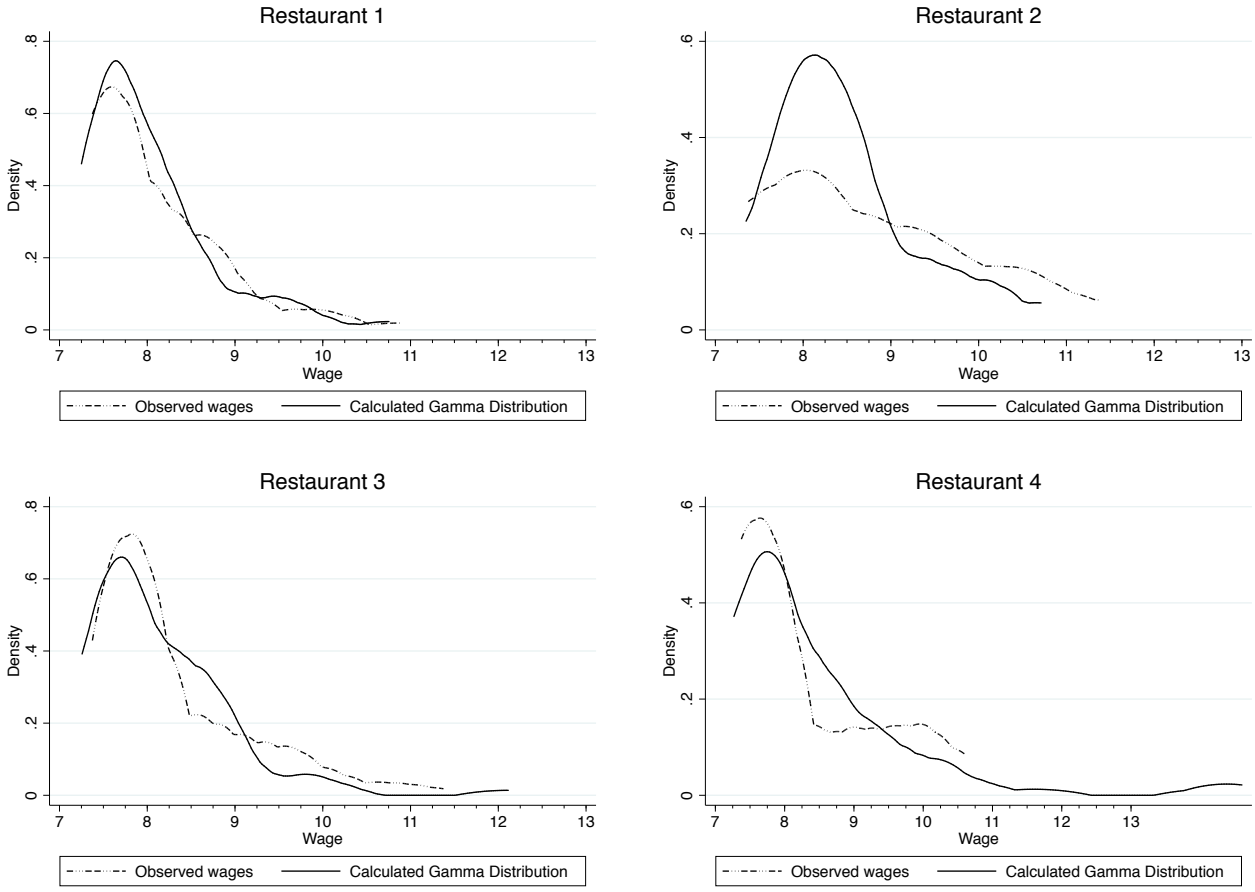

Table 1: Restaurant Level Summary Statistics, 2006-2010

	Stand Alone Restaurants		Mall Restaurants	
	(1)	(2)	(3)	(4)
	mean	sd	mean	sd
(Profits / Total Sales)	36.0	(4.1)	35.0	(5.4)
(Wage Costs / Total Costs)	31.2	(1.9)	31.6	(2.2)
(Food Costs / Total Costs)	44.1	(2.5)	43.7	(2.8)
(Paper Costs / Total Costs)	7.1	(0.6)	7.3	(0.7)
(Other Employment Costs / Total Costs)	4.4	(0.7)	5.0	(1.0)
Percent of Sales from Catering	2.7	(2.8)	4.6	(5.5)
Restaurant Age (quarters)	28.1	(20.1)	84.0	(36.3)
Tenure of Rest. Owner (quarters)	22.1	(17.2)	27.1	(30.8)
Total Rest. Employment	60.8	(16.7)	36.8	(12.3)
Total Hours Worked	15,525	(3,958)	7,873	(2,341)
Percent Male	41.7	(8.6)	41.4	(10.2)
Average Employee Tenure (quarters)	6.3	(3.0)	5.9	(3.2)
Hourly Wage Rate	8.93	(0.81)	8.59	(0.89)
Average Hours Worked Each Week	20.1	(4.1)	17.2	(4.2)
Number of Restaurants	409		106	
Number of Obs.	6,891		2,084	

Table 2: Changes in the Minimum Wage Between 2006-2010 by State

Year	Quarter	High MW States [CA, CO, FL, MD, NC, OH, PA] (1)	Federal MW States [AL, GA, SC, TN, TX, VA] (2)
2007	1	0.76	0
2007	3	0.09	0.70
2008	1	0.10	0
2008	3	0.14	0.70
2009	1	0.17	0
2009	3	0.27	0.70
Num. of Restaurants		236	279

Notes: "High MW States" are states that had minimum wages above the federal minimum in 2007. The change in the minimum wage reported for "High MW States" is the average change across the states, weighted by the number of restaurants in each state. By 2009Q3, only California, Colorado, and Ohio had minimum wages above the federal minimum.

Table 3: Estimated Impact of Minimum Wage Changes on Restaurants

Year	Quarter	Wage Gap (1)	Percent of Hours Worked Below New MW (2)	Number of Restaurants Impacted (3)
2007	1	1.029	45.1	163
2007	3	1.020	35.0	251
2008	1	1.006	40.0	104
2008	3	1.021	41.3	318
2009	1	1.013	45.8	94
2009	3	1.023	49.0	425

Notes: The distribution of wages is assumed to follow a gamma distribution with parameters determined by the mean and standard deviation of wages for all workers. "Wage Gap" measures the percent change in wages that would have to occur to bring every worker's wage up to the new minimum wage. "Percent Below" measures the percent of worker-hours that are estimated to be below the new minimum wage.

Table 4: Trends in Impact of Minimum Wage on Restaurant Wages, Employment and Total Hours, 2006-2010

	State Minimum Wage				Restaurant Wage Gap			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Workers	Ages <18	Ages 18-22	Ages 23-29	All Workers	Ages <18	Ages 18-22	Ages 23-29
	Dep. Var. = ln(Hourly Wage)							
$ln(MW_{t-3})$	0.171	-0.003	-0.029	0.141	0.026	-1.288***	-1.149***	-0.181
	(0.171)	(0.046)	(0.062)	(0.099)	(0.443)	(0.216)	(0.221)	(0.270)
$ln(MW_{t-2})$	-0.069	-0.049	-0.041	-0.102***	-0.867**	-1.609***	-1.528***	-0.723***
	(0.120)	(0.035)	(0.039)	(0.030)	(0.398)	(0.144)	(0.170)	(0.222)
$ln(MW_{t-1})$	0.074	0.043	0.030	0.101*	-0.547	-1.432***	-1.383***	-0.418
	(0.095)	(0.053)	(0.036)	(0.053)	(0.401)	(0.237)	(0.160)	(0.238)
$ln(MW_t)$	0.067	0.259***	0.104***	-0.023	-0.160	-0.121	-0.746***	-0.330
	(0.038)	(0.038)	(0.026)	(0.024)	(0.485)	(0.172)	(0.156)	(0.268)
$ln(MW_{t+1})$	-0.077	0.152***	0.101***	0.016	-0.016	0.685***	-0.018	-0.154
	(0.045)	(0.019)	(0.021)	(0.031)	(0.417)	(0.198)	(0.147)	(0.228)
$ln(MW_{t+2})$	0.029	0.019	0.043	-0.032*	0.114	0.718***	0.241	0.055
	(0.069)	(0.031)	(0.028)	(0.016)	(0.401)	(0.166)	(0.136)	(0.203)
$ln(MW_{t+3})$	0.033	0.075**	0.043	0.068	0.413	0.368**	0.163*	-0.015
	(0.066)	(0.028)	(0.036)	(0.062)	(0.237)	(0.152)	(0.087)	(0.200)
Adj. R^2	0.190	0.692	0.202	0.031	0.191	0.685	0.229	0.032
Observations	5986	5859	5986	5959	5983	5856	5983	5956
	Dep. Var. = ln(Employment)							
$ln(MW_{t-3})$	0.301	0.798*	0.446	-0.292	1.574***	3.137***	1.633**	-0.313
	(0.176)	(0.411)	(0.387)	(0.450)	(0.399)	(0.901)	(0.748)	(1.014)
$ln(MW_{t-2})$	-0.227	-0.243	-0.076	0.105	0.633	2.763*	0.801	-1.024
	(0.129)	(0.247)	(0.124)	(0.192)	(0.717)	(1.533)	(0.740)	(0.825)
$ln(MW_{t-1})$	0.164	0.439	-0.129	-0.026	0.921***	3.305***	0.879	-0.705
	(0.133)	(0.273)	(0.127)	(0.257)	(0.287)	(0.839)	(0.524)	(0.911)
$ln(MW_t)$	-0.087	-0.116	-0.013	-0.044	0.122	1.269	0.157	-1.317
	(0.053)	(0.183)	(0.098)	(0.137)	(0.385)	(0.815)	(0.699)	(0.940)
$ln(MW_{t+1})$	-0.144*	-0.235	-0.190	-0.084	-0.125	-0.013	0.544	-1.035
	(0.072)	(0.208)	(0.118)	(0.136)	(0.346)	(0.802)	(0.710)	(0.969)
$ln(MW_{t+2})$	-0.074	-0.219**	0.031	-0.281*	-0.470	-1.219	0.240	-1.495
	(0.071)	(0.101)	(0.097)	(0.153)	(0.269)	(0.788)	(0.603)	(0.981)
$ln(MW_{t+3})$	0.066	0.557**	0.026	0.287	0.436	0.446	0.772	0.999
	(0.067)	(0.241)	(0.153)	(0.237)	(0.411)	(0.691)	(0.776)	(0.679)
Adj. R^2	0.079	0.357	0.069	0.030	0.081	0.358	0.071	0.032
Observations	5986	5859	5986	5960	5983	5856	5983	5957
	Dep. Var. = ln(Total Hours)							
$ln(MW_{t-3})$	0.275*	1.058*	0.147	0.157	0.726*	2.248	0.189	0.747
	(0.141)	(0.553)	(0.347)	(0.453)	(0.405)	(1.884)	(0.680)	(1.461)
$ln(MW_{t-2})$	-0.103	0.333	0.015	0.079	0.562	3.460*	0.342	0.721
	(0.091)	(0.379)	(0.159)	(0.104)	(0.332)	(1.660)	(0.623)	(1.251)
$ln(MW_{t-1})$	0.046	-0.178	-0.086	-0.080	0.366	2.506	0.225	0.257
	(0.066)	(0.317)	(0.118)	(0.317)	(0.346)	(1.454)	(0.471)	(0.994)
$ln(MW_t)$	-0.018	0.143	0.062	0.048	0.459	1.442	0.483	0.608
	(0.041)	(0.326)	(0.093)	(0.123)	(0.492)	(0.923)	(0.701)	(1.222)
$ln(MW_{t+1})$	-0.095	-0.380	-0.090	-0.294	0.116	0.629	0.671	0.066
	(0.082)	(0.316)	(0.129)	(0.197)	(0.389)	(1.425)	(0.591)	(0.984)
$ln(MW_{t+2})$	-0.048	-0.393**	0.090	-0.047	-0.084	-2.018	0.949	0.213
	(0.070)	(0.166)	(0.124)	(0.242)	(0.348)	(1.301)	(0.658)	(1.070)
$ln(MW_{t+3})$	0.046	0.889***	-0.014	0.048	0.243	0.813	0.835	1.460
	(0.066)	(0.279)	(0.185)	(0.242)	(0.215)	(1.149)	(0.549)	(0.990)
Adj. R^2	0.437	0.357	0.142	0.042	0.437	0.357	0.144	0.042
Observations	5986	5859	5986	5959	5983	5856	5983	5956

Notes: All specifications include controls for owner tenure, local population, local unemployment rate, and period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 5: Trends in Impact of Minimum Wage on Restaurant Profits, Revenue, and Turnover, 2006-2010

	State Minimum Wage			Restaurant Wage Gap		
	(1)	(2)	(3)	(4)	(5)	(6)
	Profit	Total Revenue	Emp. Turnover	Profit	Total Revenue	Emp. Turnover
$ln(MW_{t-3})$	-0.636*	-0.105	-0.218*	0.386	0.388	0.109
	(0.342)	(0.127)	(0.117)	(0.384)	(0.308)	(0.328)
$ln(MW_{t-2})$	-0.265	-0.104	-0.041	-1.629***	-0.706**	0.066
	(0.188)	(0.147)	(0.045)	(0.524)	(0.314)	(0.274)
$ln(MW_{t-1})$	0.284*	0.113	0.014	-0.553	-0.265	-0.157
	(0.149)	(0.102)	(0.038)	(0.777)	(0.375)	(0.267)
$ln(MW_t)$	-0.195	-0.023	-0.042**	-1.481**	-0.425	-0.265
	(0.147)	(0.070)	(0.017)	(0.621)	(0.318)	(0.321)
$ln(MW_{t+1})$	0.169	-0.048	0.031	-0.929	-0.365	-0.276
	(0.127)	(0.066)	(0.027)	(0.602)	(0.316)	(0.256)
$ln(MW_{t+2})$	0.072	0.062	-0.019	-0.816	-0.272	-0.293
	(0.137)	(0.088)	(0.017)	(0.755)	(0.375)	(0.235)
$ln(MW_{t+3})$	-0.053	-0.012	-0.109*	0.048	0.237	-0.105
	(0.145)	(0.065)	(0.053)	(0.827)	(0.375)	(0.191)
Adj. R^2	0.181	0.222	0.180	0.178	0.223	0.175
Observations	5985	5986	5454	5982	5983	5454

Notes: All specifications include controls for owner tenure, local population, local unemployment rate, and period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 6: Impact of Minimum Wage on Restaurant Wages, Employment and Total Hours, 2006-2010

	State Minimum Wage				Restaurant Wage Gap			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	All Workers	Ages <18	Ages 18-22	Ages 23-29	All Workers	Ages <18	Ages 18-22	Ages 23-29
	Dep. Var. = ln(Hourly Wage)							
ln(Min Wage)	0.158***	0.409***	0.208***	0.026				
	(0.035)	(0.047)	(0.048)	(0.046)				
ln(Wage Gap)					-0.260***	0.190**	-0.272***	-0.152
					(0.048)	(0.082)	(0.072)	(0.133)
Owner Tenure	0.000	0.000	-0.000	-0.000	0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
ln(Population)	0.027	0.215	0.244	0.227	0.324	0.941**	0.633*	0.282
	(0.211)	(0.227)	(0.258)	(0.395)	(0.230)	(0.336)	(0.301)	(0.362)
Unemp. Rate	0.001	0.002	0.002	0.004	-0.001	-0.004	-0.001	0.004
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)
Constant	1.375	-2.356	-2.293	-1.480	-3.156	-13.366**	-8.211	-2.319
	(3.395)	(3.628)	(4.132)	(6.356)	(3.716)	(5.415)	(4.865)	(5.871)
Adj. R^2	0.604	0.751	0.311	0.056	0.595	0.711	0.295	0.056
Observations	8972	8784	8972	8931	8972	8784	8972	8931
	Dep. Var. = ln(Employment)							
ln(Min Wage)	-0.062	0.355	-0.025	-0.134				
	(0.082)	(0.311)	(0.104)	(0.177)				
ln(Wage Gap)					-0.014	0.739	-0.187	-0.292
					(0.236)	(0.645)	(0.234)	(0.576)
Owner Tenure	-0.002***	-0.000	-0.002***	-0.007***	-0.002***	-0.000	-0.002***	-0.006***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
ln(Population)	1.020**	1.383	0.840	-0.842	0.910*	1.987**	0.803	-1.072
	(0.423)	(0.971)	(0.691)	(1.348)	(0.457)	(0.761)	(0.810)	(1.363)
Unemp. Rate	-0.020**	-0.077***	-0.005	0.023	-0.019***	-0.083***	-0.004	0.025*
	(0.007)	(0.017)	(0.012)	(0.015)	(0.006)	(0.016)	(0.011)	(0.014)
Constant	-12.378*	-20.259	-10.670	15.750	-10.696	-29.392**	-10.116	19.234
	(6.822)	(15.297)	(11.278)	(21.817)	(7.378)	(12.278)	(13.103)	(22.074)
Adj. R^2	0.066	0.351	0.106	0.041	0.066	0.350	0.106	0.041
Observations	8972	8784	8972	8933	8972	8784	8972	8933
	Dep. Var. = ln(Total Hours)							
ln(Min Wage)	-0.013	0.435	0.064	-0.120				
	(0.073)	(0.464)	(0.143)	(0.230)				
ln(Wage Gap)					1.092***	1.692**	1.010**	1.173
					(0.330)	(0.711)	(0.371)	(0.679)
Owner Tenure	0.001	0.000	-0.000	-0.005**	0.001	0.000	-0.000	-0.005**
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
ln(Population)	0.111	0.864	-0.383	-2.865	0.037	1.567	-0.316	-3.138*
	(0.486)	(1.305)	(0.611)	(1.631)	(0.474)	(0.979)	(0.729)	(1.713)
Unemp. Rate	-0.019**	-0.101***	-0.003	0.039*	-0.019**	-0.108***	-0.004	0.041*
	(0.007)	(0.024)	(0.011)	(0.020)	(0.007)	(0.022)	(0.011)	(0.021)
Constant	7.718	-6.988	14.287	54.139*	8.896	-17.585	13.309	58.331*
	(7.833)	(20.429)	(9.962)	(26.468)	(7.644)	(15.755)	(11.753)	(27.738)
Adj. R^2	0.211	0.338	0.150	0.066	0.213	0.337	0.150	0.066
Observations	8972	8784	8972	8931	8972	8784	8972	8931

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 7: Impact of Minimum Wage on Other Employment Outcomes, 2006-2010

	Avg. Age		ln(Wage Taxes)		ln(Benefits)		ln(Total Labor Costs)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Min Wage)	-1.215		0.388***		0.070		0.146*	
	(0.857)		(0.066)		(0.179)		(0.077)	
ln(Wage Gap)		-4.085***		-0.118		0.750		0.654**
		(1.021)		(0.306)		(0.562)		(0.299)
Owner Tenure	0.019***	0.019***	-0.001*	-0.001*	0.012***	0.012***	0.002**	0.002**
	(0.005)	(0.005)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
ln(Population)	5.761	3.757	0.260	0.966	-1.963*	-1.873*	0.180	0.413
	(4.420)	(4.003)	(0.570)	(0.547)	(1.047)	(0.935)	(0.567)	(0.533)
Unemp. Rate	0.041	0.061	0.006	-0.001	-0.014	-0.015	-0.017**	-0.019**
	(0.052)	(0.055)	(0.005)	(0.007)	(0.013)	(0.013)	(0.008)	(0.007)
Constant	-65.381	-35.119	-4.972	-15.701	35.866*	34.536**	8.537	5.025
	(70.736)	(64.827)	(9.184)	(8.836)	(16.727)	(15.067)	(9.140)	(8.614)
Adj. R^2	0.167	0.166	0.461	0.449	0.120	0.120	0.270	0.269
Observations	8972	8972	8970	8970	8890	8890	8970	8970

Notes: "Wage Taxes" include FICA, federal and state unemployment tax, and workers compensation insurance. "Benefits" include health insurance and retirement contributions. All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 8: Impact of Minimum Wage on Product Prices, 2006-2010

	Price Change		Price Increase		Price Pass Thru	
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Min Wage)	0.340		0.005			
	(0.246)		(0.004)			
Per Change in MW					0.018	
					(0.011)	
ln(Wage Gap)		4.645**		0.130**		
		(1.842)		(0.049)		
Per Change Gap						0.069*
						(0.037)
Owner Tenure	-0.001***	-0.001***	0.000	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Population)	-1.513*	-1.115	0.003	0.007	0.008	0.019
	(0.722)	(0.806)	(0.009)	(0.010)	(0.010)	(0.013)
Unemp. Rate	-0.003	-0.009	0.000	0.000	0.000	0.000
	(0.010)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	23.900*	18.070	-0.062	-0.107	-0.136	-0.308
	(11.723)	(13.037)	(0.153)	(0.165)	(0.158)	(0.206)
Adj. R^2	0.890	0.894	0.872	0.876	0.883	0.883
Observations	8975	8972	8975	8972	8835	8458

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 9: Impact of Minimum Wage on Customer Demand, 2006-2010

	ln(Transaction Price)		ln(Total Revenue)	
	(1)	(2)	(3)	(4)
ln(Min Wage)	0.031		0.013	
	(0.025)		(0.066)	
ln(Wage Gap)		-0.182**		0.578**
		(0.064)		(0.240)
Owner Tenure	0.000***	0.000***	0.002***	0.002***
	(0.000)	(0.000)	(0.001)	(0.001)
ln(Population)	-0.076	-0.011	-0.299	-0.303
	(0.200)	(0.175)	(0.447)	(0.433)
Unemp. Rate	-0.004**	-0.005**	-0.018***	-0.019***
	(0.002)	(0.002)	(0.006)	(0.005)
Constant	3.009	2.008	17.938**	18.031**
	(3.216)	(2.837)	(7.205)	(7.005)
Adj. R^2	0.724	0.724	0.304	0.304
Observations	8970	8970	8970	8970

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 10: Impact of Minimum Wage on Customer Satisfaction, 2006-2010

	Overall	Taste	Speed	Service	Cleanliness
	(1)	(2)	(3)	(4)	(5)
Minimum Wage					
ln(Min Wage)	-2.285	-3.517	-1.381	-1.896	-1.378
	(2.974)	(2.163)	(2.538)	(2.623)	(2.745)
Owner Tenure	0.020	0.027	0.030	0.020	0.003
	(0.020)	(0.016)	(0.018)	(0.022)	(0.017)
ln(Population)	-13.594	-17.123	-14.433	-23.738	-2.086
	(14.722)	(12.543)	(12.530)	(14.821)	(11.704)
Unemp. Rate	0.567**	0.258	0.388*	0.399	0.409*
	(0.220)	(0.182)	(0.179)	(0.226)	(0.220)
Constant	266.573	348.426	298.200	455.928*	99.501
	(237.590)	(202.062)	(202.367)	(237.136)	(188.689)
$Adj.R^2$	0.297	0.279	0.254	0.344	0.234
Number	8736	8736	8736	8736	8736
Wage Gap					
ln(Wage Gap)	2.755	7.418	8.479	9.696	1.868
	(8.850)	(6.734)	(8.458)	(8.480)	(9.518)
Owner Tenure	0.020	0.027	0.030	0.020	0.003
	(0.019)	(0.016)	(0.018)	(0.022)	(0.017)
ln(Population)	-17.817	-23.778*	-17.314	-27.599*	-4.643
	(14.565)	(11.534)	(12.933)	(12.836)	(12.052)
Unemp. Rate	0.603**	0.313*	0.409**	0.429*	0.431*
	(0.204)	(0.165)	(0.166)	(0.226)	(0.210)
Constant	330.830	449.818**	342.343	515.015**	138.417
	(235.466)	(186.631)	(208.882)	(207.218)	(194.467)
$Adj.R^2$	0.296	0.278	0.254	0.344	0.234
Number	8736	8736	8736	8736	8736

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 11: Impact of Minimum Wage on Profit by Restaurant Type, 2006-2010

	(1)	(2)	(3)	(4)
ln(Min Wage)	-0.066	-0.071		
	(0.126)	(0.188)		
<MW Var> * Mall Rest.		0.089		-0.948
		(0.277)		(0.874)
ln(Wage Gap)			0.325	0.725
			(0.387)	(0.552)
Owner Tenure	0.003***	0.002**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
ln(Population)	-1.194*	-1.652**	-1.328*	-1.751**
	(0.595)	(0.637)	(0.671)	(0.717)
Unemp. Rate	-0.020**	-0.024**	-0.019*	-0.023**
	(0.009)	(0.008)	(0.010)	(0.009)
Constant	31.557***	38.957***	33.604***	40.470***
	(9.675)	(10.335)	(10.850)	(11.594)
Adj. R^2	0.199	0.276	0.199	0.276
Observations	8969	8969	8969	8969

Notes: Profit calculations exclude data on occupancy costs, credit card fees, and franchise fees. All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 12: Impact of Minimum Wage on Employment Structure, 2006-2010

	Turnover	Percent Male	Avg. Tenure	Avg. Hours
	(1)	(2)	(3)	(4)
Minimum Wage				
ln(Min Wage)	-0.121*	2.425	0.026	0.513
	(0.057)	(2.873)	(0.105)	(1.397)
Owner Tenure	0.002***	-0.041	0.029***	0.039***
	(0.001)	(0.025)	(0.004)	(0.007)
ln(Population)	-0.951***	-14.278	-2.255**	-15.433**
	(0.265)	(12.707)	(0.911)	(5.944)
Unemp. Rate	0.011**	0.202	0.005	0.017
	(0.004)	(0.124)	(0.011)	(0.093)
$Adj.R^2$	0.272	0.019	0.417	0.198
Number	7779	8972	8972	8972
Wage Gap				
ln(Wage Gap)	-0.120	10.972	0.306	10.911**
	(0.118)	(8.230)	(0.677)	(3.847)
Owner Tenure	0.002***	-0.042	0.029***	0.039***
	(0.001)	(0.024)	(0.004)	(0.007)
ln(Population)	-1.160***	-10.411	-2.222**	-15.019**
	(0.329)	(8.314)	(0.957)	(6.684)
Unemp. Rate	0.013**	0.163	0.004	0.009
	(0.005)	(0.136)	(0.010)	(0.088)
$Adj.R^2$	0.270	0.019	0.418	0.199
Number	7779	8972	8972	8972

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 13: Impact of Minimum Wage on Productivity, 2006-2010

	Per. Catering		Transactions		Trans/Employee		Sales/Hour Worked	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Min Wage)	0.974		-0.019		0.045		0.030	
	(0.864)		(0.068)		(0.104)		(0.061)	
ln(Wage Gap)		-3.169		0.760***		0.781***		-0.474**
		(4.374)		(0.244)		(0.243)		(0.177)
Owner Tenure	0.032***	0.032***	0.002***	0.002***	0.003***	0.003***	0.001*	0.001*
	(0.008)	(0.008)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Population)	-10.278	-8.369	-0.222	-0.292	-1.251***	-1.206**	-0.309	-0.233
	(8.033)	(7.322)	(0.475)	(0.430)	(0.409)	(0.444)	(0.223)	(0.266)
Unemp. Rate	0.019	0.004	-0.014**	-0.014**	0.005	0.005	0.000	-0.000
	(0.071)	(0.074)	(0.005)	(0.005)	(0.006)	(0.005)	(0.004)	(0.004)
$Adj.R^2$	0.043	0.043	0.113	0.114	0.092	0.093	0.561	0.561
Number	8970	8970	8970	8970	8970	8970	8970	8970

Notes: All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 14: Impact of Minimum Wage on Other Costs, 2006-2010

	Paper Costs		Discounts		Cleaning		Utilities		Kitchen	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ln(Min Wage)	-0.039		-0.180		-0.039		0.182**		-0.017	
	(0.071)		(0.175)		(0.109)		(0.081)		(0.229)	
ln(Wage Gap)		0.570**		0.638		0.379		1.620***		0.854
		(0.246)		(0.841)		(0.444)		(0.479)		(0.662)
Owner Tenure	0.002***	0.002***	0.005***	0.005***	0.000	0.000	-0.000	-0.000	-0.003**	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
ln(Population)	0.169	0.072	1.304	0.949	0.268	0.180	-0.929*	-0.677	0.616	0.545
	(0.561)	(0.523)	(1.508)	(1.311)	(0.953)	(0.856)	(0.512)	(0.507)	(0.727)	(0.506)
Unemp. Rate	-0.020***	-0.019**	0.006	0.009	-0.015	-0.015	-0.012	-0.015*	0.001	0.001
	(0.006)	(0.006)	(0.015)	(0.017)	(0.009)	(0.009)	(0.007)	(0.007)	(0.008)	(0.006)
$Adj.R^2$	0.219	0.220	0.087	0.087	0.150	0.150	0.188	0.189	0.343	0.344
Number	8970	8970	8962	8962	8970	8970	8961	8961	8968	8968

Notes: All specifications include period and Restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 15: Impact of Minimum Wage on Tightening, 2006-2010

	Hours Target		Food Cost Target	
	(1)	(2)	(3)	(4)
ln(Min Wage)	0.295		0.308	
	(0.450)		(0.395)	
ln(Wage Gap)		2.463		1.387
		(1.706)		(2.014)
Owner Tenure	-0.004**	-0.004**	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
ln(Population)	-1.029	-0.610	0.462	0.954
	(2.666)	(2.635)	(2.351)	(2.090)
Unemp. Rate	0.013	0.008	-0.001	-0.006
	(0.044)	(0.048)	(0.040)	(0.037)
$Adj.R^2$	0.035	0.035	0.058	0.058
Number	8970	8970	8969	8969

Notes: The dependent variable is the absolute value of the difference between the operational target and the actual value. All specifications include period and restaurant fixed effects. Robust standard errors are clustered at the state level. The time period is a quarter.

Table 16: Summary of Minimum Wage Accounting

Category	Lower Bound (1)	Dube, Giuliano, and Leonard (2)	Neumark, Schweitzer, and Wascher (3)	Upper Bound (4)
Minimum Wage				
Employees	0.257	0.454	0.530	0.854
	(0.392)	(0.288)	(0.248)	(0.077)
Customers	0.178	0.131	0.113	0.035
	(0.933)	(0.685)	(0.590)	(0.183)
Owners	0.931	0.684	0.589	0.183
	(1.779)	(1.308)	(1.126)	(0.350)
Production Fcn.	-0.366	-0.269	-0.232	-0.072
	(1.152)	(0.847)	(0.729)	(0.226)
Wage Gap				
Employees	0.346	0.519	0.586	0.871
	(0.298)	(0.219)	(0.189)	(0.059)
Customers	1.610	1.183	1.019	0.316
	(0.669)	(0.491)	(0.423)	(0.131)
Owners	-0.906	-0.666	-0.573	-0.178
	(1.076)	(0.791)	(0.681)	(0.211)
Production Fcn.	-0.050	-0.037	-0.031	-0.010
	(0.770)	(0.566)	(0.487)	(0.151)

Notes: Standard errors are in parentheses. Results report the share of costs that are paid for by each category.