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DISCUSSION PAPER SERIES

IZA DP No. 17594

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ABSTRACT

Menu Adjustment in Response to the Minimum Wage: A Return to the New Jersey-Pennsylvania Border*

This paper studies how output prices are affected by increases in the minimum wage. To the best of our knowledge, we provide the first examination of how the prices of an entire menu of items at a single business adjust in response to a minimum wage increase. Using data we gather form a fast-food chain, we find that a $1 minimum wage rise increased average prices by 7 cents, implying a pass-through elasticity of around 0.13. We also study how the price response across individual goods varies with the labor intensity in production of those goods. Consistent with a theoretical framework we describe, the prices of items that require more labor to produce increased by more due to the minimum wage increase. A $1 increase in the minimum wage raised the item price by an extra 0.3 cents for every additional preparation step. We also find that more price adjustment takes place at the store level than at the item level, and that it takes longer for prices to respond to a minimum wage increase than the existing literature suggests.

JEL Classification: J23, J38, L11, L81

Keywords: minimum wages, prices, restaurants, menus

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1. Introduction

The literature on minimum wages is heavily focused on employment effects, but there are many other channels through which businesses could absorb higher labor costs or adjust to them.[1] One obvious mechanism of adjustment in monopolistically competitive markets would be for firms to pass a portion of the costs associated with a higher minimum wage onto consumers in the form of higher prices. The extent to which higher costs lead to higher prices is referred to as the degree of 'pass-through.' This has major implications for the labor market: if firms can pass on most of their costs to consumers, there would less need for them to make other economies, such as fewer jobs, tighter work schedules, or cuts in training and employee benefits.

Relatively few previous studies have examined how minimum wages affect prices, and this research has found notably different estimates of the extent of pass-through and the speed at which price adjustment occurs. This paper seeks to add to economists' understanding of how employers respond to minimum wage increases by differentially adjusting the prices of the items they sell. Specifically, we provide the first examination of how the prices of an entire menu of items at a single business adjust in response to a minimum wage increase. While many employers sell more than one product, no previous paper (of which we are aware) has studied how the price response to minimum wage increases might vary across the range of goods and services offered by affected firms. We also study how the price response across individual goods varies with the labor intensity in production of those goods.

On 4 February 2019, Governor Phil Murphy of New Jersey signed legislation raising that state's minimum wage from $8.85 to $10 on July 1, 2019, and by another $1 every following January until it reached $15 on January 1, 2024.[2] Meanwhile, the Pennsylvania state minimum wage has remained at the federal level of $7.25 since 2009, and no future increases are planned in that state. This environment provides a natural experiment, with stores in New Jersey as the treatment group and stores in Pennsylvania as the control group. This is the same choice of treatment and control states used by Card and Krueger (1994) in their seminal study of the effects of the minimum wage on employment at fast food restaurants.

[1] See Neumark and Shirley (2021) and Dube (2019) for recent summaries of the literature, including employment effects. Clemens and Strain (forthcoming) offers evidence of the employment effect of relatively recent minimum wage increases. Clemens (2021) discusses the relevance of margins of adjustment other than employment in the face of minimum wage increases. Clemens and Strain (2020) provide an illustrative example of schedule irregularity as one potential, non-employment adjustment margin.

[2] New Jersey Legislative Statutes 34:11-56a4 (accessed September 18, 2024).

We gathered data for a sample of 45 stores on the border between New Jersey and Pennsylvania. These stores all belonged to the same major U.S. fast food restaurant chain. Every Monday between April 1, 2019, and March 31, 2021, we gathered price data on every menu item (around 120) on each store's website. Using these data, we examine the effects of the first three planned increases in the New Jersey minimum wage (in July 2019, January 2020 and January 2021). The fast food sector is the largest employer of minimum wage workers in the United States, with around a third of workers in the industry earning within 10% of the minimum wage (Dube et al. 2010).

We present four main results. First, we find a $1 increase in the minimum wage raises the price of an average item by 7 cents. This is equivalent to a pass-through elasticity of around 0.13, in line with some previous studies. In addition, our detailed data allow for more nuanced conclusions than the existing literature provides. Specifically, we gathered data from employee training manuals to identify which items on the menu were the most labor intensive and use that information to better understand how an increase in labor costs affects prices. We find that menu items that are most labor intensive are the most price sensitive to minimum wage increases. For every additional step required to produce an item, the item's price increases by an additional 0.3 cents in response to a $1 minimum wage increase. The pass-through coefficient for an item that requires 19 steps to prepare (the 90th percentile of the preparation steps distribution) is around 3 times larger than for an item that requires 3 steps (the 10th percentile).

Third, we find that more price adjustment takes place at the store level than at the item level, which might reflect menu adjustments by management. There is evidence that stores switch to items that sell for relatively higher prices after the minimum wage rises, principally by no longer offering a breakfast menu or combo deals. Finally, we find that it takes longer for prices to respond to a minimum wage increase than the existing literature suggests. We find that significant price adjustment only takes place six weeks after the minimum wage is changed.

Unlike some of its competitors, the vast majority of the chain's stores are owned and operated by franchise holders. Under the terms of the franchise agreements for the chain we study, owners are free to set their own prices. However, they are obligated to sell the same list of menu items and to use the same ingredients and preparation methods for each item. Since the menu is chosen at the national level and ingredients are supplied by national distributors, these factors are unlikely to change in response to an increase in the minimum wage in a few states in any given month. Hence, one can be confident that item quality does not vary systematically with labor costs.

Our paper is related to Allegretto and Reich (2018), which to our knowledge is the only previous paper that has used web-scraped price data, Since they had to manually transcribe data from restaurant menus in PDF format, they were only able to collect data twice (once before and once after a minimum wage increase) and then average prices over all items at a given restaurant. We build on their methodology by collecting price data each week from April 1, 2019, to March 31, 2021, using web scraping software. This allows us to compare the price of each menu item in the months leading up to each of the three minimum wage increases with its price in the months afterwards.

This study is also related to several recent paper that have found that firms pass on a significant fraction of the costs associated with minimum wages to consumers (Aaronson 2001; Aaronson et al. 2008; Dube et al. 2007; Allegretto and Reich 2018; Leung 2021; Renkin et al. 2022; Ashenfelter and Jurajda 2022, Esposito et al. 2024, Kunaschk 2024, Link 2024). These studies typically examine the effects the minimum wage has on average prices at a firm or within a U.S. state. A drawback of this approach is that the selection of products that are available or the way in which they are produced is likely to change in response to increases in the minimum wage. We build on this methodology by studying the effect of a minimum wage increase on the full menu of prices offered by an establishment.

2. A simple model of menu adjustment

Dixit and Stiglitz (1977) consider the case of a representative consumer choosing between single goods that are differentiated in some way. Here, we extend their model to consider the case of firms selling multiple goods, using the version of Dixit and Stiglitz put forward by Neary (2004). Assume that there are S firms, all selling differentiated versions of the same N goods. In this paper, we are specifically interested in the case of restaurants offering multiple menu items. Each of these items corresponds to an equivalent item at a competitor and serves the same function from the consumer's perspective (a drink, dessert, main entrée, etc.) but will be distinguished from competitor's product by, for example, belonging to a different style of cuisine.

Next, assume that there is a representative consumer with a utility function that is additively separable and displays constant elasticity of substitution for each good:[3]

$$U_t = \sum_{i=1}^{N} \sum_{s=1}^{S} \left(q_{ist}^{\rho_i}\right)^{\frac{1}{\rho_i}},\ 0 < \rho_i < 1, \tag{1}$$

where *s* indicates the firm, *i* indicates the good, *t* indicates the time period and *q* denotes the amount of each good purchased from each firm. ρ_i is a measure of substitutability between the different versions of each good that are available and reflects the fact that the consumer likes a certain degree of variety. A lower value of ρ indicates a stronger preference for variety. The limiting case of ρ_i = 1 corresponds to a case of perfect substitutability across the versions of each good.

Producing one unit of any of the *N* goods involves some fixed capital cost, *r*, and a fixed amount of labor (measured in time), *h*. There may also be fixed costs of production, including the salaries of managers and building rental costs etc. Therefore, a firm's profit function can be written:

$$\pi_{st} = \sum_{i=1}^{N} (p_{ist}q_{ist} - w_{st}h_{ist}q_{ist} - r_{ist}q_{ist}) - f_{st}, \tag{2}$$

where *p* is the price of item *i* at firm *s* in period *t*, *h* is the amount of labor (in hours) required to produce a unit of item *i*, *w* is the unit cost of labor, *r* is the cost of capital required to produce item *i*, and *f* is the fixed costs incurred by firm *s* in period *t*.

Given this, the firm should set the price of each good in order to maximize profits. This requires that the following set of first order conditions be satisfied:

$$\frac{\partial \pi_{st}}{\partial p_{ist}} = q_{ist} + (p_{ist} - w_{st}h_{ist} - r_{ist})\frac{\partial q_{ist}}{\partial p_{ist}} = 0,\ \ \forall i = 1, \dots, n. \tag{3}$$

This gives the following expression for the price of each good:

$$p_{ist} = w_{st}h_{ist} + r_{ist} - q_{ist}/\frac{\partial q_{ist}}{\partial p_{ist}}. \tag{4}$$

[3] An equivalent way to think about would be to have firms competing over "meals," each of which is made up of a combination of menu items. This leads to the same outcome.

As in the one-good Dixit and Stiglitz model, the final term in equation 4 is equal to the price divided by the elasticity of substitution, except that this varies by good and is equal to $\frac{1}{1-\rho_i}$ (see the appendix for a proof). Therefore, this equation can be simplified as follows:

$$p_{ist} = \frac{w_{st}h_{ist}+r_{ist}}{\rho_i}. \quad (5)$$

Equation 5 shows that the price of each differentiated product should be set equal to its marginal cost, marked up by a fixed percentage. Given the presence of fixed costs, *f*, firms may or may not make a profit in the short run, but in the long run firms will enter or exit the market until profits are driven to zero.[4]

A given wage increase would be expected to have a larger effect on the prices of items which require a relatively high amount of labor to produce or for which consumers have a strong preference for variety. Specifically, a one unit increase in the wage should raise the price of an item by h/ρ units. Equation 5 implies that the relationship between the price and wage is linear, not log-log as has been used in the empirical specifications of most previous studies. A one unit increase in the wage should lead to the same unit increase in prices for all items that require the same amount of time to produce and for which preferences are the same, regardless of the starting wage or the amount of capital required to produce the item.

According to equation 5, the pass-through elasticity will equal $wh/(wh+r)$, which is simply the labor share of production costs. This will not be constant across products, meaning that the regression coefficient in a log-log specification will be equal to the average labor share in production across the items in the sample and implying that information on the labor intensity in production of different goods is crucial to understanding the effects of minimum wage increases on prices.

3. Data

We identified a set of 45 stores belonging to a single fast food chain within roughly 20 km of the New Jersey-Pennsylvania state border. Of these 45 stories, 21 were in New Jersey (NJ) and 24

[4] In our empirical analysis we use only 24 months of data, therefore it is reasonable to assume that the number of firms is fixed.

were in Pennsylvania (PA). The locations of these are shown in Figure 1. Price data for every menu item (around 120 items at any point in time) were available on the chain's website for each store. Since the prices listed exclude taxes, variation in sales taxes across locations is controlled for in our models.

Each Monday between April 1, 2019, and March 31, 2021, we scraped the prices of all the items that were sold from the chain's website.[5] This provides three months (or 13 weeks) of data before July 1, 2019, when New Jersey first raised its minimum wage, six months (or 27 weeks) of data between the July 2019 and January 2020 upratings, twelve months (or 52 weeks, with one missing week of data) of data between the January 2020 and January 2021 upratings, and three months (or 13 weeks) of data thereafter. We also collected information about the sub-menu(s) on which the item was listed: dessert, drink, main, side.

In addition, we gathered employee training manuals to harvest data on the number of steps required to prepare each item. Preparing a side item often requires the employee to simply gather one ingredient from a heating cabinet or a bin and therefore involves only one or two steps. However, main entrées typically involve more steps – anywhere from four to ten. For example, an entrée might require the employee to assemble four ingredients and then grill the item. In this case, we would code the item as involving five steps (four assembly steps and one cooking step). Data on the number of preparation steps was found for 98% of the items. We set the number of steps involved in preparing a combination deal equal to the sum of the steps involved in producing each item included in the deal.

Items on the drinks menu exhibited significant price fluctuations from week to week. On inspection, we discovered that this depended on whether we scraped the data during the "happy hour" period each week. Since our prices give an inconsistent measure of the price charged for these items, we chose to drop all drinks from our main analysis. This resulted in the sample size falling by 21%, from 463,423 to 365,798. However, as a robustness test we show that this decision makes little difference to our findings.

Table 1 presents means for the key variables in the analysis, separately for each state and for the four phases of the New Jersey minimum wage increase (April 1-June 30, 2019, July 1-December 31, 2019, January 1-December 31, 2020, January 1-March 31, 2021). Before July 1, 2019, the average prices in New Jersey and Pennsylvania were $4.15 and $4.11, respectively.

[5] Data for 20 July 2020 are missing due to fault with the scraper that week.

However, after January 1, 2021, the order had reversed and the average prices were \$5.43 and \$5.15, respectively. The prices of the items on the menu during the sample period vary widely, from \$0 (for a cup of water) to \$24.99 (for a combination deal involving 12 items).

4. Analysis

In our analysis, we compare the prices of identical items across stores belonging to the same chain. This allows us to simplify equation 5 in two ways. First, it is reasonable to assume that the amounts of both labor and capital required to produce each item are fixed over time and across stores, since that the national restaurant chain dictates the methods for preparing each menu item. Second, it is reasonable to assume that the price of capital is the same across all stores at any time, given that the chain generally uses national suppliers of the ingredients required for each item and the stores in our sample are geographically close together, meaning that delivery costs should be similar.

In addition, since the wage measure in the Dixit-Stiglitz model refers to the variable labor cost associated with producing each item and not the fixed costs, it is reasonable to assume that this is equal to the prevailing minimum wage in any location, $\bar{w}$, since checkout operators and cooks at fast food restaurants are widely paid the minimum wage.[6] This gives the following equation for the price of each item:

$$p_{ist} = \frac{\bar{w}_{st} h_i + r_{it}}{\rho_i}. \tag{6}$$

Event study estimates

To begin, we estimate an event study model to allow for the possibility of both anticipation of a minimum wage uprating and gradual adaptation after it. For this analysis, we restrict the sample to include only observations from between 12 weeks before a minimum wage increase to 12 weeks after. We then estimate the following specification separately for each uprating:

$$p_{ist} = \sum_{\tau=-12}^{12} \gamma_\tau I(\bar{w}_{s(t-\tau)} > \bar{w}_{s(t-\tau-1)}) + \mu_i + \theta_s + \lambda_t + \varepsilon_{ist}, -12 \leq \tau \leq 12, \tag{7}$$

[6] The Bureau of Labor Statistics' May 2023 Occupational Employment and Wage Estimates data show that the median wage for Fast Food and Counter Workers in New Jersey was \$14.66, while the minimum wage was \$14.13.

where $I(\cdot)$ is an indicator variable capturing weeks when the minimum wage rose in New Jersey and the γ terms capture the change in price in New Jersey relative to Pennsylvania in each of these weeks. Therefore, the γ coefficients should be zero before the uprating if there are no anticipation effects and the coefficients should be equal and positive after the uprating if there is immediate adjustment to the uprating. Equation 7 imposes a restriction that the effect of each minimum wage uprating is the same across all menu items. We examine the heterogeneity in the price response across items later.

The results of estimating equation 7 separately for the three minimum wage increases are presented in the first three columns of Table A1 and are depicted in Figure 2. These suggest that the first significant positive effects of the July 2019 increase appeared after six weeks. The adjustment to the January 2020 increase appeared to take even longer, with the price gap between the two states not widening significantly until 11 weeks after the minimum wage change. The January 2021 increase appeared to have no significant lasting effect on prices.

To assess the average effects of the three minimum wage increases, we combine the three event studies in the final column of Table A1 and estimate a single set of γ coefficients. The average effects reflect the same pattern as the initial minimum wage hike – a positive effect on prices appears six weeks after the minimum wage increase occurs. This result contrasts with Aaronson (2001), who found that most price adjustment occurs in the month before and month of a minimum wage increase.

Difference-in-difference estimates

Next, we take a difference-in-difference approach, simply including a dummy variable for whether an observation is from New Jersey and after one of the three minimum wage increases occurred. To begin, we again estimate the effect of each uprating using data for the 12 weeks before and after that uprating, as follows:

$$p_{ist} = \sum_{\tau=0}^{12} \gamma I(\overline{w}_{s(t-\tau)} > \overline{w}_{s(t-\tau-1)}) + \mu_i + \theta_s + \lambda_t + \varepsilon_{ist}, -12 \leq \tau \leq 12, \quad (8)$$

As seen in the first three columns of Table 2, the July 2019 uprating raised the average price by 4.8 cents and the January 2021 uprating by 5.5 cents but the January 2020 uprating had no significant effect on prices. When we pool data for the 12 weeks before and after the three upratings in the fourth column, we find a significant effect of the January 2020 uprating, suggesting that price adjustment to this may have occurred but took more than 12 weeks to manifest itself. In the final column of Table 2, we include data for the full April 2019-March 2021 period. The coefficients are little changed from the fourth column. Adding together the three coefficients implies that the three rounds of minimum wage increases collectively raised the price of an average item by 20.6 cents.

To test whether the common trends assumption is satisfied, we regress prices on a full set of interactions of week dummies with a dummy for the state the store was in, as well as fixed effects for store and item. As shown in Figure 2, before July 2019 (the 'pre-treatment' period) prices in New Jersey and Pennsylvania appear to follow the same trend and there is no significant difference in the price of a given product between the two states in any week. After July 1, 2019, a significant and persistent price difference emerges between the two states, as prices in New Jersey exceed the equivalent prices in Pennsylvania.

In order to account for the varying sizes of the three minimum wage upratings, our main analysis focuses on the following regression specification, in which the prevailing minimum wage, $\overline{w}_{st}$, enters:

$$p_{ist} = \beta \overline{w}_{st} + \mu_i + \theta_s + \lambda_t + \varepsilon_{ist}, \tag{9}$$

where μ, θ and λ represent item, store and week fixed effects, respectively. Standard errors are clustered at the store level, to reflect the fact that we are assuming that a store's location on either side of the border essentially assigns it randomly to either the treated or untreated state (Abadie et al. 2023).

As seen in the first column of Table 3 (and first column of Table A2), when equation 9 is estimated using the item-level data, the coefficient on the minimum wage is 0.070. At the means of prices and the minimum wage, this implies a pass-through elasticity of 0.128. This is slightly higher than the estimates for limited-service and chain restaurants reported by Allegretto and Reich (2018), which were 0.109 and 0.072, respectively, and the elasticity of 0.072 reported by Aaronson et al. (2001).

By including item fixed effects, our estimates control for both the non-labor cost and demand for each item. However, in the second column of Table A2, the item and week fixed effects are interacted, more closely matching equation 6, in which non-labor costs vary by item and time. This makes little difference to the minimum wage coefficient. If we exclude observations from weeks during which an item was sold at a heavily discounted price (defined as being more than 10% less than the previous week), the results are unaffected, as seen in the third column of the table.

A store is unable to reduce the quality of the items they sell, since they are supplied ingredients by the national organization. However, store owners have a limited degree of control over which items to sell, including whether they open for breakfast at all. In situations where demand for an item is especially elastic and profit margins are low, it may be optimal to stop selling the item entirely when costs increase. Hence, as well as adjusting prices, menu adjustment might take place at the extensive margin. One would expect more adjustment to prices among those items that were retained, as store owners attempted to keep their profit margins constant on these goods. To examine this possibility, we restricted our sample to items which were available throughout our period at a given store (that is, they were available on the first day and the last day in the sample). Among this group of products, the minimum wage coefficient was 0.078, as seen in third column of Table A2. As anticipated, this is higher than the coefficient using the full sample.

To further examine whether adjustment occurs in the composition of the menu, the prices of all items are averaged within each store each week. This resembles the structure of the firm-level dataset used by Allegretto and Reich. When the average price at a store each week is regressed on the minimum wage and a full set of store and week fixed effects (as reported in the last column of Table A2), a coefficient of 0.110 is found. The coefficient implies an elasticity of 0.201 compared to 0.128 using the item-level data. The fact that there was more price adjustment at the store level than at the item level is consistent with restaurant managers adjusting their menus by dropping cheaper (and presumably lower-margin) items in response to the minimum wage increases and/or adding more expensive items. Hence, there appears to be a combination of price adjustment and menu adjustment in response to the minimum wage. Among items that are not offered by all 45 stores in our sample on a given date, 62% are breakfast items and 18% are combo deals. This suggests that the principal way in which store owners adjust their menus is by discontinuing these items.

Allowing for heterogeneity in labor intensity and taste for variety

In this section, we relax equation 9 to examine how the minimum wage coefficient varies across items. Equation 6 implies that the coefficient on the minimum wage should vary from item to item according to the amount of labor required to produce the item and consumers' taste for variety in the item.

First, we consider an item's degree of labor intensity. We are unable to measure the exact amount of time required to produce each menu item. Instead, we assume that the amount of labor required to produce an item can be thought of as the number of steps required to produce that item, π, times the time required to produce each step, τ, so that $h_i = \tau\pi_i$ in equation 6.[7] We then augment equation 9 by interacting the minimum wage with the number of steps required to prepare an item, as follows:

$$p_{ist} = \alpha\overline{w}_{st} + \beta\pi_i\overline{w}_{st} + \mu_i + \theta_s + \lambda_t + \varepsilon_{ist}, \tag{10}$$

Comparing equations 6 and 10 shows that $\alpha = 0$ and $\beta = \tau/\rho_i$. The second column of Table 3 shows that, as expected, the estimated value of α is insignificant and the estimated value of β is positive. Going from the 10th percentile to the 90th percentile of number of preparation steps (3 and 19 steps, respectively) raises the minimum wage coefficient from 0.031 to 0.085. In the limiting case of ρ_i = 1, that is, when items are perfect substitutes for each other across restaurants, the coefficient on β in the second column of Table 3 would imply a value of τ of 12.4 seconds, which is a plausible completion time for a single preparation step.

Next, we examine whether the pass-through coefficient varies according to consumers' taste for variety. This might vary because distinct groups of consumers tend to purchase different items or because the items themselves vary in terms of their importance to the customer's overall experience. In terms of customer factors, there tends to be less distinctiveness in the breakfast menus offered across U.S. fast food chains, compared to the menus they offer later in the day, suggesting that the elasticity of substitution may be higher among items that are only available at breakfast. Further, consumers who choose from the value menu, which comprises items that are marketed on the basis of their price, may be relatively more likely to substitute between restaurant

[7] Of course, each preparation step may take a different length of time to perform, but there is no clear pattern in the dataset between time per step and the number of steps required for an item.

chains. Finally, we examined whether combo deals have a different pass-through coefficient. Combo deals consist of a number of other items on the menu and therefore are effectively bulk discounts. Customers who buy more than one of the same item presumably prioritize variety less than other customers.

To examine variation in the minimum wage coefficient across items because of these factors, in the third column of Table 3 we add interactions of the minimum wage with dummies for whether an item is only available at breakfast-time, whether an item is listed on the value menu, and whether an item is a combo deal. The coefficient on the combo deal interaction term is significant and negative, indicating that the prices of combo deals are relatively less sensitive to changes in the minimum wage than other items. The coefficients on the other interaction terms are insignificant. The addition of these interactions has little effect on the relationship between wages and number of steps, which remains positive and significant.

To examine whether consumers demand more variety in the more important components of a meal, we interact the minimum wage with dummies for which sub-menu an item appears on – dessert, mains or sides. One might expect to see a larger effect of the minimum wage on the price of main items. However, as seen in the fourth column of Table 3, there are no significant differences in the minimum wage coefficient across sub-menus. Once again, this makes relatively little difference to the coefficient on the wage-number of steps interaction.

Pass-through coefficients versus pass-through elasticities

The theory presented in Section 2 implies that there should be a linear relationship between price and minimum wage. However, as noted earlier, most previous studies have used a log-log specification, in which the estimated coefficient will be equal to the labor share of production costs. In a linear specification, the only reason why the coefficient on the minimum wage should vary across items is because differing amounts of labor are required to produce the items. In a log-log specification, the coefficient on log minimum wage might vary due to differences in the amount of labor required, the amount and cost of capital required, or the level of the minimum wage. This does not matter when the analyst is examining the relationship between prices and the minimum wage across the entire labor market, but it does matter when considering how pass-through varies from good to good.

In our setting, the minimum wage does not vary by item, but the amount of capital does. Since the amounts of labor and capital are likely to be positively correlated across items, a log-log specification is likely to mask the heterogeneity in the price response to minimum wage increases across products. For example, an item that requires 2 minutes to produce should go up in price by twice as much as an item that requires 1 minute to produce when the minimum wage changes. But if the first item also involves more capital to produce, the percentage change in price might be similar for the two items.

Our item-level data allow us to test this theoretical prediction. To do so, we calculated separate pass-through coefficients for each item by interacting the minimum wage with item dummies in equation 9. In panel A of Figure A1 we depict these against the number of preparation steps for each item. A line of best fit is included and has a slope of 0.003 – very similar to the relationship found in Table 3.

Next, we repeated this exercise using log price and log minimum wage instead of price and minimum wage. The coefficient on log minimum wage should give an estimate of the pass-through elasticity for each item. As seen in panel B, the predicted elasticity does not vary significantly by number of steps and is around 0.14 in all cases. This is consistent with a situation in which labor accounts for a similar share of production costs across items. The linear model fits the data better than the log-log model, with an R-squared of 0.9935, for the former compared to 0.9902 for the latter.

Robustness tests

To test whether the results are affected by the presence of stores in New Jersey located very close to the state border, which are forced to compete with lower-cost stores across the border, the regressions are run separately for firms located less than 7 km from the border and firms located more than 7 km from the border. As seen in the first two columns of Table A3, the minimum wage coefficient is 0.095 for stores within 7 km of the border and 0.035 for firms further away from the border. When we interact the minimum wage with distance from the border (in kilometers), the interaction term is negative but insignificant, as reported in the third column of the table.

The finding that there is a significant effect of the minimum wage on prices even among restaurants very close to the border accords with the conclusion reached by Allegretto and Reich in their study of restaurants on either side of the San Jose City border that restaurant demand is spatially inelastic. To examine this further, we regressed price on distance to the border interacted with both state dummies and dummies for the four minimum wage periods (April-June 2019, July-December 2019, January-December 2020, January-March 2021), plus item dummies. In Figure A2, we plot the predicted change in price after each minimum wage uprating from this regression, by distance from the border. Between April-June 2019 and July-December 2019, the average price increased by more the further to the east a restaurant was located, that is, by most among those restaurants in New Jersey and relatively far from the state border. However, there is a clear discontinuity in price change at the state border, with larger price increases on the New Jersey side. Between July-December 2019 and January-December 2020, and again between January-December 2020 and January-March 2021, the spatial pattern of price increases reversed, with larger increases in the west. Despite this, there were again discontinuities at the border in both cases.

In our main analysis we chose to drop drinks, as these were subject to significant price fluctuations from week to week depending on whether we scraped the data during the "happy hour" period or not. Despite this, adding the drink observations to the sample makes little difference to the minimum wage coefficient, as seen in the fourth column of Table A3.

The prices of some items are lowered in certain weeks as part of promotional deals. Since these deals are often part of nationwide campaigns and are designed to attract new customers, they might not reflect the prices stores would choose if they were maximizing profits. To examine how important these deals are, we excluded observations where an item had been reduced in price by more than 10% from the previous week. As seen in the final column of Table A3, the minimum wage coefficient is found to be slightly larger in this case.

5. Conclusion

In this study, we examine the effects that recent changes in the minimum wage in New Jersey had on the prices of individual menu items at a large fast food chain. In early 2019, New Jersey passed legislation raising the minimum wage to $15 over the following 5 years. The first phase of this took effect on July 1, 2019, when the minimum wage increased from $8.85 to $10, the second phase raised it to $11 on January 1, 2020, and the third phase raised it to $12 on January 1, 2021. The minimum wage was unchanged during this period in neighboring Pennsylvania, therefore this state provides an appropriate control group. Using a difference-in-difference specification, we find that these three rounds of minimum wage increases collectively raised the price of an item by 20.6 cents on average or that every $1 increase in the minimum wage raises prices by 7.0 cents. Theory suggests that prices should rise the most on items that are highly labor intensive and for which consumers have a greater taste for variety. Consistent with this, we find substantially larger pass-through coefficients on items that require more steps by employees to prepare. For every additional preparation step, a $1 minimum wage increase raises the price of an item by an additional 0.3 cents. Similarly, the pass-through coefficient is lower on items that are combo deals and whose consumers are more motivated by quantity than variety.

These findings suggest that managers behave rationally when responding to increases in costs brought about by the minimum wage and take into account the specific characteristics of each product they sell when adjusting prices, rather than simply raising prices evenly across the board. The fact that prices may be adjusted by different amounts according to the degree of labor intensity is consistent with monopolistic competition, but not perfect competition and suggests that the minimum wage might be most effective at raising wages without concomitant job loss in other industries where consumers value variation in the products they are offered.

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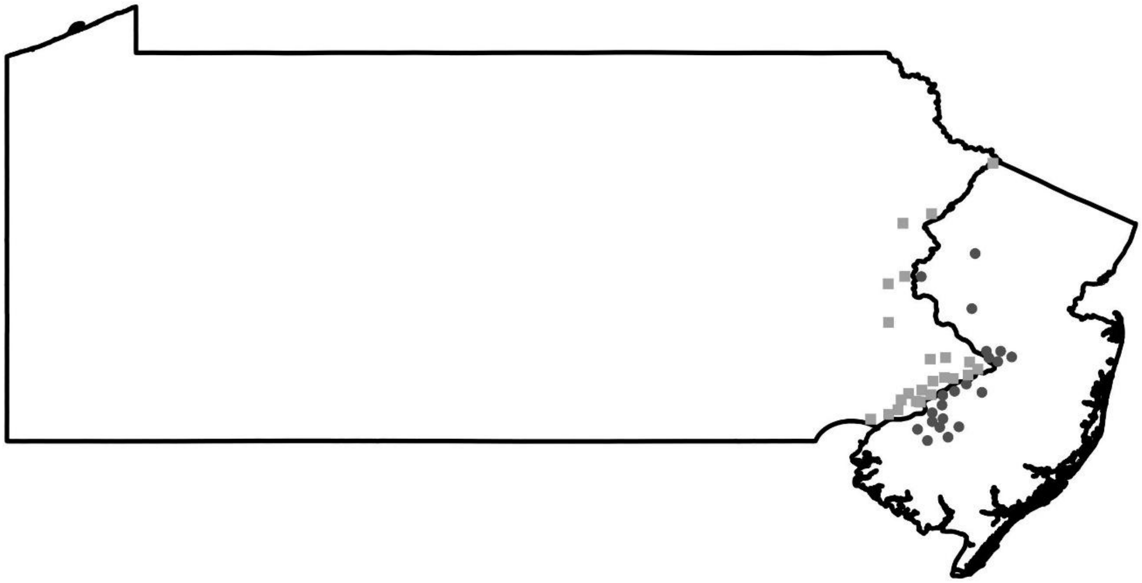
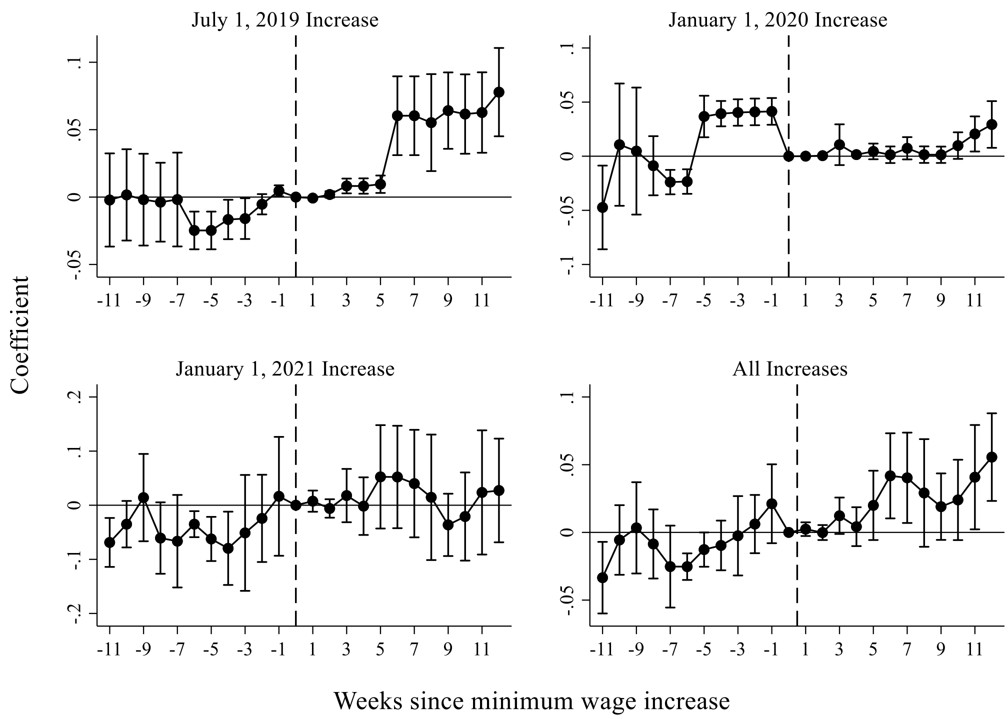
Figure 1. Location of stores in New Jersey and Pennsylvania



Notes: Circle markers denote New Jersey (treatment; right) stores; square markers denote Pennsylvania (control; left) stores.

Figure 2. Estimates from the event study model



Notes: The markers plot the coefficient estimates from estimating equation (7) for each minimum wage increase individually as well as estimating the combined effect of all three increases. All specifications include item, store and week fixed effects. Standard errors are clustered by store. The bars represent 95% confidence intervals around the coefficients.

Table 1. Means for the full regression sample

Period	April-June 2019		July- December 2019		January-December 2020		January 2021-March 2021	
Variable	NJ	PA	NJ	PA	NJ	PA	NJ	PA
Item price ($)	4.109	4.153	4.535	4.513	5.060	4.919	5.434	5.145
Dessert	0.0795	0.0800	0.0719	0.0721	0.0762	0.0739	0.0855	0.0813
Main	0.765	0.761	0.767	0.763	0.750	0.753	0.717	0.728
Side	0.123	0.124	0.121	0.122	0.121	0.118	0.117	0.112
Multiple item	0.274	0.274	0.293	0.296	0.310	0.311	0.356	0.352
Breakfast time only	0.231	0.219	0.220	0.213	0.178	0.180	0.190	0.213
Value menu	0.0599	0.0600	0.0407	0.0419	0.0475	0.0463	0.0595	0.0589
Within 7 km of border	0.429	0.619	0.429	0.621	0.420	0.624	0.406	0.626
Number of preparation steps	9.903	9.947	11.02	11.08	12.20	12.18	12.86	12.62
Number of observations	25,613	28,927	50,544	57,328	77,085	88,710	17,186	20,405

Notes: This table displays means for item prices in dollars, the share of items on each menu, share of stores near the state border, and the number of preparation steps per item. The sample is the full sample of all items from April 1, 2019 – March 31, 2021 used in Table 2 column 5.

Table 2. Results of difference-in-difference price regressions

Variable	(1) July 2019 Uprating	(2) January 2020 Uprating	(3) January 2021 Uprating	(4) Upratings Combined	(5) Full Sample
New Jersey × post-July 2019	0.048***			0.076***	0.077***
	(0.008)			(0.009)	(0.010)
New Jersey × post-January 2020		0.007		0.052***	0.075***
		(0.006)		(0.015)	(0.019)
New Jersey × post-January 2021			0.055*	0.078**	0.057*
			(0.030)	(0.035)	(0.033)
R-squared	0.994	0.993	0.992	0.993	0.993
Number of observations	102,618	89,409	67,525	259,552	365,798

Notes: The columns report the results of estimating equation (8) in the main text separately for each minimum wage increase as well as for all increases combined. Columns 1, 2, and 3 present results using the 12 weeks before and after the July 2019, January 2020, and January 2021 increases, Column 4 presents results from a regression pooling the samples from columns 1-3. Column 5 presents results from a regression on the full sample of weeks from April 1, 2019 - March 29, 2021. All specifications include item, store and week fixed effects. Standard errors are clustered by store and are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Table 3. Results of price regressions using continuous minimum wage changes and allowing for heterogeneity

Variable	(1)	(2)	(3)	(4)
Minimum wage	0.070***	0.020	0.026	0.016
	(0.013)	(0.019)	(0.022)	(0.021)
Minimum wage × number of steps		0.003***	0.004***	0.004***
		(0.001)	(0.001)	(0.001)
Minimum wage × breakfast time only			0.001	
			(0.008)	
Minimum wage × value menu			-0.016	
			(0.015)	
Minimum wage × combo			-0.035***	
			(0.010)	
Minimum wage × dessert				0.011
				(0.007)
Minimum wage × sides				0.014
				(0.010)
R-squared	0.994	0.994	0.994	0.994
Number of observations	365,798	365,798	365,798	365,798

Notes: The columns report the results of estimating equation (9) or (10) in the main text. Column 1 presents results from our main specification. Column 2 reports results from estimating equation (10) which adds an interaction between the minimum wage and number of preparation steps. Column 3 adds interactions between the minimum wage and whether an item appears on the breakfast, value and combo menus. Column 4 adds interactions between the minimum wage and whether an item appears on the dessert or side menus. All specifications include item, store and week fixed effects. Standard errors are clustered by store and are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Appendix

The representative consumer wishes to maximize utility, as given in equation 1, subject to the budget constraint $\sum_{i=1}^{N}\sum_{s=1}^{S} p_{ist}q_{ist} = I$. Solving the resulting Lagrangian gives the following demand function for each good:

$$q_{ist} = (\frac{\lambda p_{ist}}{\rho_i})^{\frac{1}{\rho_i - 1}}, \tag{11}$$

where λ is the Lagrange multiplier. Taking the ratio of the amounts demanded of any two varieties, *r* and *s*, of a given good *i* yields:

$$\frac{q_{irt}}{q_{ist}} = (\frac{p_{irt}}{p_{ist}})^{\frac{1}{\rho_i - 1}}. \tag{12}$$

Rearranging gives:

$$p_{irt}q_{irt} = q_{ist}p_{ist}^{\frac{-1}{\rho_i - 1}}p_{ist}^{\frac{\rho_i}{\rho_i - 1}}. \tag{13}$$

Summing over all values of *r* and defining $\sigma_i \equiv \frac{1}{1-\rho_i}$ gives the following expression:

$$\sum_{r=1}^{S} p_{irt}q_{irt} = q_{ist}p_{ist}^{\sigma_i}\sum_{r=1}^{S} p_{irt}^{1-\sigma_i}. \tag{14}$$

The left-hand side is the share of the consumer's income that is spent on good *i*. Define this as B_i. Also define a price index for each good equal to $P_i \equiv (\sum_{s=1}^{S} p_{ist}^{1-\sigma_i})^{\frac{1}{1-\sigma_i}}$. Then:

$$q_{ist} = p_{ist}^{\sigma_i}P_i^{\sigma_i - 1}B_i. \tag{15}$$

As in Neary (2004), as long as there are a large number of firms and goods, a small change in the price of any good at any one firm will not affect the price index for that good, *P*. In the same way, the price change will not affect the budget share. Therefore:

$$\frac{\partial q_{ist}}{\partial p_{ist}} = -\sigma_i p_{ist}^{\sigma_i - 1} P_i^{\sigma_i - 1} B_i. \qquad (16)$$

Combining equations 15 and 16 gives:

$$q_{ist} / \frac{\partial q_{ist}}{\partial p_{ist}} = -\frac{p_{ist}}{\sigma_i}. \qquad (17)$$

Table A1. Results of event study price regressions

	(1)	(2)	(3)	(4)
Variable	July 2019 Uprating	January 2020 Uprating	January 2021 Uprating	Upratings Combined
New Jersey × 11 weeks before	-0.000	-0.137***	-0.070***	-0.063***
	(0.018)	(0.030)	(0.025)	(0.017)
New Jersey × 10 weeks before	0.000	0.003	-0.041	-0.007
	(0.017)	(0.029)	(0.031)	(0.015)
New Jersey × 9 weeks before	-0.001	0.003	0.020	0.005
	(0.018)	(0.031)	(0.064)	(0.022)
New Jersey × 8 weeks before	-0.004	-0.009	-0.061*	-0.009
	(0.015)	(0.014)	(0.035)	(0.013)
New Jersey × 7 weeks before	-0.002	-0.024***	-0.056	-0.023
	(0.018)	(0.006)	(0.056)	(0.020)
New Jersey × 6 weeks before	-0.025***	-0.023***	-0.041**	-0.028***
	(0.007)	(0.006)	(0.017)	(0.006)
New Jersey × 5 weeks before	-0.025***	0.045***	-0.083**	-0.015
	(0.007)	(0.016)	(0.035)	(0.010)
New Jersey × 4 weeks before	-0.017**	0.040***	-0.103**	-0.016
	(0.007)	(0.006)	(0.045)	(0.012)
New Jersey × 3 weeks before	-0.016**	0.040***	-0.023	0.006
	(0.008)	(0.006)	(0.071)	(0.021)
New Jersey × 2 weeks before	-0.008	0.041***	-0.013	0.006
	(0.006)	(0.006)	(0.043)	(0.012)
New Jersey × 1 weeks before	0.005**	0.041***	0.033	0.026
	(0.002)	(0.006)	(0.076)	(0.021)
New Jersey × 1 weeks after	-0.001	0.000	0.011	0.003
	(0.001)	(0.000)	(0.016)	(0.004)
New Jersey × 2 weeks after	0.002	0.001	-0.032	-0.007
	(0.001)	(0.001)	(0.028)	(0.007)
New Jersey × 3 weeks after	0.008***	0.014	0.032	0.016
	(0.003)	(0.012)	(0.040)	(0.012)
New Jersey × 4 weeks after	0.008***	0.002**	-0.001	0.004
	(0.003)	(0.001)	(0.031)	(0.009)
New Jersey × 5 weeks after	0.010***	0.004	0.086	0.028*
	(0.003)	(0.004)	(0.055)	(0.016)
New Jersey × 6 weeks after	0.060***	0.001	0.079	0.046***
	(0.015)	(0.004)	(0.049)	(0.016)
New Jersey × 7 weeks after	0.060***	0.010	0.052	0.043**
	(0.015)	(0.008)	(0.055)	(0.019)
New Jersey × 8 weeks after	0.049**	0.001	0.008	0.024
	(0.023)	(0.004)	(0.060)	(0.021)
New Jersey × 9 weeks after	0.062***	0.002	-0.039	0.017
	(0.015)	(0.004)	(0.029)	(0.012)
New Jersey × 10 weeks after	0.062***	0.012	-0.010	0.028
	(0.015)	(0.007)	(0.049)	(0.018)
New Jersey × 11 weeks after	0.063***	0.021**	0.007	0.037
	(0.015)	(0.008)	(0.067)	(0.022)
New Jersey × 12 weeks after	0.078***	0.039**	0.034	0.060***
	(0.017)	(0.016)	(0.050)	(0.017)
R-squared	0.994	0.993	0.992	0.993
Number of observations	102,618	89,409	67,525	259,552

Notes: The columns report the results of estimating equation (7). All specifications include item, store and week fixed effects. Standard errors are clustered by store and are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Table A2. Additional price regressions

Variable	(1) Main results	(2) Flexible fixed effects	(3) Items sold throughout	(4) Store-level
Minimum wage	0.070***	0.065***	0.078***	0.110***
	(0.013)	(0.015)	(0.017)	(0.030)
Store fixed effects	Yes	No	Yes	Yes
Item fixed effects	Yes	No	Yes	No
Week fixed effects	Yes	No	Yes	Yes
Item × week fixed effects	No	Yes	No	No
Item × store fixed effects	No	Yes	No	No
R-squared	0.993	0.998	0.994	0.863
Number of observations	365,798	365,798	194,455	4,680

Notes: The columns report the results of estimating equation (9) in the main text. Column 1 presents results from our main specification. Column 2 adds both item-week and item-store fixed effects. Column 3 restricts the sample to items sold in all weeks from April 1, 2019 - March 29, 2021. Column 4 presents results from regressions estimated using store-level data. Standard errors are clustered by store and are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

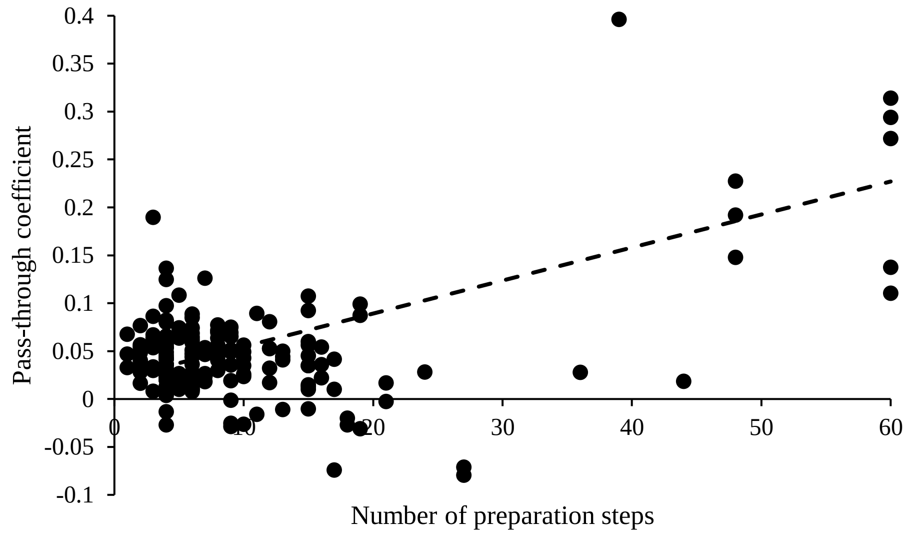
Table A3. Robustness tests

	(1)	(2)	(3)	(4)	(5)
Variable	Less than 7 km	More than 7 km	Distance control	Including Drinks	No specials
Minimum wage	0.095***	0.035***	0.083***	0.063***	0.066***
	(0.018)	(0.009)	(0.013)	(0.013)	(0.012)
Minimum wage × distance to border (km)			-0.002		
			(0.001)		
R-squared	0.992	0.995	0.993	0.992	0.993
Number of observations	193,678	172,120	365,798	463,423	362,317

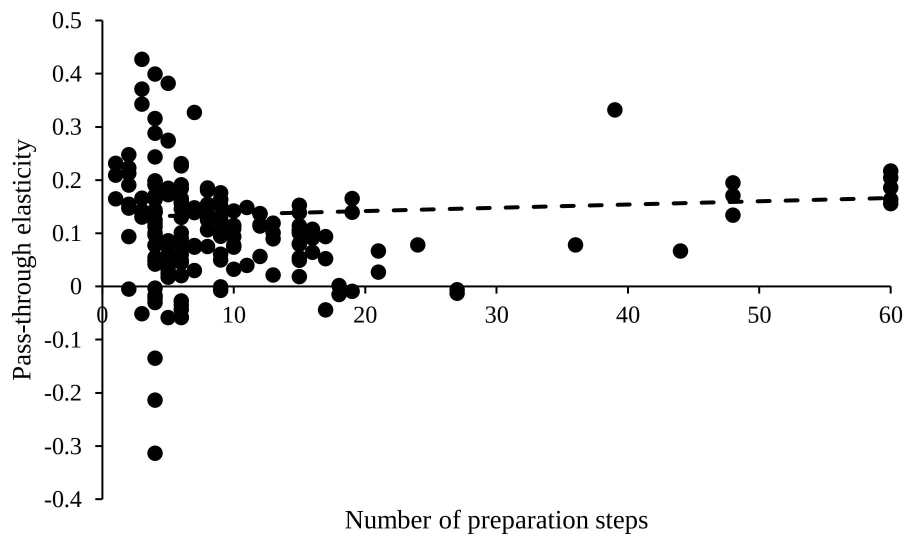
Notes: The columns report the results of estimating equation (9) in the main text. Column 1 presents results for stores within 7 km of the state border. Column 2 includes stores more than 7 km from the state border. Column 3 includes an interaction between the minimum wage and the distance from the state border. Column 4 includes drinks in the sample. Column 5 drops special promotions from the sample, defined as a price decrease of more than 10 percent relative to the prior week. . Standard errors are clustered by store and are presented in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Figure A1. Heterogeneity in pass-through by number of preparation steps

Panel A. Item pass-through coefficient and number of steps



Panel B. Item pass-through elasticity and number of steps



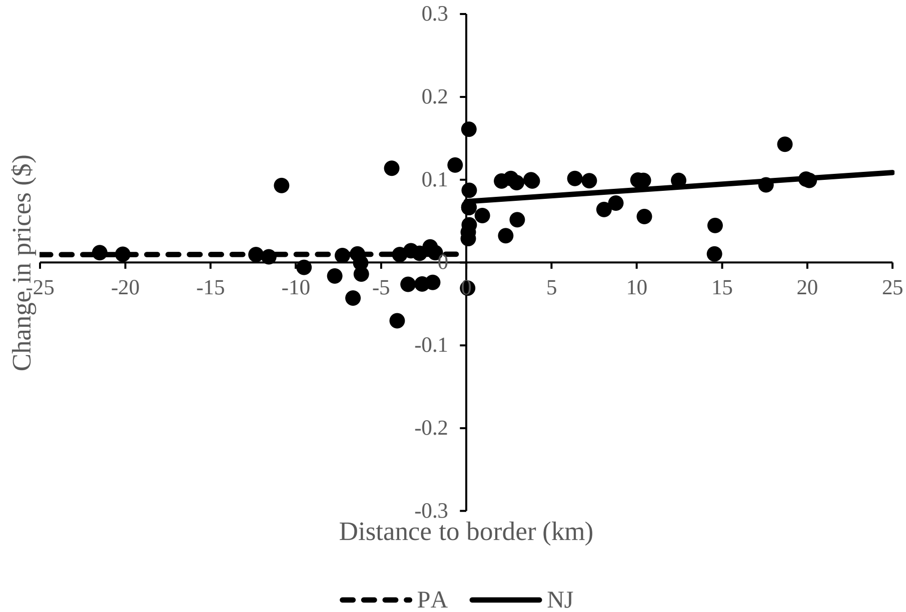
Notes: The markers depict the predicted coefficients from a linear regression (in panel (a)) or log-log regression (in panel (b)) where the (log) minimum wage is interacted with item dummies, plotted against number of preparation steps.

The dashed line depicts the predicted coefficients from a linear regression (in panel (a)) or log-log regression (in panel (b)) where the (log) minimum wage is interacted with number of steps.

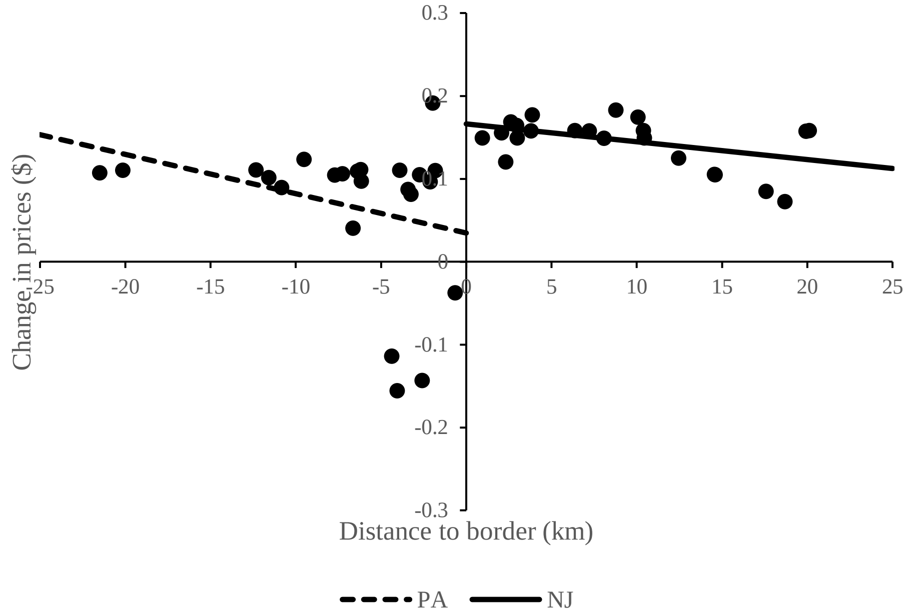
All regressions also include item, store and week fixed effects.

Figure A2. Predicted price change by distance to border

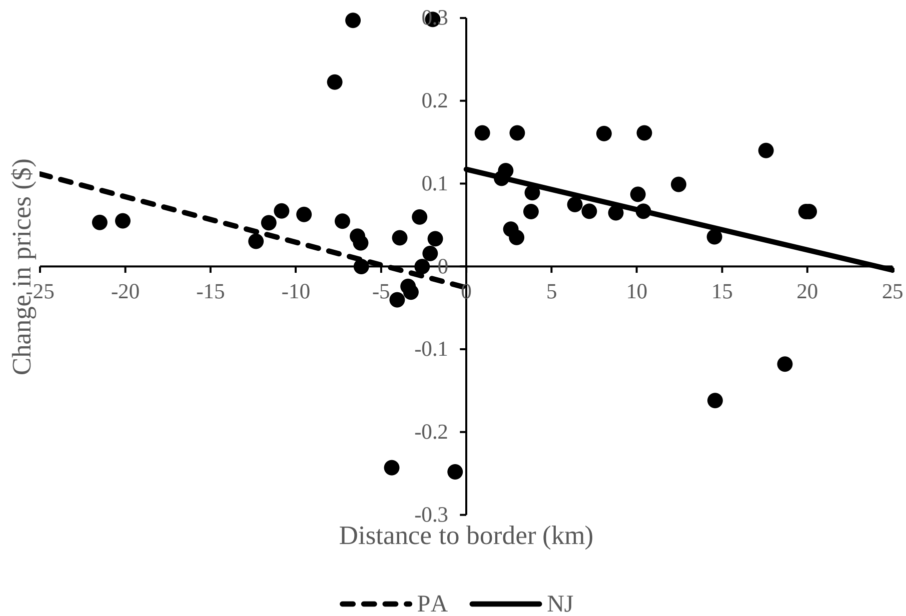
Panel A. Change in prices between April-June 2019 and July-December 2019



Panel B. Change in prices between July-December 2019 and January-December 2020

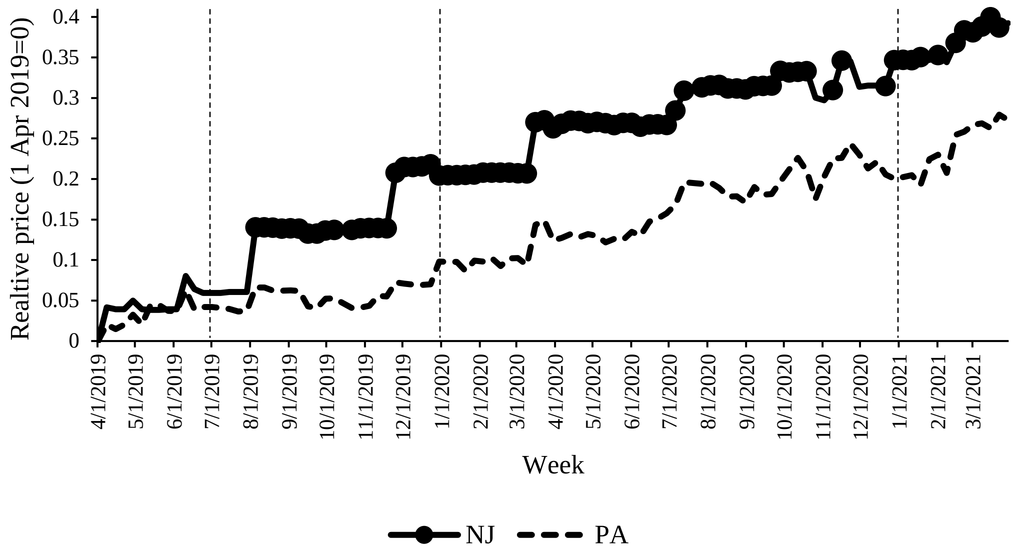


Panel C. Change in prices between January-December 2020 and January-March 2021



Notes: Negative distances refer to the Pennsylvania side of the border.
The markers indicate the predicted change in price between the indicated time periods at each store from a regression that also includes item fixed effects.
The lines indicate the predicted change in price from before to after July 2019 by distance from the border, separately for each state, from a regression that also includes item fixed effects.

Figure A3. Weekly price growth in New Jersey and Pennsylvania



Notes: The series plot the estimated price by week in each state from a regression that also included state, item and store fixed effects. The circle markers indicate a significant difference between the two states at the 1% level. The vertical dashed lines indicates the dates when the New Jersey minimum wage was raised.