The Pass-through of Minimum Wages into US Retail Prices: Evidence from Supermarket Scanner Data[a]

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Abstract

We study the impact of increases in local minimum wages on the dynamics of prices in local grocery stores in the US during the 2001–2012 period. We find a significant impact of increasing minimum wages on prices in grocery stores. Our baseline estimate of the minimum wage elasticity of grocery prices is 0.02. This magnitude is consistent with a full pass-through of cost increases into prices. We show that price adjustments occur mostly in the months following the passage of minimum wage legislation rather than at the actual implementation of higher minimum wages. This forward-looking pattern of price adjustments is qualitatively consistent with pricing models that feature nominal rigidities. We find no differential price effect for products consumed by poorer and richer households, and no evidence for demand effects. Our results suggest that consumers rather than firms bear the cost of minimum wage increases. Moreover, poor households are most negatively affected by the price response. Price increases in grocery stores alone offset at least 10% of the nominal income gains of the poorest households.

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1 Introduction

Minimum wage increases are very popular among voters in the US and many other countries. For example, in an opinion poll conducted in 2016 in the US (YouGov/HuffPost, 2016), 78% of the respondents were in favor of increasing the federal minimum wage. Perhaps as a result, minimum wage increases at the federal, state and local level have been ubiquitous in the last decade in the US. Several European countries have recently implemented or scheduled important minimum wages hikes as well, for example Germany and the United Kingdom in 2015.

One goal of minimum wage policy is to raise the incomes of low-wage workers. A long line of research in labor economics suggests that moderate increases in the minimum wage have no or limited disemployment effects. Increases in nominal wages are thus unlikely to be offset by reductions in hours or employment, and low-wage workers should see their nominal incomes increase. However, we typically care about real rather than nominal incomes. To assess the impact of minimum wages on real incomes, it is central to understand the pass-through of minimum wage increases into prices. In this paper, we study the impact of minimum wage increases on prices in one key sector, grocery stores. Grocery stores employ a substantial number of minimum wage workers, and their marginal costs are therefore likely affected by minimum wage hikes. Moreover, groceries make up a large share of consumer expenditure—especially in poor households—and grocery prices thus substantially affect the real incomes of workers.

Minimum wage laws in the US typically institute a schedule of increases rather than one-off hikes. After the corresponding legislation is passed, the minimum wage increases in steps over several years to the final value set in the law. Especially the later steps are known long in advance, and firms may increase prices in anticipation of higher future minimum wages. To take this possibility into account, we estimate the minimum wage elasticity of grocery prices at the time future increases become known and when they are implemented. We collect legislation dates for every increase, and show that these dates capture a salient event at which people get information about future minimum wage hikes. We combine this data with monthly store-level price indices for about 2000 grocery stores during the 2001–2012 period, which we construct from grocery store scanner data. We find robust significant effects on grocery prices at the time of legislation, but not at the time of implementation of minimum wage increases. Our baseline estimate of the overall minimum wage elasticity of prices in grocery stores is about 0.02. The average minimum wage legislation increases binding minimum wages by about 20% over several years. Our estimates suggest that such an increase raises grocery prices by 0.4% over three months around the time legislation is passed, long before the final level of the new minimum wage is implemented. During these three months, price inflation in grocery stores almost doubles relative to its average rate.

In a second step, we estimate the minimum wage elasticity of grocery store cost using county-sector level data from the Quarterly Census of Employment and Wages and sector-level data on grocery stores' labor cost share. We find that the minimum wage elasticity of costs is about the same size as the minimum wage elasticity of prices. Our results thus suggest a full pass-through of all future cost increases at the time minimum wage legislation is passed. This forward-looking behavior is qualitatively consistent with the predictions of pricing models with nominal rigidities.

Finally, we calculate the welfare cost of grocery stores' price response based on consumption data from the Consumer Expenditure Survey. We show that low-income households are disproportionately affected, since they spend a larger share of their expenditures at grocery stores. In particular, the price response of grocery stores alone undoes at least 10% of the nominal income gains of the poorest households. For other income brackets, this number ranges between 3% and 13%. Overall, the price response reduces the nominal gains for all households, but also makes minimum wage increases less redistributive in real than in nominal terms.

A large literature has studied the labor market impact of minimum wages following the Card and Krueger (1994) study of employment effects in fast-food restaurants. Our paper contributes to a much smaller literature studying the product market effects of minimum wage increases. Card and Krueger (1994) already provide some suggestive results on the price response in restaurants. Subsequently, Aaronson (2001), Aaronson and French (2007), Aaronson et al. (2008) and Allegretto and Reich (2017) have studied the price effects of minimum wages in restaurants in more detail. Outside of the US, Fougère et al. (2010) analyze the response of restaurant prices to an increase in the French minimum wage. Depending on the time period and type of restaurant, these papers find positive elasticities of prices between 0.04 and 0.1. Beyond restaurants, the product market impact of minimum wages has received little attention. Draca et al. (2011) study the effects of minimum wages on firm profits in the UK. They find that minimum wages reduce profits in industries in which firms have high market power and do not significantly affect profits in sectors with lower market power. The latter includes most retail firms. Harasztosi and Lindner (2015) study the firm response to a large minimum wage increase in Hungary. They find that exposure to the minimum wage increase goes along with a strong increase in cost and revenues, suggesting a large degree of pass-through into prices. They also study the price response using producer price data for manufacturing firms and find evidence for large price effects there.

Grocery stores are a particularly interesting sector to study in this context for several reasons. First, the expenditure share of groceries is much larger than the share of other low-wage sectors such as restaurants, especially for poorer households. As a result, the price effects at grocery stores are important for real incomes. Furthermore, the existing studies of prices in US restaurants rely on survey data that is potentially subject to measurement error (Allegretto and Reich, 2017; Card and Krueger, 1994; Aaronson, 2001), or small samples of city-level CPI data that is limited to the largest US metro areas (Aaronson, 2001; Aaronson and French, 2007; Aaronson et al., 2008). The availability of excellent price data for grocery stores allows us to obtain more precise results for a more varied geographical area, and to study the dynamics of adjustment in more detail than previously possible. Finally, even beyond classical measurement error in surveys, price changes in restaurants are not straightforward to measure. The prevalence of tipping complicates measurement of both wages and prices. Moreover, there is a lot of potential for unobserved quality adjustments. Both concerns do not apply to retail scanner data, as products in grocery stores are very standardized and retail workers are not tipped.

Two closely related contemporary papers also study the relationship between minimum wages and grocery store prices. Ganapati and Weaver (2017) and Leung (2016) use an alternative dataset that covers more grocery stores, but a shorter time period. Despite the fact that the two papers use the same data set and focus on a similar time period, they reach different conclusions. Ganapati and Weaver (2017) find no effect of minimum wages on prices, while Leung (2016) finds much larger significant elasticities of about 0.06. The empirical approach of both papers differs substantially from ours. Most importantly, both papers study the effect at the time of implementation of higher minimum wages, while we find effects at the time minimum wage legislation is passed. Consistent with Ganapati and Weaver (2017), we find no robust effects at the time of implementation of higher minimum wages. We estimate larger effects at implementation that are broadly consistent with the results in Leung (2016) in some specifications, but these results are not robust to the inclusion of more restrictive controls. Moreover, the estimates at the time of implementation are very drawn out, and difficult to distinguish from other factors such as changing inflation trends. In contrast, our main estimates of price effects at the time of legislation are robust to different specifications and identification strategies. We explain the differences between our work and both contemporary contributions in more detail in Appendix A.8.

The results presented in this paper contribute to the literature in three ways. First, we establish full pass-through of minimum wage induced cost increases in a key industry. Our results imply, that at least in the case of grocery stores, consumers fully bear the cost of minimum wage increases. We show that this reduces the gains from minimum wage increases especially for poor households, who are the intended beneficiaries of the policy.

Going beyond grocery stores, MaCurdy (2015) provides calculations of the impact of minimum wage increases on real incomes using Input-Output tables under the assumption of full pass-through in all sectors. Our work provides support for this assumption. His calculations suggest that these economy-wide price effects would affect households in the poorest quintile the most. Since these households also benefit the most from increasing nominal incomes, minimum wage hikes are still a redistributive policy. However, price effects limit their effectiveness as a redistributive tool, and should be taken into account when discussing the desirability of minimum wage policies.

Second, our results also contribute to the more general question of how cost shocks are passed on into retail prices. So far, the literature has studied the pass-through of changes in the costs of wholesale purchases. For instance, Eichenbaum et al. (2011) study the pass-through of wholesale cost into prices, and find that pass-through is complete but somewhat delayed. Nakamura and Zerom (2010) use variation in the market price of commodity coffee and find that the pass-through into wholesale prices is about one third, but that the increase of wholesale prices is completely passed through to consumers by retail stores. In contrast, the pass-through of labor cost into retail prices has not been studied in detail, and our paper provides estimates of the causal effect of increasing labor cost on price inflation.

Third, our paper is the first to use firm level microdata to document a price response to a future cost shock at the time it becomes known, and long before it actually occurs. Forward-looking price setting is a central prediction of models with nominal frictions. Such models include the well-known Calvo (1983) model of staggered price setting, or models with adjustment cost such as Rotemberg (1982) and more modern menu cost models studied in Nakamura and Steinsson (2008) or Midrigan (2011). In the macroeconomics literature, these models have been used as a microeconomic foundation for the New Keynesian Phillips Curve (NKPC). A central feature of the NKPC is that current inflation is driven by expectations of future marginal cost. This idea has had a great influence on the way macroeconomic policy is conducted, yet the large empirical literature estimating the NKPC from aggregate data does not provide conclusive evidence on the extent to which price setting is actually forward-looking. In a recent review article, Mavroeidis et al. (2014) conclude that "the literature has reached a limit on how much can be learned about the NKPC from aggregate macroeconomic time series". Our paper uses detailed microdata to show that firms do set prices in a forward-looking manner and respond to a clearly identified future cost shock.

The remainder of this paper is organized as follows. The next section presents the institutional context and stylized facts relevant for minimum wages and grocery stores in the US. Section 3 discusses the data we use. Section 4 describes our empirical approach.

Our main results on the minimum wage elasticity of prices are presented in section 5. In section 6, we estimate the impact of minimum wages on grocery stores' cost. Section 7 discusses the welfare cost of grocery price increases in relation to the nominal benefits of minimum wages. Section 8 summarizes our results and concludes.

2 Background and motivation

2.1 Minimum wages in the United States

Minimum wages have a long history in the United States, going back to the early 20th century. Today, federal minimum wage laws cover most workers, and higher state-level rates are common. In states that have their own minimum wage laws, the legally binding rate is the maximum of federal and state rates.[1] Both state and federal minimum wages are frequently increased, providing us with large variation in the level of minimum wages over space and time. Our price data covers 41 states over the period 2001–2012, and we observe 166 increases in the binding local minimum wage during this time. These minimum wage increases usually come in "packages". A typical minimum wage law does not just entail a one-off increase in the minimum wage, but rather sets a schedule of minimum wage hikes over several years. For example, the federal "Fair Minimum Wages Act of 2007" raised the federal minimum wage from 5.15 USD to 7.25 USD per hour. The act was passed after votes in January and May 2007 and was implemented in three steps that increased the minimum wage by 0.7 USD in July 2007, 2008 and 2009. Typically, the literature studying minimum wages has focused on the effects of minimum wages at the time they are implemented. However, due to the structure of minimum wage laws, most increases are known long in advance and firms have ample time to act in anticipation.

To take into account this possibility, we analyze the effects of minimum wage increases on prices both at the time that they are implemented and at the time minimum wage legislation is passed. We use data on binding minimum wages by state provided by IRLE Berkeley.[2] We collect legislation dates for each increase in the binding minimum wage from legislative records and media sources. In some cases, passage of legislation is preceded by a series of votes and negotiations; in this case, we try to assess from media sources at which point in the process a minimum wage increase became certain. The federal minimum wage increases set in the Fair Minimum Wages Act present a good example. The act was passed in slightly different versions with bipartisan support in both houses of Congress in January 2007. After a conference committee added tax-cuts for

[1] City and county level minimum wages have become more common recently, but until 2013 only San Francisco, CA, and Santa Fe, NM, had local minimum wage ordinances.

[2] A similar dataset of implemented minimum wages is available from Zipperer and Vaghul (2016)

small businesses to the bill, the final version was passed and signed by President Bush in May 2007. Since the passage of the actual minimum wage part of the bill seemed certain already in January[3], we use January as the month of legislation in our baseline. We later present results using only state-level legislation to show that our conclusions hold more generally and are not driven by this single important event.

2.1.1 Implemented and legislated minimum wages

The primary explanatory variables in our analysis are changes in the implemented minimum wage and changes in the "legislated minimum wage." We measure the "legislated minimum wage" as the highest future binding minimum wage set in current law. The legislated minimum wage increases to the highest future minimum wage set in a new law at the time the law is passed. This is illustrated in Figure 1. When there are no pending increases in the binding minimum wage, the legislated minimum wage is equal to the implemented minimum wage.

[Figure 1 about here.]

Table 1 describes important features of changes in the implemented and legislated minimum wage. The average increase in the binding minimum wage amounts to 8.2%. The magnitude of hikes varies a lot, and there is a number of very small increases that are due to indexation or federal minimum wage hikes that only slightly exceed prior state-level rates. Changes in the legislated minimum wage are larger, since they encompass several steps, and amount to 20% on average. The average distance between passage of legislation and implementation of a first hike is 9 months. That means that even the first increase in a package is often known long before it is implemented. Conditional on a previous increase in a state, minimum wage increases are on average 14 months apart and happen 16 months after they are set in legislation. Legislative changes are on average 23 months apart. 36% of increases in the implemented minimum wage and 42% of increases in the legislated minimum wage result from changes at the federal level. 24% of all increases in the implemented minimum wage result from indexation. Minimum wages in states with indexation are pegged to the national development of prices and exhibit small annual increases. We do not assign legislation dates to increases following from indexation.[4]

[3]See for instance http://www.nytimes.com/2007/05/25/washington/25wage.html. The discussion in conference was mostly about the extent of tax breaks and support for higher minimum wages was bipartisan.

[4]Indexation is practiced in 10 states at the end of our sample period. States with indexation in our sample are Arizona, Colorado, Florida, Missouri, Montana, Nevada, Ohio, Oregon, Vermont and Washington. Most of these states introduced indexation starting in 2008 after ballots held in November 2006. The exceptions are Florida, Vermont (both began indexation in 2007), Oregon (beginning in 2004) and Washington (beginning in 1999).

[Table 1 about here.]

Figure 2 shows the distribution of changes in the implemented and legislated minimum wage over states and time. All states in our sample experience at least 2 minimum wage hikes, and the modal number of hikes is 3 and the maximum is 11. One state in the data (Washington) experiences no legislative event. The modal number of legislative events per state is 1 and the maximum is 4.

[Figure 2 about here.]

2.1.2 Salience of minimum wage legislation

Throughout this paper, we treat the date legislation is passed as the time future minimum wage increases become known. It is a natural first question to ask whether these dates matter and if the public pays attention to legislative changes. We use Google Trends data to assess the salience of our collected legislation dates. Google trends is available from 2004 onward, which covers most of the legislative changes in our sample. We use the search volume for the term "minimum+wage+*statename*" over a month to measure interest in the local minimum wage of a given state. Note that we do not measure search requests originating from different states, but from the US as a whole for different search terms. We estimate the following simple regression using this data:

$$\log search_{s,t} = \delta_s + \gamma_t + \sum_{r=-k}^{k} \beta_r incr_{s,t-r} + \sum_{r=-k}^{k} \alpha_r legis_{s,t-r} + \epsilon_{s,t}. \tag{1}$$

$incr_{s,t-r}$ and $legis_{s,t-r}$ are dummy variables indicating implementation of a higher minimum wage and passage of minimum wage legislation in state s in period $t-r$. The results of this regression are presented in Figure 3. Both around implementation and around the date of legislation, interest in minimum wages goes up substantially, by about 30% immediately after legislation is passed, and by up to 50% in the months around implementation of minimum wages. There is no elevated interest in minimum wages in the months before legislation is passed. Three months after passage of legislation, search volume is back at the baseline value defined by fixed effects. This result shows that the passage of minimum wage legislation is a salient event and that the public takes notice of pending minimum wage increases when they are written in law. Furthermore, the results also validate our coding choices in the collection of legislation dates.

[Figure 3 about here.]

2.2 The grocery store sector

The price response of grocery stores is important for the real redistributive effects of minimum wage policy for two reason: first, groceries cover a large share of consumer expenditure and second, minimum wage hikes substantially affect production costs in this sector. In this subsection, we provide evidence to support these key stylized facts.

Table 2 presents the expenditure share of groceries using data from the Consumer Expenditure Survey (CES). We count the categories Food at Home, Household Supplies, Alcoholic Beverages and Personal Care Products and Services as groceries. Groceries make up about 11% of household expenditures on average. As groceries are a necessity good, the share is higher the poorer the household. For households in the poorest quintile, groceries make up 14 to 15% of expenditures, and for households in the richest quintile the share amounts to 9%. These numbers suggest that price increases in grocery stores have an economically significant effect on households' cost of living. Moreover, price increases are especially relevant for poor households, who are the intended beneficiaries of minimum wage increases.

[Table 2 about here.]

The extent to which minimum wages affect grocery stores' cost can be decomposed into two factors: the share of labor costs in total costs and the share of minimum wage earnings in labor costs. We present some stylized facts on both shares based on the Annual Retail Trade Survey (ARTS) and the Monthly Outgoing Rotation Group of the Current Population Survey (CPS MORG). We provide a more detailed estimation of the minimum wage elasticity of grocery stores' costs in section 6.

We first measure the share of labor costs in grocery stores' costs at the sectoral level based on data provided in the ARTS. The ARTS is an annual survey of retail establishments conducted by the Census Bureau. The results are available by detailed sectors within retail, allowing us to zoom in on grocery stores (NAICS 4451). While some of the ARTS is available at annual frequency, the detailed breakdown of operating expenses we require is only available every 5 years. We present cost shares in total costs, variable costs and revenues for 2007 and 2012 in Table 3. Total costs include all operating expenses plus the Cost of Goods Sold (COGS). Variable costs include labor costs, COGS, transport and packaging costs. By far the most important factor in grocery store costs are the COGS. Labor costs are the second largest cost factor. Their share in total costs amounts to about 14 to 15%. The share in variable costs—which should matter for price setting in the short run—is slightly higher at about 16%.[5]

[5]Note that we do not include purchased services in our measure of Labor Cost. These services make up about 2% of total costs and include some tasks that are likely done by low-skilled workers, for example

[Table 3 about here.]

In a second step, we analyze the importance of minimum wages for grocery stores' labor costs. We use data on hourly wages from the monthly CPS Monthly Outgoing Rotation Group (CPS MORG). In Figure 4, we plot the distribution of wages in grocery stores relative to the local minimum wage. Most of the minimum wage hikes in our sample happen 2006–2009, and we show the wage distribution for this period and for the following and preceding years separately. A large share of grocery store workers are paid wages at or close to the local minimum wage during all three periods.[6] 21% of grocery store workers earn less than 110% and 49% less than 130% of the local minimum wage during the 2006–2009 period. Recent literature suggests that even workers with wages above the minimum wage may be affected by "ripple effects" of a hike (Autor et al., 2016; Dube et al., 2015), and as a result a large share of grocery store workers would likely be affected by minimum wage increases. Moreover, the share of workers earning wages close to the minimum wage rises as minimum wages increase over the sample period.

Table A.17 in the appendix provides additional statistics on the share of minimum wage workers in hours and earnings, and a comparison with the restaurant sector. It is noteworthy that toward the end of our sample period, the minimum wage share in grocery store employment is close to the share of minimum wage workers in the restaurant industry 2001–2005 and almost as large as the shares reported in Card and Krueger (1994) for fast food restaurants.

Overall, the descriptive statistics presented here establish three key stylized facts. First, groceries are an important factor in households' cost of living, particularly for poor households. Second, labor costs are an important part of the overall costs of grocery stores. Third, a large share of grocery store employees are paid wages close to the minimum wage, and as a result, minimum wage increases affect the labor costs of grocery stores.

[Figure 4 about here.]

maintenance work. These costs may depend on minimum wages as well, but it is hard to determine to which extent.

[6]Some workers report wages below the local minimum wage. There are exceptions for full-time students, workers with disabilities, and workers under the age of 20 in many minimum wage laws. Typically, these workers are subject to a proportionally lower minimum wage rate. Moreover, the CPS is a survey and likely subject to some measurement error.

3 Data

3.1 Prices in grocery stores

We use scanner data provided by the market research firm Symphony IRI to construct store-level price indices. The dataset is described in detail in Bronnenberg et al. (2008). It contains weekly prices and quantities for 31 product categories sold at grocery and drug stores between January 2001 and December 2012. On average, the sample covers 1,916 stores and 60,600 products over this period. Products are identified by Unique Product Codes (UPC). As an example, a 12oz can and a 20oz bottle of Coca Cola Classic are treated as different products in our data. Stores are located in 530 counties, 41 states and belong to one of about 90 retail brands. Figure 5 shows the regional distribution of stores. The data covers 17% of US counties which are home to about 29% of the overall population. Most of the included product categories are packaged food products (frozen pizza, cereals, etc.) or beverages (soda, coffee, milk, etc.). The data also includes personal care products (deodorants, shampoo, etc.), housekeeping supplies (detergents, paper towels, etc.), alcoholic beverages (beer and some flavored alcoholic beverages) and tobacco.

[Figure 5 about here.]

We use store-level price indices throughout the analysis in this paper, instead of more disaggregated product level prices. This choice is motivated by several arguments. First, wages are paid at the store level, and we thus think that stores are the natural unit of analysis. Ex ante, we would expect heterogeneity in the effect at the level of stores—depending on the wages they pay—but not necessarily at the level of products. Our subsequent analysis confirms this intuition. Second, it is useful to weight products by their importance for stores and consumers, and price indices are a natural way to do so. Third, entry and exit are much less of a concern at the store level than at the product level. Especially low-volume products are frequently introduced and discontinued, and may also go unsold in for extended time periods due to stock-outs, seasonality or low demand. This results in frequent gaps in products' price series, while our panel at the store level is much more balanced.

Stores report total revenue (TR) and total sold quantities (TQ) at the level of UPCs for each week. We first calculate the average price of product i in grocery store j and week w from quantities and revenues:

$$P_{ijw} = \frac{TR_{ijw}}{TQ_{ijw}} .$$

An important characteristic of high frequency retail price data is that prices often change temporarily and return to their original level afterward (Kehoe and Midrigan, 2015). These movements, usually due to temporary sales, are large and affect the volatility of inflation rates at a monthly frequency. Since we study the price response to a permanent shock, temporary price changes are of no particular interest. We apply a sales filter suggested by Kehoe and Midrigan (2015) and described in more detail in appendix A.1 to remove temporary price fluctuations. The algorithm uses a moving window modal price to determine a "regular price" at any point in time. The use of regular prices for our baseline index does not affect the conclusions we draw, but increases the precision of our results.

We next calculate the average monthly price for each series and construct a geometric index of month to month price changes for each product category c in each store:

$$I_{cjt} = \prod_i \left(\frac{P_{ijt}}{P_{ijt-1}} \right)^{\omega_{ijy(t)}} . \tag{2}$$

The weight $\omega_{ijy(t)}$ is the share of product i in total revenue of category c in store j during the calendar year of month t.[7] In a second step, we aggregate across different categories to create store-level price indices and inflation rates:

$$I_{jt} = \prod_c I_{cjt}^{\omega_{cjy(t)}} \text{ and } \pi_{jt} = \log I_{jt} \tag{3}$$

Again, the weight $\omega_{cjy(t)}$ is the share of category c in total revenue in store j during the calendar year of month t. Note that this approach does not take into account changes in the price level due to the introduction of new products, or due to reappearance of products at a new price after a stock-out, a feature shared by most price indices.

Table 4 reports features of price adjustments for the regular prices that our index is based on. Prices change with a median monthly frequency of 10.3% from 2001 to 2006 and 12.2% from 2007 to 2012. This implies a median duration of a price spell of 9.2 and 7.7 months, respectively. The median size of a price change is about 11.4% during the first half period of the sample, and 10.5% during the second half. The share of price increases in price changes is about 57% during the first half of the sample and 60% during the latter half. Price increases are smaller than price decreases. Finally, monthly inflation rates are lower during the first half of the sample compared with the second half. The monthly rates correspond to annualized inflation rates of 1% in the first and 1.8% in the

[7]Price indices are often constructed using lagged quantity weights. Since product turnover in grocery stores is high, using lagged weights would limit the number of products used in the construction of our index. We thus use contemporaneous weights.

second half of the sample. Overall, those numbers are in line with what other researchers have documented for our and other retail price datasets.[8]

[Table 4 about here.]

3.2 Employment and wages in grocery stores

We use data on employment and the total wage bill in grocery stores provided by the Bureau of Labor Statistics in the Quarterly Census of Employment and Wages (QCEW). The QCEW publishes a quarterly count of employment and wages reported by employers in their UI contributions and covers more than 95 percent of jobs in the US. The QCEW is available at the county-industry level. We use data for grocery stores (NAICS 4511), retail overall (NAICS 44-45) and accommodation and food services (NAICS 72). These data are used in section 6 to estimate the impact of minimum wages on grocery stores' costs. Our main variables of interests are the employment headcount and the average salary defined as the total wage bill divided by employment.

4 Main empirical specification

We estimate the price response to minimum wage increases by relating store-level inflation rates to increases in the binding minimum wage and passage of minimum wage legislation at the state level. Our baseline identification strategy is based on the idea that, conditional on a set of controls and fixed effects, inflation in stores in states that did not experience a minimum wage hike or new legislation is a useful counterfactual for stores in states that did. Many papers studying the effects of minimum wages in the US apply variants of this identification strategy (see Allegretto et al., 2017). Furthermore, the high frequency of our price data allows us to estimate detailed temporal patterns of the effects, including for time periods preceding an event. This allows us to rule out that our estimates capture changes in trend inflation that are correlated with minimum wage increases. In particular, we obtain our baseline estimates from variants of the following flexible linear model:

$$\pi_{j,t} = \delta_j + \gamma_t + \sum_{r=-k}^{k} \beta_r \Delta mw_{s(j),t-r} + \sum_{r=-k}^{k} \alpha_r \Delta leg_{s(j),t-r} + \psi X_{j,t} + \epsilon_{j,t} \tag{4}$$

[8] See Nakamura and Steinsson (2008) for CPI data from 1998 to 2005 or Midrigan (2011) for an alternative scanner data set from 1989 to 1997. Stroebel and Vavra (2015) construct state-level indices based on the same data used in our paper and find that inflation rates are lower than CPI inflation from the beginning of the data until 2007.

This kind of model is commonly used in the international economics literature to study the pass-through of exchange rate variation (for example Gopinath et al., 2010) and has been applied in the minimum wage literature in Aaronson (2001) to study the effect of minimum wages on prices in restaurants. In this specification, $\pi_{j,t}$ is the month-on-month inflation rate in grocery store j and calendar month t. The main exogenous variables of interest are the change in the logarithm of implemented and legislated minimum wages in the state $s(j)$ in which store j is located, which we denote $\Delta mw_{s(j),t}$ and $\Delta leg_{s(j),t}$. The coefficients β_r and α_r measure the elasticity of inflation with respect to minimum wage increases or legislation r months ago, or r months in the future in case r is negative. In our baseline estimation we control for time fixed effects γ_t and store fixed effects δ_j. Because our estimation is in first differences, the latter account for trends in stores' price levels. The vector of controls $X_{j,t}$ includes the county-level unemployment rate and state-level house price growth. We include these control variables to absorb variation in grocery prices that is due to business cycles or the boom and bust in house prices.[9] None of our results depend on the inclusion of controls beyond time fixed effects, but the additional controls tend to improve the precision of the estimates.

We estimate several variants of equation 4. First, we estimate the effects at legislation and implementation separately by omitting all terms related to either $\Delta mw_{s(j),t}$ or $\Delta leg_{s(j),t}$. However, since legislation is often passed in the 9 months preceding implementation, these separate estimates may capture the same variation in prices. To take this concern into account, we also jointly estimate effects at legislation and implementation of minimum wage increases by estimating equation 4 in full. Furthermore, we present results for several alternative specifications of fixed effects, weights, and sample restrictions below. In particular, we present results that are conditional on chain-time and census division-time fixed effects. These fixed effects should capture changing trend inflation within chains or regions. They could also capture effects of changes in wholesale prices, which could correlate between stores that are geographically close or within chains that coordinate purchases of merchandise.

Because both the price level and minimum wages are non-stationary, we prefer estimating equation 4 in first differences rather than levels. However, the estimates are best illustrated as the effect of minimum wages on the price level. We construct cumulative sums of β_r and α_r coefficients in the presentation of our results. This presentation of results is also common in the exchange rate pass-through literature. We normalize the effect to zero in a baseline period two months before an event, and calculate the cumulative effect as $E_R = \sum_{r=-1}^{R} \beta_r$. We also summarize pre-event coefficients in a similar way.

[9]See Stroebel and Vavra (2015) for a discussion of the relationship between real estate and retail prices.

To be consistent with the normalization we calculate them as $P_R = -\sum_{r=2}^{-R-1} \beta_{-r}$. Our baseline measure of overall elasticities is E_4 and thus includes effects in the 6 months from one month before to 4 months after an event. In principle, we could of course report E_k and include all lag coefficients. However, coefficients beyond 4 months out are typically close to zero and insignificant. In most specifications E_k is not significantly different from E_4 but substantially less precise. We report E_4 separately for implementation of minimum wages and passage of legislation, as well as the sum of both.

An important choice in our estimation is the number of included lag and lead coefficients k. A constraint that we face here is that minimum wage hikes often occur in regular intervals, often within 12 months (see Table 1). This implies that several observations lie, for instance, 8 months after the last and 4 months before the next minimum wage hike. In principle, we can nevertheless disentangle the effects of separate events because many states do not have minimum wage increases before 2005 and after 2009, and because some states increase minimum wages only infrequently. However, our estimation strategy will not work in practice for large k, as collinearity of leads and lags becomes increasingly problematic. A second constraint that we face is that our store panel is not balanced. The more leads and lags we include, the more likely it is that changes in the underlying store sample may affect our estimates. In our baseline estimation, we settle on estimating the effect with $k = 9$. This is sufficient to show the short run impact of minimum wage increases on prices. We present results for longer or shorter windows in robustness checks.

We anticipate two main concerns about our estimation and identification strategy. The first is the possibility of reverse causality. States with higher inflation rates could have more frequent and higher nominal minimum wage increases to limit fluctuations in the real minimum wage. In this case inflation would cause minimum wage increases, rather than the other way around.[10] We deal with this concern in our estimation in several ways. First, our main specification includes store fixed effects, which absorb differences in trend inflation between states. Second, due to the high frequency of our price data and the flexible estimation model, we can closely examine the timing of the effect, and any remaining differences in inflation trends around a minimum wage event would be easily detected in our pre-event coefficients. Indeed the timing of effects in our results is not consistent with higher inflation rates causing minimum wage increases, as we observe no significant differences in inflation preceding the passage of minimum wage legislation. Third, we present some results that only use variation due to federal minimum wages. We view it as unlikely that federal lawmakers take into account regional inflation differences

[10] A special case are minimum wage increases following from indexation. All states that practice indexation peg their minimum wage to national inflation rates. Changes in national inflation are absorbed by time fixed effects in our specification.

when setting national minimum wage policies.

A second concern is that inflation in grocery stores follows a seasonal pattern: it is highest in January, declines in the following months, jumps up in July and then declines again. Incidentally, minimum wages follow a similar seasonal pattern: most of the hikes occur either in July (for federal minimum wage hikes) or in January (most state-level hikes, see Table 1). We address this concern by including time fixed effects in our baseline specification. In robustness checks, we allow for differences in seasonality between states by including separate calendar month fixed effects for each state. The results do not differ substantially. Seasonality is a lesser concern for the effects at legislation, since passage of legislation follows much less pronounced seasonal patterns.

5 The effect of minimum wage increases on prices

5.1 Main results

We first discuss the results of separate estimation of the effects of minimum wage increases at the time of legislation and implementation and discuss the results of joint estimation in a second step. Figure 6 presents the cumulative elasticities for separate estimation. Panel (a) shows our baseline estimates around the time of legislation. We see that the pre-event coefficients capture no significant movement in prices in the months leading up to passage of legislation. Prices start to increase significantly in the month preceding legislation and continue to rise for 3 months. After that, prices are stable for the remainder of the estimation window. In panel (b) we present the same results including time fixed effects for different retail chains and census divisions. The results at legislation are robust to the inclusion of these much more restrictive controls, confirming that our results do not reflect price variation at the regional or chain level that correlates with minimum wage legislation. Columns 1–3 of Table 5 list the corresponding estimates of the cumulative elasticity. Our baseline estimate for the elasticity at legislation is 0.021. The estimates including division-time and chain-time effects are slightly smaller and amount to 0.014 and 0.013. The inference in all figures and tables is based on standard errors clustered at the state level.

Panels (c) and (d) of Figure 6 present the results at the time of implementation of minimum wage increases. Our baseline estimates point to a gradual increase in prices in the months leading up to implementation of a minimum wage increase. However, when we include chain-time or division-time fixed effects we find no significant movement in prices before or after implementation of minimum wage increases. The corresponding elasticities are shown in columns 4–6 of Table 5.

Since legislation frequently occurs in the 9 months before implementation of a first hike, the point estimates following passage of legislation and preceding implementation may reflect the same variation in prices. We take this concern into account and estimate both effects jointly using the full equation 4. We find similar results as in the separate estimations. Figure 7 presents the cumulative elasticities estimated from joint specifications. Panels (a) and (b) present the results around the time of legislation. Starting one month before legislation is passed, prices increase for three months and are stable afterward. Our estimate of the elasticity at legislation from joint estimation is 0.019. As in the separate estimation, the estimates at legislation are robust to including chain-time or division-time fixed effects. Panels (c) and (d) of Figure 7 present the estimates at implementation. Controlling for legislation absorbs the pre-implementation increase in prices that we find in separate estimation. When estimated jointly with the effects at legislation, our baseline estimate points to a slight and insignificant increase in prices after implementation. However, as in the case of separate estimation, we find no effect when we include chain-time or division-time fixed effects. The corresponding insignificant elasticity estimates are reported in Table 5.

Our results indicate a significant and robust effect at the time minimum wage legislation is passed. Our baseline estimate of the elasticity at legislation is 0.02, which we obtain from the separate estimation of the effect without division-time or chain-time fixed effects. Taking into account legislation dates allows us to precisely estimate effects of minimum wages on prices that may be overlooked or appear as pre-event trends in specifications that solely focus on effects at implementation.

In our sample, the average minimum wage legislation increases the minimum wage by about 20% in several steps. Our estimates suggest that such an increase raises prices in grocery stores by about 0.4% over three months at the time when legislation is passed. By the time the minimum wage has actually risen to the level set in the new legislation, price adjustment is already long complete. The average monthly inflation rate during our sample period is about 0.13%. During the 3 months in which the price response to the average legislation occurs, monthly inflation almost doubles relative to the sample average rate. In section 6 we show that the magnitude of this effect is also consistent with a full pass-through of all future increases in grocery stores' marginal cost. Our baseline estimate for the elasticity at implementation is comparable in size to the one for legislation, but it is insignificant and not robust to the inclusion of more restrictive sets of fixed effects.

The results show that firms act in a highly forward-looking manner, and take into account future costs when they set current prices. This finding is consistent with the predictions of price setting models with nominal frictions such as adjustment costs. These frictions make firms reluctant to change their prices too often, and lead them to thus take into account the whole known future path of costs. The estimates also suggest that firms have some market power, as they are able to increase their markups in the months leading up to a minimum wage increase.

[Figure 6 about here.]

[Figure 7 about here.]

[Table 5 about here.]

5.2 Identification through within-state variation in wages

In the previous section, we use variation in increases in the legislated or implemented minimum wage across states to identify the effect on prices. In this section, we employ an alternative identification strategy that uses variation in initial wages within a state to identify the response to a given event. Similar strategies have been used in the literature studying the employment effects of minimum wages (Card and Krueger, 1994, for example). In our baseline strategy, the causal interpretation of the estimates relies on the fact that the timing of price increases is inconsistent with reverse causality. The alternative strategy presented here would allow for a causal interpretation, even if minimum wage increases were driven by changes in average state-level grocery store inflation.

A statewide minimum wage increase affects stores that pay high wages less than stores that pay lower wages, since the hike is less binding for the former. While we cannot observe stores' wages, we can exploit the large geographic variation in grocery store wages across counties within a state. We use the Quarterly Census of Employment and Wages (QCEW) to compute the average quarterly salary in grocery stores relative to a full-time equivalent minimum wage salary. We then estimate the interaction between local inflation and this relative wage level for different time periods around minimum wage legislation and implementation. The specification for the effects at legislation is presented in equation 5:

$$\pi_{j,q} = \delta_j + \gamma_{t,s(j)} + \sum_{r=-kq}^{kq} \alpha_r \Delta leg_{s(j),q-r} \times wage_{c(j),q-r} + \psi X_{j,t} + \epsilon_{j,t} \tag{5}$$

We estimate an equivalent equation for effects at implementation. The α_r coefficients in this specification capture the relationship between inflation and initial wages in the quarters around an increase in the minimum wage. In the case of legislation, we use the wage at the time legislation is passed as the initial wage. In the case of implementation, we use the wage two quarters before implementation as the initial wage to make sure that the initial wage is not yet affected by minimum wage increases. Because there is variation in wages within a state, we can include state-time fixed effects that absorb all statewide developments that could potentially drive both minimum wage and grocery price increases.

Table 6 presents the estimation results. We find that there is no significant relationship between initial grocery store wages and inflation rates in any quarter except the quarter that legislation is passed. Stores in higher wage counties within a state exhibit significantly lower inflation than those in low wage counties in the quarter legislation is passed and the same inflation rates otherwise. We find no significant relationship between inflation and initial wages in any quarter around implementation of higher minimum wages. Our estimates suggest that a 10% lower initial wage increases inflation in the quarter legislation is passed by about 0.3%. The effects at legislation are robust to the inclusion of chain-time fixed effects. Overall, these results corroborate the findings presented in the previous section.

[Table 6 about here.]

5.3 Robustness of baseline results

5.3.1 Main robustness checks

Our baseline results are robust to various alternative specifications and sensitivity checks. The most important of these are presented in Table 7 (legislation only) and Table 8 (joint estimation). First, the tables show that the estimated effects are slightly larger if we weight each store by the number of products used to construct the stores' price index (column 2). Columns 4–6 show that the results do not change if we omit the baseline controls, omit the store fixed effects, or if we include state-calendar month fixed effects, which control more restrictively for possible differences in the seasonality of prices increases across states. We also present results for price indices that are not adjusted for temporary price changes (column 7). Finally, we winsorize the inflation rates below the 1st and above the 99th percentile of the distribution to show that our results are not driven by outliers (column 8).

[Table 7 about here.]

[Table 8 about here.]

Table 9 contains further robustness checks, focusing on joint estimation. These checks show that our results are robust to only using stores that we observe throughout the whole sample period, and that our results thus do not depend on stores' entry or exit; to controlling for county level trends in the inflation rate; and to changing the event window to $k = \pm 6$ or $k = \pm 12$ months. The table also highlights that our results hold if we restrict the sample to the period before 2007, which includes less minimum wage increases. They also remain unchanged if we only look at the effects of the first minimum wage hike in each state in our sample period. The latter represents an alternative method to address the fact that all states are treated multiple times in the sample period.

[Table 9 about here.]

5.3.2 State versus federal hikes

Even though the timing of the response to legislation is not consistent with reverse causality, it remains a concern in our baseline strategy. Here, we show that the response to new minimum wage legislation is very similar for federal and state-level minimum wage laws. The main idea of this robustness check is that changes in state-level minimum wages could potentially be a response to local price increases, but that federal legislation is much less likely to be driven by price developments in particular states.

We estimate these effects by including separate sets of leads and lags of state and federal legislation in our estimation. The results are presented in Figure 8. The figure suggests that the source of the minimum wage hike does not play an important role, as the response is significant in both cases and very similar in terms of timing and magnitude.

[Figure 8 about here.]

5.3.3 Placebo test

We conduct a placebo test to show that our results are not spurious and that our statistical inference leads to conservative confidence intervals. We repeatedly match all stores of a state with the minimum wage series of a random state. The match is drawn without replacement from a uniform distribution including the correct match. We then estimate the E_4^{leg} elasticity at legislation using equation 4. A similar permutation test is proposed by Abadie et al. (2010) to conduct inference when applying synthetic control methods. The logic of permutation inference is to compute the distribution of a test statistic under random permutations of the sample units' assignments to the "treatment" and "non-treatment" groups. We present the distribution of 1000 estimated elasticities in Figure 9. Our baseline elasticity estimate of 0.02 lies well above the 99th percentile of the placebo estimates. In fact, none of the placebo estimates in our trial is larger than our baseline estimate. Furthermore, the placebo estimates are centered around zero. The test suggests that our results are not driven by misspecification or structural breaks in the inflation series that correlate with temporal patterns of minimum wage increases. Finally, the results suggest that our statistical inference is rather conservative, as the probability of obtaining an estimate as big as ours in absence of a real relationship is less than 0.01, when state-clustered standard errors suggest a significance level above 0.01.

[Figure 9 about here.]

5.3.4 State-level estimation

Finally, we conduct an analysis of the response of prices at the state level instead of at the store level. Our construction of state-level price indices largely follows Stroebel and Vavra (2015). One advantage of the state-level estimation is that the state panel is balanced and we can extend the estimation to a longer panel without missing leads and lags due to store entry and exit.

Table 10 presents the estimation results for the baseline specifications using the state panel data set. The results confirm our baseline estimates, both in terms of timing and magnitude of the effect. The estimated elasticity at legislation amounts to about 0.02 and there are no significant estimates around implementation of hikes. Figure 10 shows the estimated effect on price inflation (panel a) and on the price level (panel b) if we allow the event window to span more than one year before and after the event, focusing on the effects at legislation. The figures provide no evidence for differential trends in the 15 months leading up to the legislation of a minimum wage hike.

[Table 10 about here.]

[Figure 10 about here.]

5.4 Heterogeneity of the price response

5.4.1 Time from legislation to implementation

Our baseline results suggest a high degree of anticipation of future cost increases in grocery stores' price setting. We now look at events with different lead times between legislation and implementation of higher minimum wages. Pricing models with frictions would predict that for increases that are known long in advance, adjustment should be slow and gradual, whereas for increases that become known shortly before they are implemented, adjustment should be quicker. Many laws schedule two or three successive minimum wage increases for several years ahead. Especially the later hikes in such packages are known a long time in advance.

We split minimum wage laws into those that are followed by a first implemented increase within 9 months and those with longer time between legislation and a first increase. There are 48 legislative events with a "short" and 14 with a "long" lead time between legislation and the first hike. Furthermore, we split increases in the implemented minimum wage into those that follow legislation within 9 months, or those that are further away from their legislative event. There are 48 minimum wage increases that happen within 9 months of their legislation, and 80 that happen further out. Increases resulting from indexation are excluded from this analysis.

Figure 11 shows the effects for both kinds of increases. In panel (a), we look into the effects at legislation. We find that prices respond at legislation when implementation happens shortly after legislation, but not when implementation is further than 9 months away. In panel (b) we look into the effects at implementation. We find no significant effects at implementation irrespective of the distance between legislation and implementation. This suggests that increases that are known very long in advance may be passed into prices very gradually in a way that is not detectable in our data.

[Figure 11 about here.]

5.4.2 Store size, expensiveness, and chain

We now study potential heterogeneity in the response by several store characteristics, namely their size, their price level relative to other nearby stores, and what kind of retail brand they belong to. We split our sample in two groups along each of these dimensions and estimate separate coefficients by restricting the sample to the group in question. We reduce the length of the estimation window to 6 months before and after an event in order to reduce the number of coefficients estimated from these smaller samples. We present the results in Figure 12. Table A.14, Table A.15 and Table A.16 in the appendix list the corresponding elasticities.

We first differentiate stores by size, which we measure by annual revenue. We average revenues over the time period that a store is observed in the data, and then split the sample of stores into large and small stores at the median. We find larger and more precise point estimates for larger stores. Furthermore, we find larger, but still insignificant, point estimates after implementation for larger stores. For smaller stores, we find a significant effect in the month of legislation; however, this effect appears to be transitory and becomes insignificant 5 months after legislation. In Table A.14 we show that the results are very similar for a measure of store size based on the number of products sold instead of revenue.

Next, we differentiate stores by their price level relative to other nearby stores. We use a procedure implemented by Coibion et al. (2015) to calculate expensiveness relative to other stores in a county.[11] We find slightly larger and more robustly significant effects for cheaper stores. However, the difference in the response of the two groups of stores are not significant. In Table A.15 we show that the results are very similar for a measure of expensiveness relative to other stores in a state rather than a county.

Overall, we interpret the heterogeneity in terms of size and price level as suggestive evidence for more pronounced effects in larger and cheaper stores, which may be thought of as discounters. One may expect that discounters' compete more strongly through prices, and that these stores are more reluctant to increase prices. However, anecdotal evidence suggests that discounters also pay lower wages. As a result, their cost could be more strongly affected by minimum wage increases, and this may explain the larger price response.

Finally, we differentiate stores by the retail chain they belong to. We split chains into "national" and "regional" chains. Regional chains are those with stores in less than 5 distinct states on average, and "national" chains are those with stores in more states. We find larger and significant point estimates for regional chains. For national chains, we find some small and significant individual coefficients around the month of legislation, but those effects are not significant when summed up to our baseline elasticity E_4^{leg}. The results are consistent with the idea that national chains may be more likely to set their prices at a level broader than a state, and that their overall profits may be less sensitive to changes in the local cost for some of their stores. In Table A.16 we also present results for chain size based on the number of stores rather than regional composition. Size is highly correlated with the national versus regional distinction, and we find that the effects are stronger in smaller chains.

[Figure 12 about here.]

5.4.3 Elasticities of income-specific cost-of-living indices

In this section, we analyze differences in the price development of products that differ by their consumers' income. Heterogeneity along this dimension would imply that the price response has a differential impact on households in different income brackets, even without taking into account the differences expenditure shares for groceries. It would also suggest that demand shifts may play a role for the price response.

[11] We first calculate the mean price during a year for each product and store. For each product, we then calculate the mean price in a county. We then calculate the deviation of each store from this price and aggregate deviations over all products sold in each store, weighted by the dollar revenue of the product. We only use products that are sold in at least 3 stores in a county and drop counties with less than 3 stores. Finally, we label stores that are on average more expensive than other stores in a county as expensive, and the remaining stores as cheap.

We construct price indices for low-, medium- and high-income households, using a panel of household shopping data for about 5000 households that accompanies the IRI data set. This panel allows us to calculate yearly expenditures for each UPC by household income. We pool households in three brackets of yearly income: less than $25,000, between $25,000 and $74,999 and more than $75,000. We then use expenditure shares of each UPC for a given bracket as weights to compute a cost-of-living price index for this bracket. Households in the panel are located in just two metropolitan areas. We pool households in both areas and assume that their expenditure weights are representative for the US overall. Furthermore, we average expenditure shares over all 10 years of data and keep weights constant in our index. Since we only observe expenditures for products bought by households in the panel, the cost-of-living indices cover a selected and smaller sample of products.[12] Inflation rates of the resulting income-specific price indices are highly correlated. However, we find that on average over the sample period, higher income households experience lower inflation rates, which is consistent with the findings in Jaravel (2016). Using the new indices, we then estimate the same regressions as for our baseline price index. The results are shown in Table 11. The estimates are very close to our baseline estimates. The point estimates for the three indices are almost identical, and there are no significant differences between the response of price indices with expenditure weights for different income groups. This suggests that our baseline estimates reflect an across-the-board price increase of grocery products.

[Table 11 about here.]

5.4.4 Right-to-work versus no-right-to-work states

Finally, we split our sample along a geographic dimension. 17 US states in our sample have what is commonly referred to as "Right-to-work" (RTW) laws. RTW laws prohibit mandatory union membership for workers in unionized firms, and weaken the position of unions. States with RTW laws exhibit lower unionization rates and laxer labor market regulations in general. Unionized firms are more likely to pay wages above the local minimum wage, and minimum wages in RTW states may thus be more binding than in other states. In fact, Addison et al. (2009) find that earnings in grocery stores are more responsive to minimum wages in RTW states. Our own earnings regressions, presented in Table 12, and discussed in more detail below, also support this view. Because of a larger sensitivity of labor cost to minimum wages in these states, we would expect prices to be more sensitive as well.

[12] Many products that are present in the store-level price data are sold to none or few households in our panel. There are two potential reasons for this. First, our sample is much smaller. Second, some products may not be sold in the locations of panel households.

We restrict our baseline sample to stores located in either RTW or non-RTW states and estimate separate elasticities. We estimate the effects for a smaller estimation window and omit controls, because the lower number of states in the split samples limits the number of state clustered standard errors we can estimate. The results are presented in Figure 13. We find an effect at legislation of comparable magnitude for both stores in RTW and non-RTW states. Not surprisingly, the effects are much less precisely estimated than for the full sample. Furthermore, we find a large effect at implementation for stores in RTW states but not for stores in non-RTW states. Taken together, the effect seems to be substantially larger in RTW states.

[Figure 13 about here.]

6 The effect of minimum wage increases on cost

To calculate the extent of pass-through, we need to relate the baseline minimum wage elasticity of prices of 0.02 to an estimate of the minimum wage elasticity of grocery stores' cost. Pass-through is complete when the minimum wage elasticity of prices is equal to the minimum wage elasticity of marginal cost. We use data on the sectoral labor share of grocery stores combined with data on county-level labor cost per worker to estimate the impact of minimum wages on cost. These estimates can be interpreted as the minimum wage elasticity of marginal cost at constant output under some assumptions on production technology that we present below. We find that our estimates of the minimum wage elasticity of prices and cost are consistent with full pass-through of cost increases into prices.

6.1 A benchmark model

We first present a simple model assuming Cobb-Douglas production, CES demand and monopolistic competition to illustrate our approach. We assume grocery stores produce retail services using minimum wage labor L_M, skilled labor L_H and merchandise X with a constant returns to scale Cobb-Douglas technology, $Q = L_M^{\alpha} L_H^{\beta} X^{1-\alpha-\beta}$. Furthermore, we assume that factor markets are competitive. MW denotes the minimum wage, W the market wage of non-minimum wage labor, and P_X the price of merchandise. The cost function of a cost-minimizing grocery store in this setting equals:

$$C(Q, MW, W, P_X) = QMW^{\alpha} W^{\beta} P_X^{1-\alpha-\beta} \Omega \tag{6}$$

Ω is a constant that depends on α and β. With CES demand, firms charge a constant markup over marginal cost. As a result, the minimum wage elasticity of prices is equal to the minimum wage elasticity of marginal cost:

$$\frac{\partial P}{\partial MW}\frac{MW}{P} = \frac{\partial C_Q}{\partial MW}\frac{MW}{C_Q} = \alpha \tag{7}$$

In the Cobb-Douglas case, α also corresponds to the minimum wage share in cost:

$$\frac{MWL_M}{C} = \frac{MW\frac{\partial C}{\partial MW}}{C} = \alpha$$

There are two key takeaways from this simple example. First, full pass-through means that the minimum wage elasticity of prices is equal to the minimum wage elasticity of marginal cost. Second, the minimum wage elasticity of marginal cost is equal to the cost share of minimum wage workers. These results generalize beyond the Cobb-Douglas case.[13] The minimum wage elasticity of marginal cost could thus be inferred from the cost share of minimum wage workers for the simple case of two types of workers. In practice, it is not clear how minimum wage workers should be defined. The empirical wage distribution is continuous, and recent research (Dube et al., 2015; Autor et al., 2016) suggests that workers earning wages above the minimum wage also benefit from minimum wage hikes to some degree.

In the next step, we generalize our framework to accommodate this fact. This allows us to derive an expression that we subsequently estimate. We assume grocery stores provide retail services using a production technology $F(L, X)$, where F is homogeneous to some degree—including the possibility of non-constant returns to scale. X still denotes the quantity of purchased merchandise, and L is a composite input defined by a linear homogeneous aggregator over N different types of labor inputs $L_1, L_2, \ldots, L_N$ with wages $w_1, w_2, \ldots w_N$. The wages of these different types of workers may be affected by minimum wages to different degrees. We continue to assume monopolistic competition in product markets and competitive labor markets.

Under the minimal assumptions outlined above, the minimum wage elasticity of marginal cost at constant output is equal to the labor share in cost times the minimum wage elasticity of the average wage $\overline{W}$:

$$\frac{\partial P}{\partial MW}\frac{MW}{P} = \frac{\partial MC}{\partial MW}\frac{MW}{MC} = \frac{\overline{W}L}{C}\frac{\partial \overline{W}}{\partial MW}\frac{MW}{\overline{W}} \tag{8}$$

We derive this expression in appendix A.3 and estimate it in the next section. To derive equation 8, and to interpret the subsequent estimates as the effects of minimum wages on marginal cost, we require three assumptions. First, we need to assume that different

[13]See Silberberg (1974) or Wohlgenant (2012) for a proof in the case of constant returns to scale and appendix A.3 for a generalization to any homogeneous production function.

labor inputs can be aggregated in a linear homogeneous way. This implies that the shares of different types of workers do not depend on the size of a store. Second, we need to assume that grocery stores' overall production technology is homogeneous to some degree. This assumption is much less restrictive and is fulfilled by all commonly used production functions we are aware of. Finally, equation 8 gives the elasticity of marginal cost at constant output. Output does not matter for marginal cost in the case of constant returns to scale. In the case of non-constant returns, any change in output affects marginal cost in a way we do not account for here. We look into the effects on minimum wages on grocery store output in Table A.25 in the appendix and do not find any evidence for a change in grocery stores' output.

It is important to stress that these derivations are based on the assumption of a competitive labor market. We use this assumption because our evidence for price effects of minimum wages is inconsistent with monopsonistic labor markets (Aaronson et al., 2008), which have been used to explain the evidence against disemployment effects of minimum wages (Card and Krueger, 1995; Stigler, 1946). Our assumptions and our results are nevertheless compatible with small or no disemployment effects if low-skilled labor is difficult to substitute with other factors—at least in the short run—and full price pass-through has small or no effects on sectoral output. Substitution effects are entirely absent in the limit case of Leontief production. A limited scale effect is consistent with our evidence that minimum wages have no effects on grocery stores' output—shown in Table A.25 in the appendix—, and similar evidence in Aaronson et al. (2012), who shows that minimum wages do not affect the consumption of nondurable goods.[14]

6.2 Estimating the minimum wage elasticity of labor cost

We now use equation 8 to estimate the minimum wage elasticity of grocery stores' cost. As discussed in section 2.2, sectoral balance sheet data suggests that the labor cost share of grocery stores is about 0.16 on average. In this section, we estimate the minimum wage elasticity of the average wage $\overline{W}$ in grocery stores at the county level. We calculate $\overline{W}$ from QCEW data as the ratio of total earnings of grocery store workers and grocery store employment. We restrict the data to the set of states and the time period that we use to estimate the price response. Our empirical specification is similar to the standard state-level two-way fixed effects regressions that are often used to estimate minimum wage effects on employment in the US (see Allegretto et al., 2017, for a critical assessment).

[14]There are at least two explanations for this finding. First, demand for most grocery products is inelastic (Okrent and Alston, 2012, for categories of food consumed at home). Second, most groceries are food products. The closest substitute these products would be food at restaurants, whose prices increase as well. As a result, even though grocery prices increase, the relevant relative prices may not.

In particular, we estimate:

$$\log \overline{W}_{c,q} = \gamma_c + \delta_q + \beta \log MW_{c(s),q} + Controls_{c,q} + \epsilon_{c,q} \quad (9)$$

Table 12 reports the estimated labor cost elasticities. As expected, we find statistically significant and positive elasticities. Our baseline estimate for the labor cost elasticity in grocery stores is 0.11.[15] The elasticity is slightly larger in the accommodation and food service industry, and smaller for retail trade as a whole. We also present a specification that additionally controls for state-specific linear time trends, because estimated employment elasticities have been shown to be sensitive to the inclusion of trends (Allegretto et al., 2017). Indeed, the results we find are slightly smaller when we include these trends[16]. Finally, we do not find any evidence for negative employment effects as reported in Table 12. When we account for linear state trends, the estimated elasticity of grocery store employment is significantly positive.[17] We also test whether the number of establishments in a county is related to the prevailing minimum wage, but we find no statistically significant effect in any of the three industries.

[Table 12 about here.]

As expected, the regressions suggest that the labor cost of grocery stores is affected by minimum wage hikes. Further investigations, discussed at more length in appendix A.4, provide two further results. First, when studying the dynamics of the wage effects by including leads and lags of the minimum wage to the regression, we find that the earnings effect of the minimum wage hike is concentrated in the quarter when the hike is implemented. The response of prices at legislation thus reflects an anticipation of future wage increases, rather than premature compliance with future minimum wage laws. Second, as one would expect, the minimum wage elasticity of earnings in grocery stores increases with the bindingness of a minimum wage hike, which we compute as the average difference between the prevailing average wage in a county prior to a hike and full time equivalent minimum wage earnings after a hike.

[15] Our baseline labor cost elasticities are somewhat smaller than the elasticities for the US retail sector estimated in Sabia (2009) using CPS wage data. They are larger than those estimated in Addison et al. (2009) for the 1990–2005 period. Our estimates are similar to those reported in Leung (2016) and Ganapati and Weaver (2017), who also use QCEW data for a similar time period.

[16] Another specification check suggested by Allegretto et al. (2017) is the inclusion of time fixed effects by census division. This robustness test is presented in Table A.18 in the appendix.

[17] This evidence replicates earlier results from Addison et al. (2009) who also use county-level QCEW data but focus on the 1990–2005 period.

6.3 Pass-through

Our combined estimates of the labor cost share and the minimum wage elasticities of the average wage allow us to compute pass-through rates using equation 8. Our baseline point estimate for the elasticity of cost is $0.16 \cdot 0.11 = 0.018$. We compute pass-through rates by dividing the price elasticity at legislation by the estimated cost elasticity. The results are shown in Table 13. Our estimate for pass-through based on our baseline specification amounts to 1.1. We cannot reject the hypothesis that pass-through is equal to 1—the p-value on the test is 0.78. If we base the pass-through ratio on our estimates including division-time or chain-time fixed effects, we get values of 1.17 (p-value: 0.53) and 0.84 (p-value: 0.65). Our estimates are not extremely precise—however, they are close to the price elasticity in magnitude, and our estimates of the minimum wage elasticity of prices are consistent with full pass-through.

[Table 13 about here.]

6.4 Discussion of potential increases in COGS

In the previous section, we show that the minimum wage elasticity of prices is about the size of the minimum wage elasticity of marginal cost. However, so far we only took into account changes in stores' labor cost. In this section, we discuss the possibility that minimum wages increase the cost of goods sold (COGS). As shown in Table 3, COGS make up about 83% of grocery stores' variable cost. Moreover, retail stores have been shown to be very responsive to changes in COGS (see e.g. Eichenbaum et al. (2011) or Nakamura and Zerom (2010)). If minimum wage workers are employed in the production of grocery products, one may expect that producers also increase their prices. Due to the high cost share of COGS in retailers' cost, even a relatively minor increase in producer prices could affect retail prices.

Our price data does not include any measure of wholesale cost, and we cannot estimate the impact of minimum wages on the wholesale cost of grocery products directly. We thus follow MaCurdy (2015) and use input-output tables to calculate a prediction of the elasticity of prices for sectors producing groceries under the assumption of full pass-through all along the production chain.

The input-output tables of the national accounts cover sectoral labor shares[18] s_j^L, which we use as the labor cost elasticity of prices for this sector. We use minimum wage shares in sectoral earnings s_j^{mw} computed from the CPS as the elasticity of labor cost to minimum wages. Finally, we compute the value of output of industry j used to

[18] These labor shares are in revenues, not cost.

product one dollar of output in industry i from the input-output tables.[19] We denote this coefficient $\alpha_{i,j}$. We can then predict the minimum wage elasticity of producer prices in each sector as:

$$\frac{\partial P_i}{\partial MW}\frac{MW}{P_i} = \sum_j \alpha_{i,j} \cdot s_j^L \cdot s_j^{mw} \tag{10}$$

The predicted minimum wage elasticities of prices of manufacturing industries relevant to grocery stores are listed in Table A.20 in the Appendix. The elasticities are of similar magnitude as the direct impact of increases in labor cost on retail marginal cost. The output-weighted average predicted elasticity of producer prices in grocery manufacturing industries amounts to 0.018 when we use 110% of the minimum wage to define minimum wage workers and 0.026 when we use 130%. Full pass-through in manufacturing industries could thus affect the marginal cost of grocery stores to a comparable extent as the direct effect of increasing labor costs.

The extent to which increases in COGS affect our estimates depends on whether they are passed through, but also on whether they occur locally. If wholesale groceries are perfectly tradeable, a minimum wage hike would increase COGS equally for stores everywhere, and any pass-through of this cost increase would be absorbed in time fixed effects in our baseline estimation. Our estimates would thus underestimate the extent of price increases. If, on the other hand, groceries were not tradeable at all, pass-through of increases in COGS would be captured in our baseline estimates. However, because we do not take increases in COGS into account in the denominator of our pass-through calculations, we would overstate actual pass-through rates.

Our data does not contain information about where a particular product is produced. However, we can study the origin composition of groceries sold in a state using grocery wholesale-to-retail flows reported in the Commodity Flow Survey.[20] This dataset covers sales of manufacturing companies, but also intermediaries such as merchant wholesalers or warehouses. As a result, we cannot identify the location of production with certainty. In Figure A.17 in the Appendix, we document that a disproportionate share of grocery products are delivered by wholesalers located in the same state or census division as the retailers they supply. We interpret this as weak evidence for some home bias in grocery consumption. This suggests that our baseline estimates may capture some pass-through of increases in COGS. Since COGS are likely correlated within regions or chains, our specifications including census division-time and chain-time fixed effects should absorb most of these effects. Consistent with this idea, the estimates of the minimum wage elasticity of prices are are lower in these specifications. The corresponding pass-through

[19] This corresponds to the i, j entry of the domestic requirements matrix in the input-output tables.

[20] The Commodity Flow Survey has been used to document home bias in intra-national trade in the US by Wolf (2000). We refer the reader to his paper for a detailed description of the data.

rates are slightly lower too, but we still cannot reject the hypothesis of full pass-through of direct labor cost increases.

6.5 Discussion of the importance of demand increases

In this section, we discuss the possibility that expected or implemented minimum wage increases shift the demand for grocery products upward, and that stores raise prices in response to or in anticipation of this demand shock. This view has been advocated in Leung (2016) and Alonso (2016), who find a positive impact of minimum wages on real grocery store revenues. In contrast, Aaronson et al. (2012) find no impact of minimum wages on consumption of nondurables and services, even in households with minimum wage earners.

The role of demand in the price response to minimum wage increases is determined by three factors. First, grocery stores' prices have to be responsive to changes in demand. Second, demand for groceries has to be responsive to changes in incomes. Third, minimum wages need to have a substantial effect on local aggregate incomes. Taking these three factors into account, it seems implausible that minimum wage hikes lead to a shift in market demand that would affect prices in a quantitatively important way.

First, existing estimates of grocery stores' supply curve suggest that prices are unresponsive to changes in demand, even in the face of very large demand shifts (Chevalier et al., 2003; Gagnon and Lopez-Salido, 2014; Cavallo et al., 2014). Second, the magnitude of the shift in individual demand associated with increasing income depends on the income elasticity of grocery demand. Products sold in grocery stores are typically necessities with income elasticities below one (see Banks et al. (1997) or Lewbel and Pendakur (2009) for food at home). Any shift in individual demand is thus smaller than the underlying increase in income. Finally, it is questionable that minimum wage increases would cause a significant increase in local *aggregate* income and local *market* demand. Dube (2017) shows that minimum wages do increase the income of low-income families with an elasticity of up to 0.5 over two years. He finds effects up to the 15th percentile of family incomes. However, these families account for less than 2% of total incomes (in the 2011 CPS). The elasticity of total incomes would then be at the order of magnitude of $0.5 \cdot 0.02 = 0.01$. Taken together, the last two arguments suggest that minimum wage increases should cause no economically significant movement in market demand. Indeed, results presented in Table A.25 also suggest that minimum wages do not affect grocery consumption. In light of the lack of a response to much larger demand shocks, we conclude that demand effects are unlikely to play a role for the price response to minimum wages.

7 The welfare cost of price increases in grocery stores

Our results suggest that consumers rather than firms bear the cost of minimum wage hikes. We now discuss how some of the costs and benefits of a hike are distributed between households with different incomes. In particular, we are interested in how the welfare costs of price increases in grocery stores compare to the benefits that accrue through increasing nominal labor incomes. However, our analysis is partial and does not take into account many other potential costs of minimum wage hikes.

We illustrate static welfare gains and losses based on a hypothetical increase of all binding minimum wages in the US by 20%. We compare the predicted gain in nominal incomes with the Equivalent Variation of the grocery price caused by such a hike. The Equivalent Variation is a first order approximation to the welfare cost of a price change, measured in USD. It assumes that households maximize utility and abstracts from second order effects reflecting the response to changes in relative prices. In particular, the overall USD value of the welfare gain of a household can be expressed as:

$$\Delta U_h^{USD} = \Delta Y_h - \sum_j E_{h,j} \Delta P_j \tag{11}$$

Here, ΔY_h denotes the mean USD increase in household incomes in income bracket h, E_{hj} denotes mean household expenditure for goods sold in sector j and ΔP_j denotes the price change in sector j. The product $E_{hj}\Delta P_j$ represents the Equivalent Variation of a price change in sector j.

7.1 The cost of price increases

We first discuss the welfare cost of the minimum wage hike, i.e. the Equivalent Variation of price increases. We use expenditure data by income bracket provided in the Consumer Expenditure Survey (CES) and include expenditures for the CES categories Food at Home, Personal Care Products and Services, Household Supplies and Alcoholic Beverages as groceries. As shown in Section 5.4.3 we do not find differences in the response of cost-of-living indices for different brackets, so we use our baseline elasticity of 0.02 for all brackets.

Figure 14a presents the costs of price increases caused by minimum wage hikes, measured in USD and relative to household incomes. The USD value of costs is increasing in household incomes. Since groceries are not an inferior good, this is to be expected. For households with incomes below 10,000 USD, the annual costs amounts to about 13 USD. The costs increase up to 43 USD for households with incomes above 150,000 USD. Expressing the costs as a percentage of annual household incomes reveals the regressive impact of the price response. The costs make up about 0.2% of annual income for households in the poorest bracket, and just one tenth of that, i.e. 0.02% for households in the richest bracket.

[Figure 14 about here.]

7.2 The benefits of nominal wage increases

We now discuss how the costs of the price response relate to the first order effect of increasing nominal incomes for each household income bracket. We predict the mean increase in household incomes ΔY_h for each income bracket based on the March 2011 joint distribution of wages, hours worked per week, and weeks worked during the last year. Throughout this exercise, we assume that minimum wage increases have no effect on employment. The welfare effects are thus based on an upper bound on the benefit side, and would be lower if employment effects were negative.

We use the wage and weekly hours distribution during March 2011 avaibale for the CPS monthly outgoing rotation group (MORG). We combine the MORG with the CPS Annual Socioeconomic supplement (ASEC) collected each March, which contains information on annual Household incomes and the number of weeks worked during the previous year. For every person i in the MORG, we calculate the distance to the local binding minimum wage $W_i/MW_{s(i)}$. We then construct a counterfactual labor income as follows:

$$\widehat{Y}_i^L = \begin{cases} W_i \cdot 1.2 \cdot hours_i \cdot weeks_i, & \text{if } \frac{W_i}{MW_{s(i)}} \leq 1.1 \\ W_i \cdot \left(1 + 0.2\frac{1.3 - \frac{W_i}{MW_{s(i)}}}{1.3 - 1.1}\right) \cdot hours_i \cdot weeks_i, & \text{if } 1.1 < \frac{W_i}{MW_{s(i)}} < 1.3 \\ W_i \cdot hours_i \cdot weeks_i, & \text{if } \frac{W_i}{MW_{s(i)}} \geq 1.3 \end{cases} \quad (12)$$

This calculation assumes that wages below 1.1 times the local minimum wage are increased by 20%, and that wages between 1.1 and 1.3 times the local minimum wage increase by a linearly declining factor. This is in line with ripple effects documented in Dube et al. (2015). We calculate the predicted increase in labor income $\Delta Y_i^L = \widehat{Y}_i^L - Y_i^L$ for each individual. We then sum the increase over all household members. Finally, we calculate the average predicted increase in household income for each income bracket using the ASEC household sampling weights.

Figure 14b presents the predicted increase in nominal incomes in USD and in percent of household income as the full length of the respective bars. The distribution of USD gains may seem surprising at first.[21] The poorest households gain relatively little

[21] Dube (2017) estimates the impact of minimum wage increases on family incomes at different per-

compared to other brackets. Their annual incomes go up by about 136 USD and the biggest nominal benefits accrue to middle class households with incomes between 50,000 and 79,000 USD, who gain about 565 USD. This can be explained by low labor supply in the poorest bracket. Table A.22 in the Appendix illustrates that households in the lowest bracket work about 5 hours a week and 7 weeks a year on average, and as a result, labor is a relatively minor source of income. Second, households in the richest bracket still gain substantially. Minimum wage workers in this bracket differ from those in poorer households in one important aspect. As shown in Table A.23 in the appendix, 71% of minimum wage workers in the richest bracket are children of the CPS household reference person, compared to around 10% in poorer brackets. Relative to household incomes, gains are distributed in a more progressive way: the poorest households gain 2.2% of their annual incomes, middle class households 1%, and the richest households gain 0.15%. Figure 14b also illustrates the part of nominal gains that is offset by the Equivalent variation of price increases, which we discuss in more detail in the next subsection.

7.3 Comparing cost and benefits

Figure 15 shows the Equivalent Variation as a percentage of nominal gains to illustrate how much of the nominal gains are offset by the Equivalent Variation of price increases. For the poorest households, the price response in grocery stores offsets 9.8% of the nominal gains. The impact of price increases is substantially smaller for slightly less poor households with higher labor supply. Households with annual incomes between 10,000 and 79,000 USD see 3–4% of their nominal gains offset by the price response. For the richer households the percentage rises again and goes to up to 12.8% for the richest bracket. In the right panel of Figure 15, we also take into account price increases in restaurants for comparison. We use a minimum wage elasticity of restaurant prices of 0.07 estimated in Aaronson (2001) and expenditures for "Food Away from Home" in the CES to calculate the Equivalent Variation. This further reduces the gains from minimum wage increases. For the poorest households, the Equivalent Variation now offsets 20.8% of nominal gains, and for the richest households it offsets almost 40%.

[Figure 15 about here.]

The price response mechanically reduces the nominal gains for all households. Moreover, due to differences in expenditures for groceries, the price response not only affects the level, but also the distribution of gains over different income brackets. To separately

centiles. The range of his reported estimates is quite large and the magnitudes depend on the included controls. He also finds that the poorest families gain less than slightly less poor families. Overall, our predictions for different income brackets are within the range of his estimates.

analyze the redistributive effectiveness of minimum wage increases, we compare the distribution of gains to an inequality neutral income subsidy. In particular, we decompose gains for each income bracket as follows:

$$\frac{\widehat{Y}_h^L - Y_h^L - E_h \Delta P}{Y_h} = (1 + g + s_h) \tag{13}$$

In this decomposition, we choose the level of the inequality neutral subsidy g to equal the overall increase in labor incomes, $\sum_i \hat{Y}_h^L - Y_H^L = (1+g)\sum_i Y_i$. We then calculate s_h for each bracket. These bracket-specific subsidies s_h measure the extent to which a minimum wage increase is redistributive. We calculate g and s_h for three measures of gains: for the initial nominal gains, for the gains taking into account price increases in grocery stores, and for the gains taking into account price increases in grocery stores and restaurants.

Figure 16 presents the bracket specific subsidies. As expected, minimum wages reduce income inequality. The impact on inequality is largest for the purely nominal gains. Taking into account the price response reduces the redistributive impact. This is especially the case for redistribution toward the poorest income bracket. In terms of nominal gains, households in this bracket gain an additional 1.5% of household income over an inequality neutral policy. Taking into account the price response in grocery stores reduces the additional gains to 1.34% and further taking into account restaurants reduces the gains to 1.15%. For less poor households, the price response has a smaller impact on redistribution. Households that earn above 80,000 USD gain less from a minimum wage increase than they would from an inequality neutral policy. For these households the impact of the price response on redistribution is relatively minor as well.

[Figure 16 about here.]

8 Conclusion

In this paper, we study the effects of minimum wage increases on prices in grocery stores. We use scanner data to analyze the response to 166 minimum wage increases and 62 legislative events in the US from 2001 to 2012.

Our findings can be summarized by three key results. First, the minimum wage elasticity of prices is about 0.02. We estimate the minimum wage elasticity of cost as well, and find that this elasticity is roughly the same size. Our results are consistent with a full pass-through of cost increases to consumers. Second, we find that the response to minimum wage increases happens around the time of passage of legislation, rather than at the time of implementation of hikes. This result suggests that grocery stores set their prices in a forward-looking manner and confirms a key prediction of macroeconomic models with nominal frictions. Third, we show that the price response of grocery stores affect the poorest households the most. In particular, price increases offset about 10% of the average nominal gains from minimum wage increases for households in this bracket. Overall, the price response lowers the benefits of minimum wage increases, and makes them less redistributive in real than in nominal terms.

Minimum wage increases are frequently proposed as a measure to address growing wage inequality. Our results suggest that one needs to consider the effects of minimum wages on prices to fully judge their effectiveness as a redistributive policy. In particular, we show that price effects especially reduce the effectiveness of minimum wages as an anti-poverty tool.

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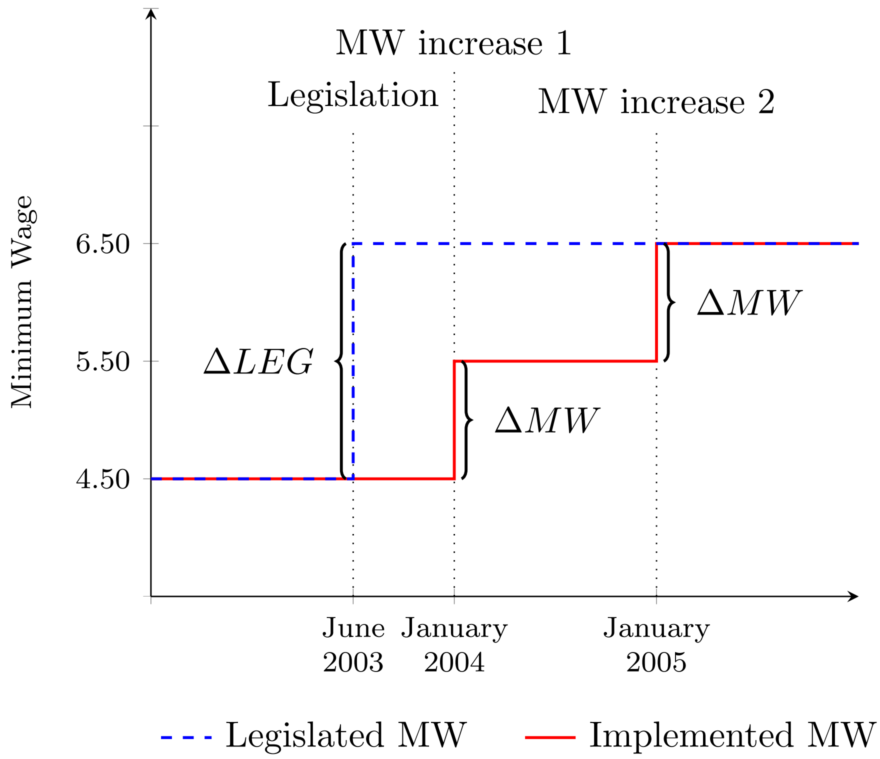
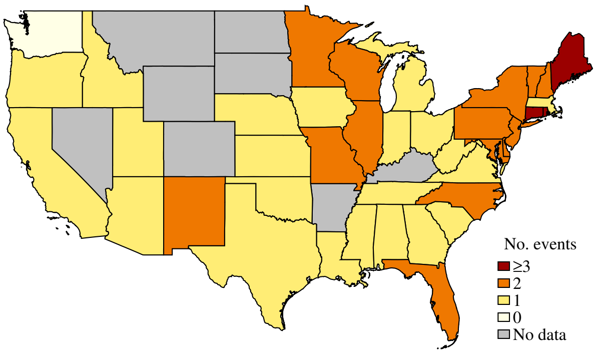
Figures

Figure 1: Example for the measurement of changes in legislated minimum wages

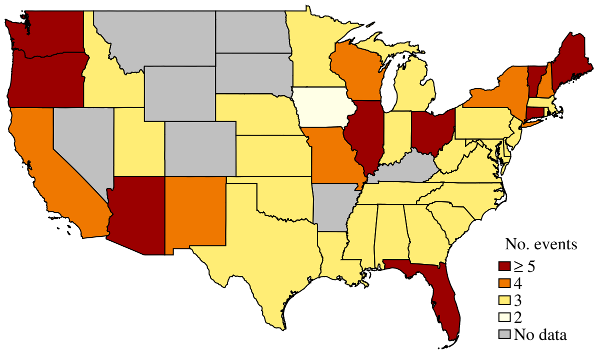


Notes: The figure illustrates the measurement of changes in the legislated and implemented minimum wage based on an hypothetical minimum wage increase in two steps. In June 2003, legislation is passed that will increase the minimum wage in from an initial value of 4.50 USD to 6.50 USD. The law schedules an increase to 5.50 in January 2004, and to 6.50 in January 2005. Our measure of the legislated minimum wage is equal to 4.50 before June 2003. It increases to 6.50 when the legislation is passed in June 2003. Before June 2003 and after January 2005 the legislated minimum wage is equal to the implemented minimum wage.

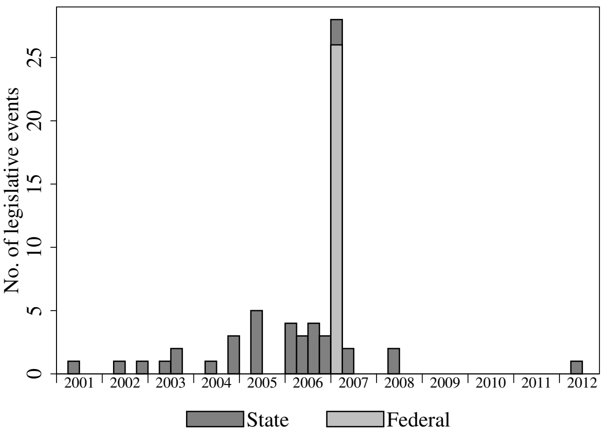
Figure 2: Distribution of minimum wage hikes and legislative events over time and states



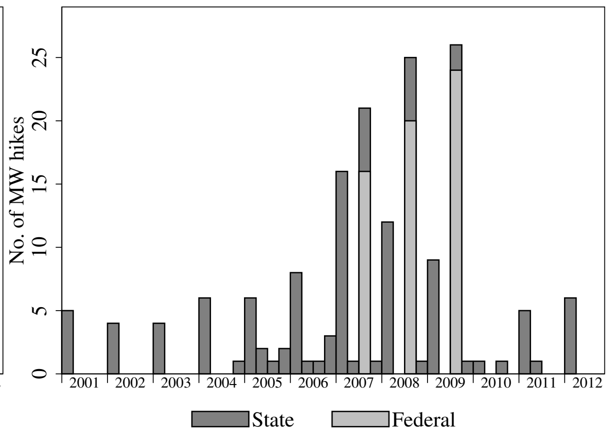
(a) Legislative events by state



(b) Minimum wage increases by state



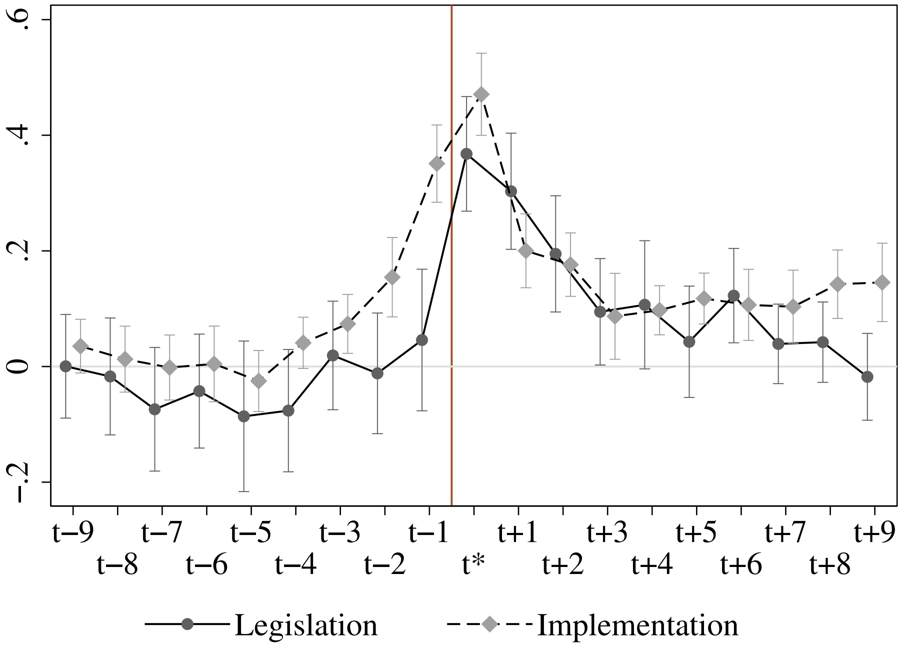
(c) Legislative events over time



(d) Minimum wage increases over time

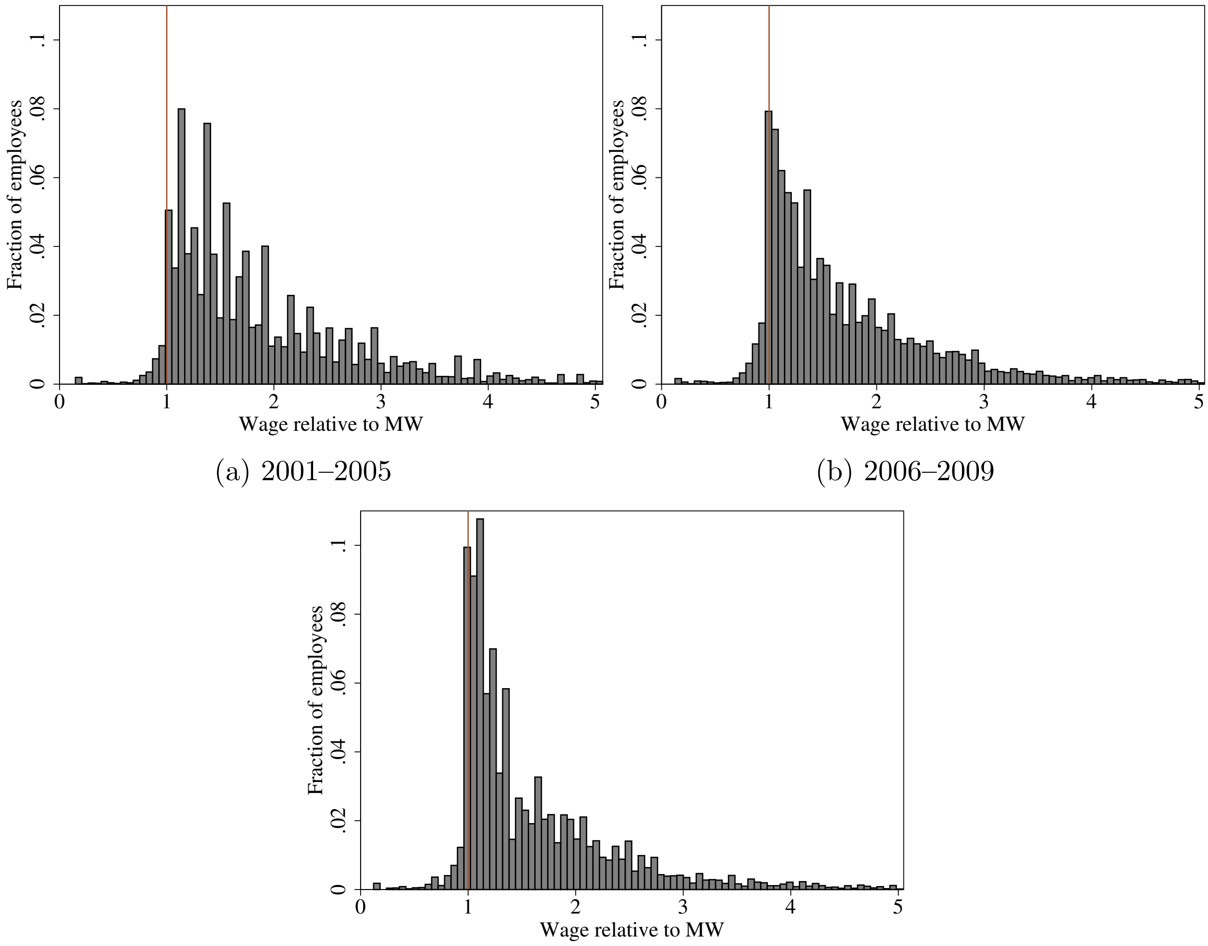
Notes: The figure illustrates the distribution of changes in the implemented minimum wage and changes in the legislated minimum wage over time and states. Overall, we observe 166 increases in the implemented minimum wage and 62 legislative events from 2001 to 2012. 60 changes in the implemented minimum wage and 26 changes in the legislated minimum wage follow from federal minimum wage policy. The remainder follows from state-level policies.

Figure 3: Google search volume for "minimum wage *statename*" around legislation and implementation of minimum wage increases



Notes: The figure shows the log change in monthly Google search volume for the search term "Minimum wage+*statename*" around changes in minimum wage legislation and implementation of higher minimum wages in state *statename*. The coefficients are estimated from equation 1. The effects are relative to state and time fixed effects. Note that the search terms differ between states, but measured search volume is for United States as a whole.

Figure 4: The wage distribution in grocery stores relative to local minimum wages



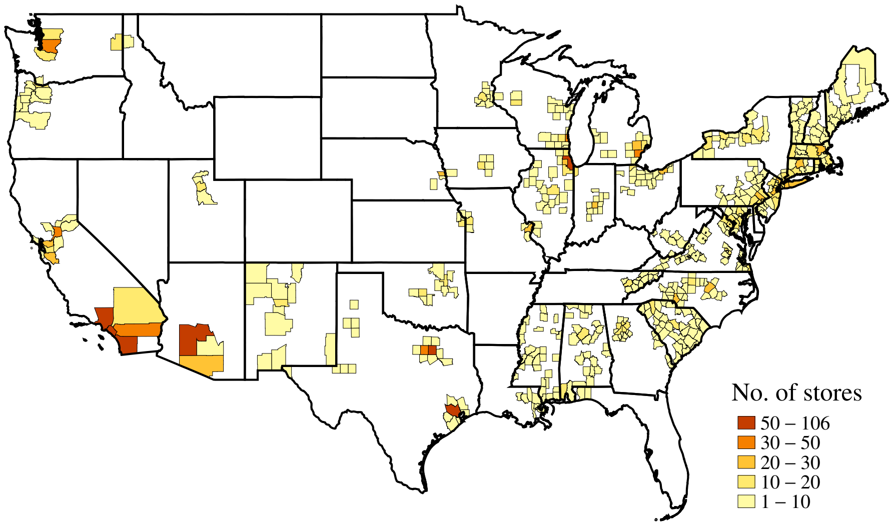
(a) 2001–2005

(b) 2006–2009

(c) 2010–2012

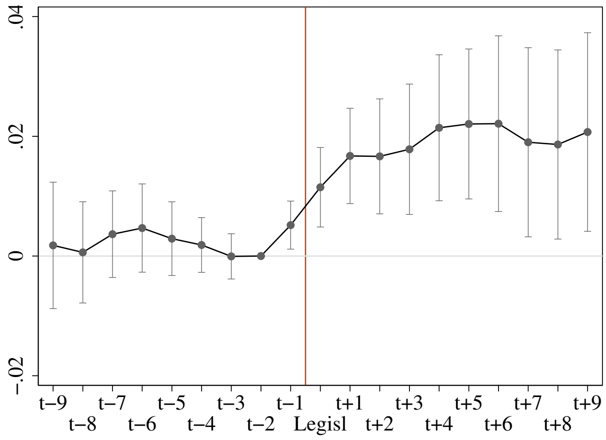
Notes: The figure illustrates the wage distribution in grocery stores relative to local minimum wages. It is based on CPS MORG data for the sector "grocery stores" (NAICS 4451). Wages are computed using reported hourly wages for workers paid by the hour, and weekly earnings divided by weekly hours for other workers. All observations are pooled for the indicated periods. Distributions are calculated using CPS earnings weights. Wages below the local minimum may correspond to workers exempted from minimum wage laws (for example full-time students, workers with disabilities) or measurement error in the CPS survey.

Figure 5: Regional distribution of stores in IRI data across the US

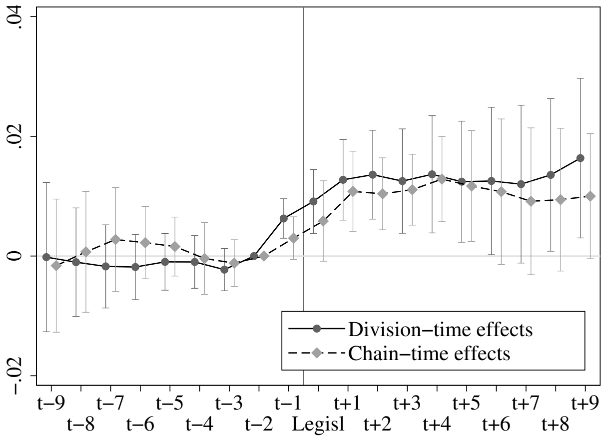


Notes: Geographical distribution of stores in the IRI data. The map shows stores per county. Of the 3142 counties in the US, 530 (17%) are covered with at least one store in the IRI data.

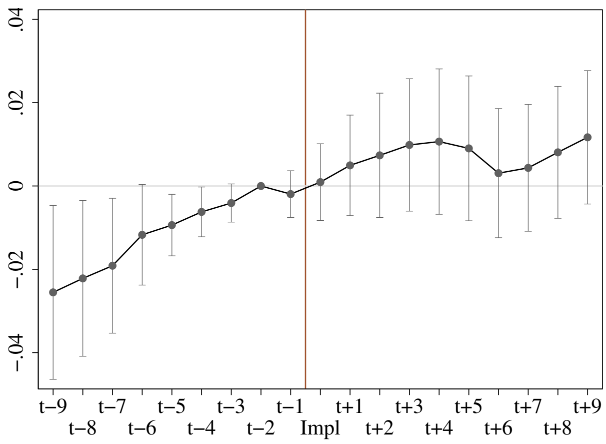
Figure 6: Cumulative minimum wage elasticities of prices from separate estimation



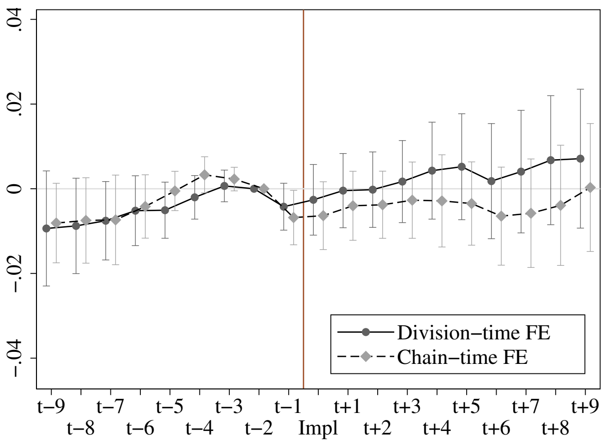
(a) Legislation: Baseline specification



(b) Legislation: Controlling for chain-time or division-time effects



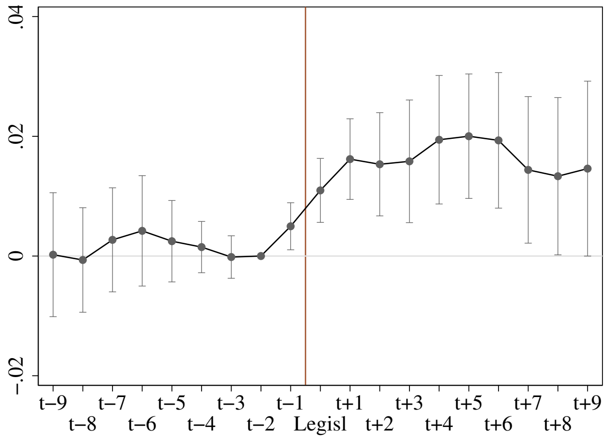
(c) Implementation: Baseline specification



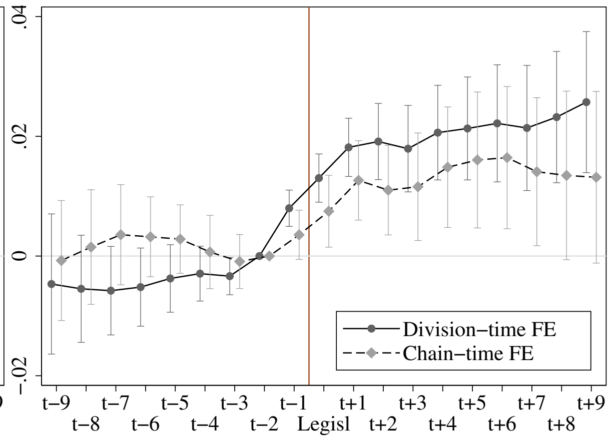
(d) Implementation: Controlling for chain-time or division-time effects

Notes: The figures present the cumulative minimum wage elasticity of prices at grocery stores. Effects at legislation and implementation are estimated separately. Panels (a) and (c) show the cumulative elasticities at legislation and implementation estimated from the separate baseline specifications. Panels (b) and (d) show elasticities estimated controlling for chain-time or division-time effects. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also present 90% confidence intervals of these sums based on SE clustered at the state level.

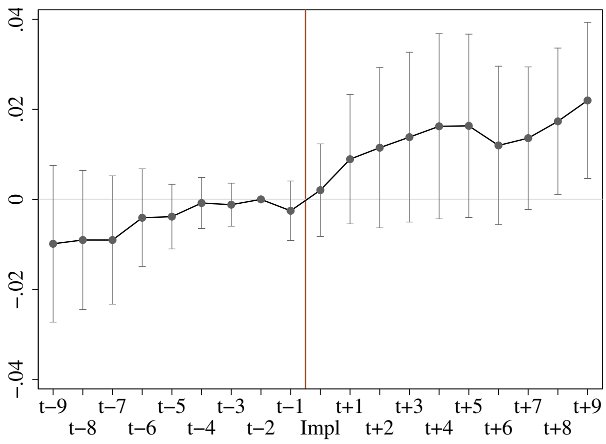
Figure 7: Cumulative minimum wage elasticities of prices from joint estimation



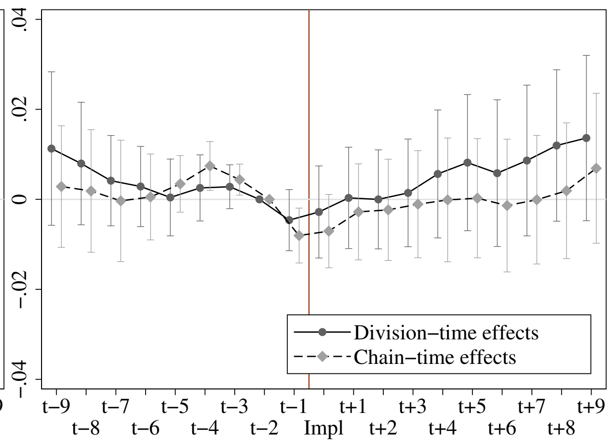
(a) Legislation: Baseline specification



(b) Legislation: Controlling for chain-time or division-time effects



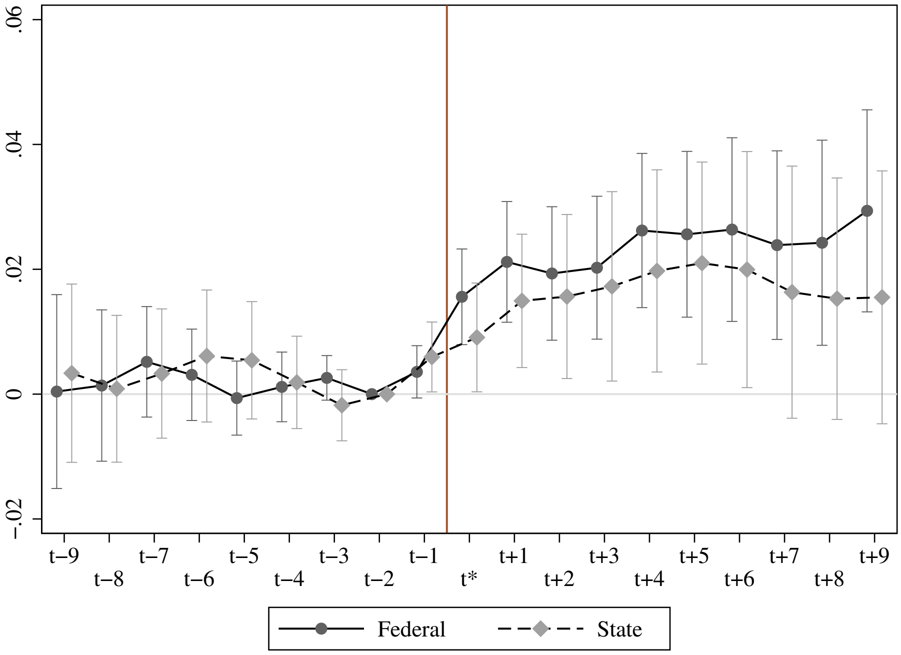
(c) Implementation: Baseline specification



(d) Implementation: Controlling for chain-time or division-time effects

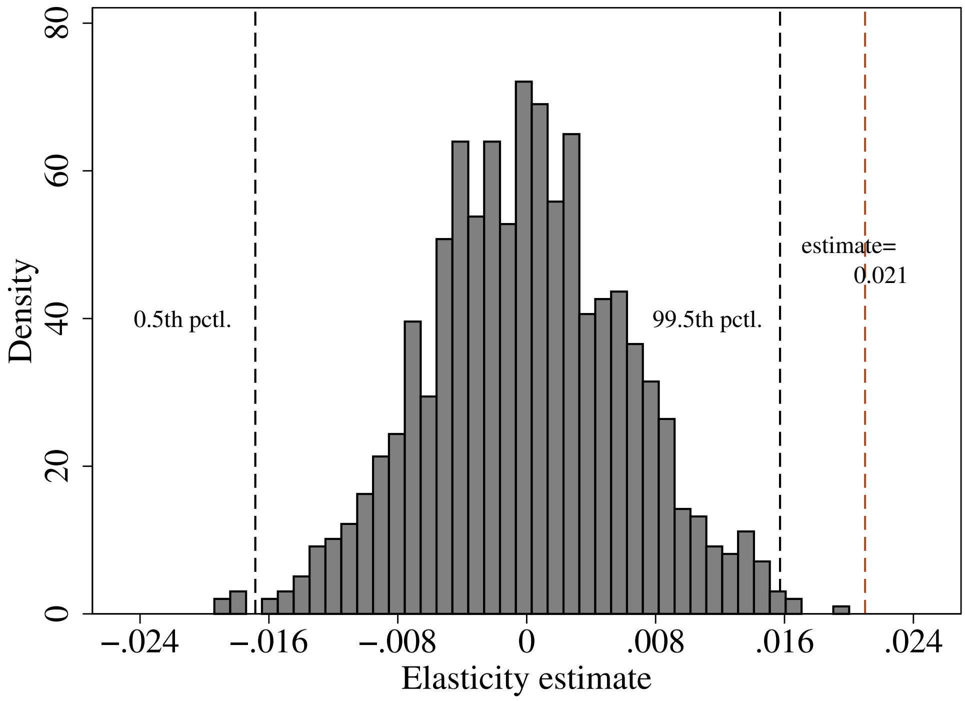
Notes: The figures present the cumulative minimum wage elasticity of prices at grocery stores. For each specification, the effects at legislation and implementation are estimated jointly from equation 4. Panels (a) and (c) show the cumulative elasticities at legislation and implementation estimated from the baseline specification. Panels (b) and (d) show elasticities estimated controlling for chain-time or division-time effects. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also present 90% confidence intervals of these sums based on SE clustered at the state level.

Figure 8: Cumulative minimum wage elasticities of prices around federal- and state-level minimum wage legislation



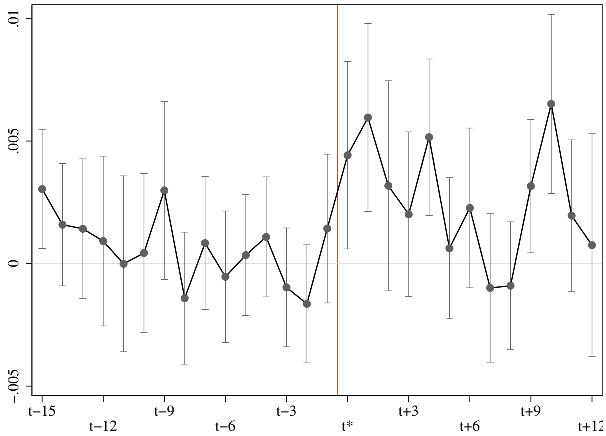
Notes: The figure presents the cumulative minimum wage elasticity of prices at grocery stores around federal and state-level minimum wage legislation. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also present 90% confidence intervals of these sums based on SE clustered at the state level.

Figure 9: Placebo test

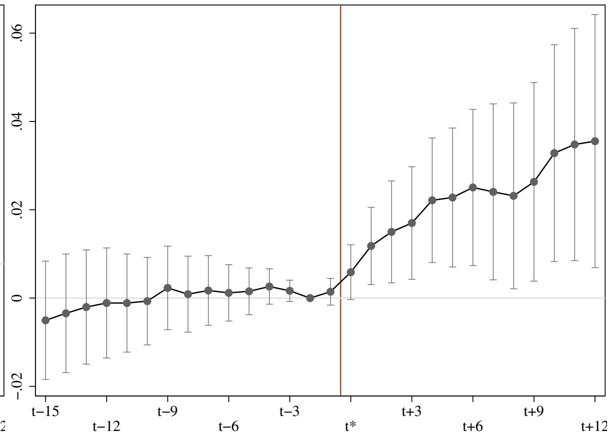


Notes: The figure presents the results of a placebo test in which we match all stores in a state with a random state's minimum wage series. Draws are without replacement and include the correct match. The histogram shows the distribution of elasticity estimates at legislation over 1000 randomly matched samples. The mean elasticity estimate is −0.00003. Our baseline estimate of the elasticity at legislation is 0.021 and clearly outside the suggested 99% confidence interval.

Figure 10: State level estimates of the price effects of the minimum wage around the time of legislation, using an extended event window



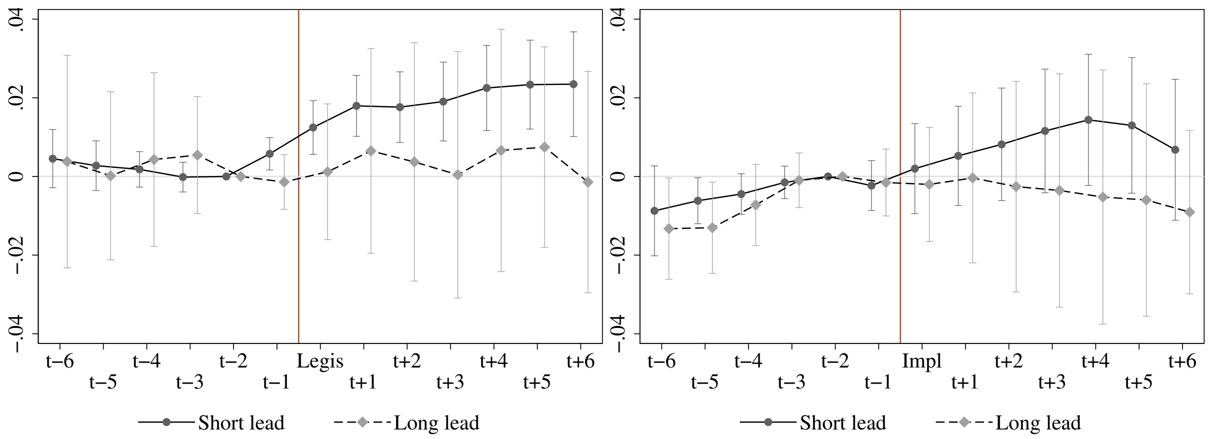
(a) Effect on the inflation rate



(b) Effect on the price level

Notes: The figure presents estimates using state level price indices and an extended event window of $k = -15$ to $k = 12$, focusing on the minimum wage effects at legislation. The dependent variable is the state-level month-on-month inflation rate. The panel on the right presents the estimates of α_r and the left panel their cumulative sum over the 24 month panel. Each panel also shows corresponding 90% confidence intervals based on SE clustered on the state level. The controls included are time and state FE, local unemp. rate and house price growth.

Figure 11: Cumulative minimum wage elasticities of prices for events with different timing

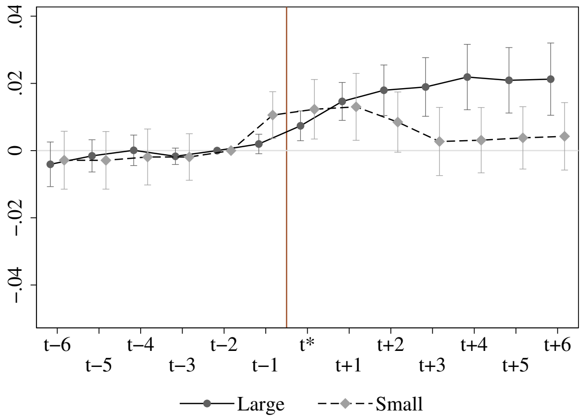


(a) Effects at legislation

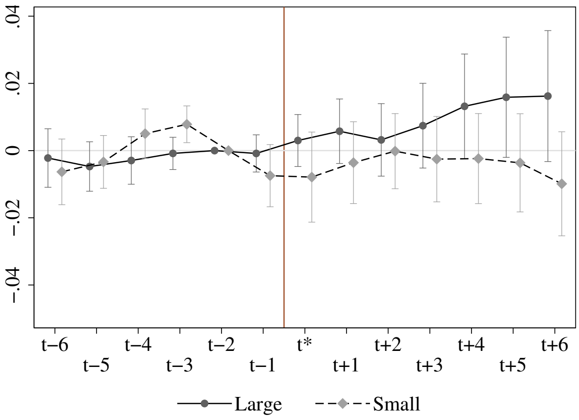
(b) Effects at implementation

Notes: The figure presents the cumulative minimum wage elasticity of prices at grocery stores. Panel (a) shows the effects at legislation for legislation that is followed by implementation of a first increase within 8 months and legislation that is implemented further in the future. Panel (b) shows the effects at implementation for increases that are preceded by legislation within the previous 8 months and those whose legislation lies further in the past. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also show 90% confidence intervals of these sums based on SE clustered at the state level.

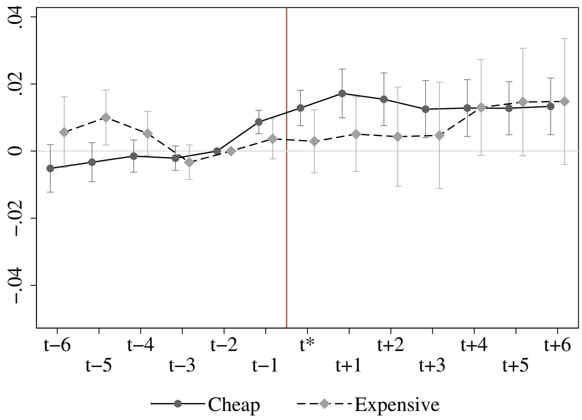
Figure 12: Cumulative minimum wage elasticities of prices by store characteristics



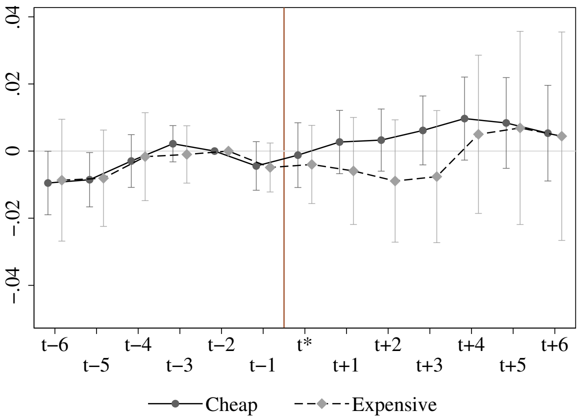
(a) Effects by store size: legislation



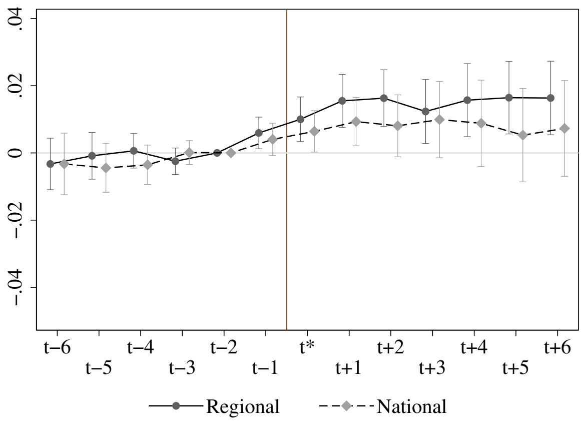
(b) Effects by store size: implementation



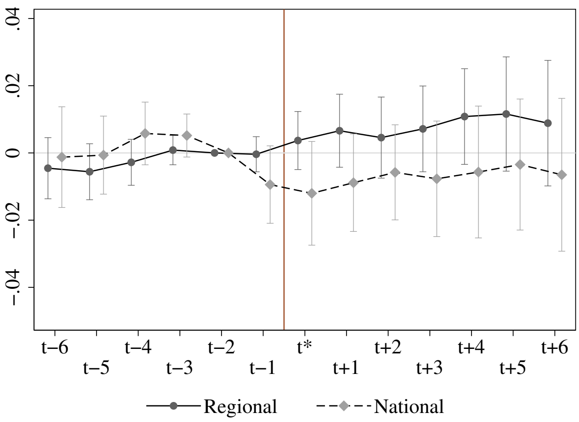
(c) Effects by expensiveness: legislation



(d) Effects by expensiveness: implementation



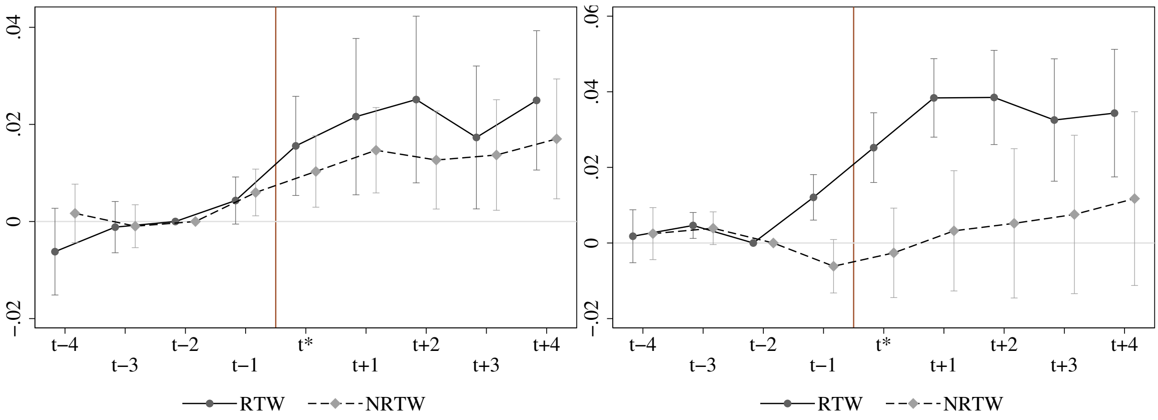
(e) Effects by chain size: legislation



(f) Effects by chain size: implementation

Notes: The figures present the cumulative minimum wage elasticity of prices at grocery stores by several heterogeneity dimensions. The effects shown in panels (a) and (b), (c) and (d) and (e) and (f) are estimated jointly from equation 4, where we include the full set of leads and lags for both dimensions of heterogeneity. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also show 90% confidence intervals of these sums based on SE clustered at the state×dimension-of-heterogeneity level.

Figure 13: Effects for stores in RTW and non-RTW states



(a) Elasticity at legislation (b) Elasticity at implementation

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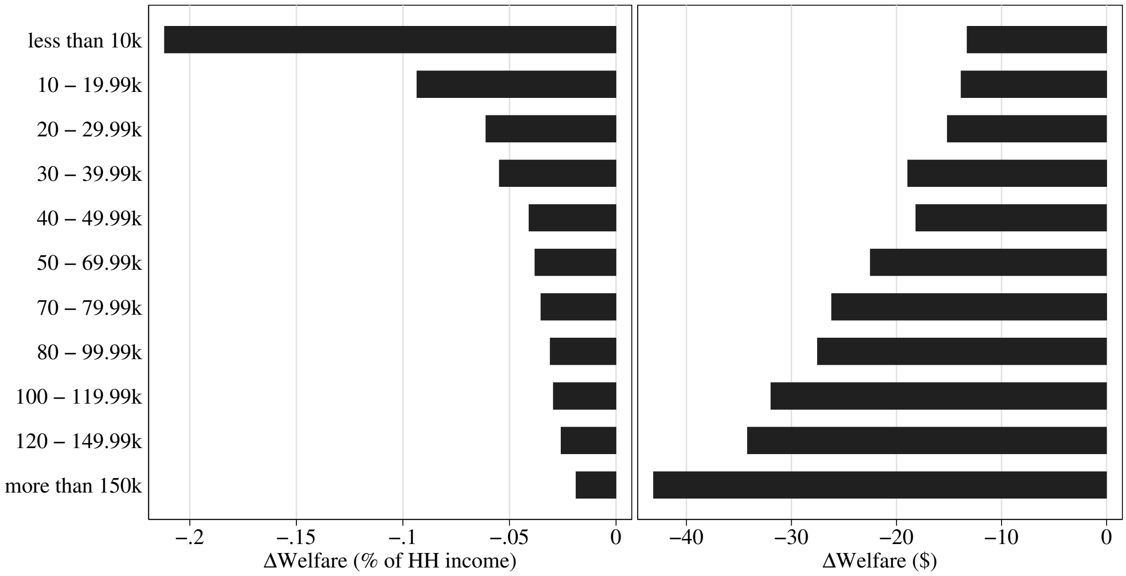
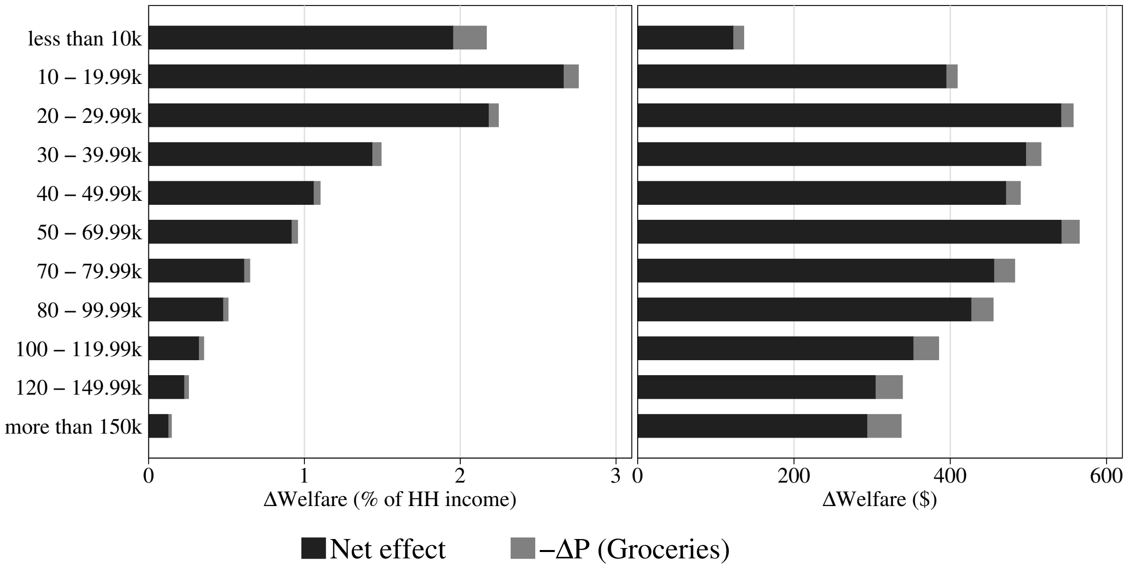
Notes: The figures present the cumulative minimum wage elasticity of prices at in states with or without Right-to-work (RTW) laws. 17 states in our sample have RTW laws. Effects at legislation and implementation are estimated jointly. The estimated coefficients are summed up to cumulative elasticities E_R as described in section 4. The figures also show 90% confidence intervals of these sums based on SE clustered at the state level.

Figure 14: The welfare costs of price increases after a 20% minimum wage increase



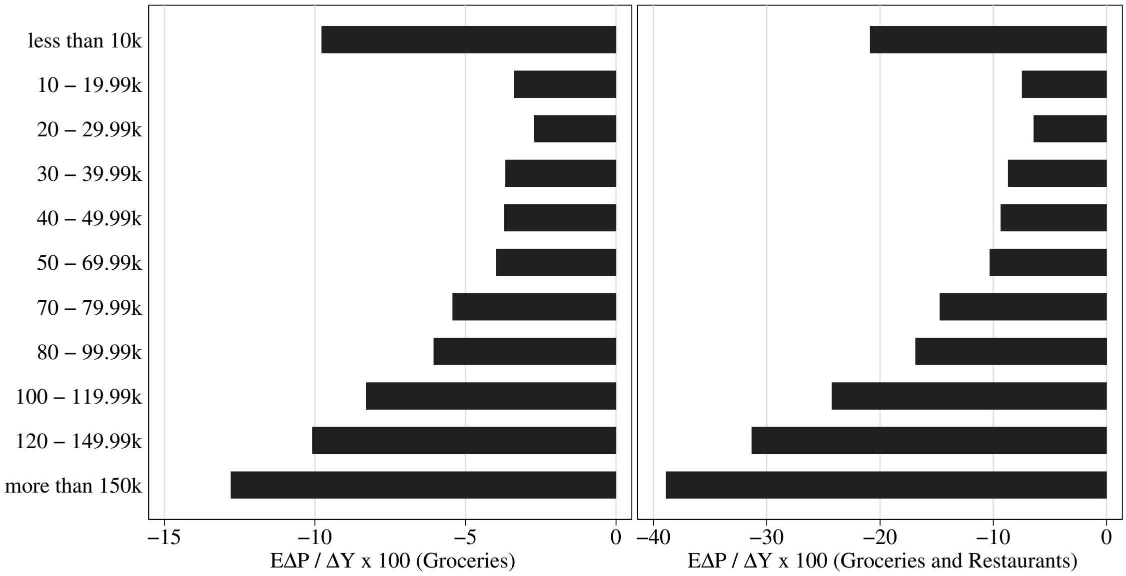
(a) Equivalent Variation of price increase



(b) Nominal gains, Equivalent Variation and Net effect

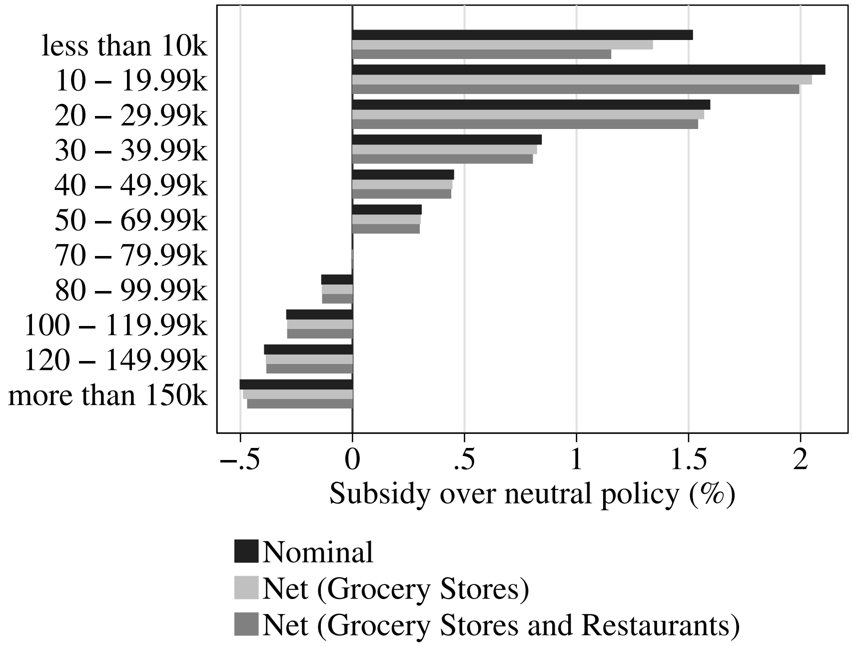
Notes: The figures illustrate the Equivalent Variation (EV) of increasing all binding minimum wages in the US by 20%. See section 7 for a detailed description of the calculations involved. Figure 14a shows the EV for each income bracket in USD (right) and relative to mean household incomes (left). Figure 14b shows nominal gains (length of the bar), EV (gray) and the net effect (black) in USD (right) and relative to mean household incomes (left).

Figure 15: Equivalent Variation as percentage of nominal gains



Notes: The figure illustrates the Equivalent Variation (EV) as a percentage of nominal gains. The left panel is based on price increases in grocery stores. The right panel is based on price increases in grocery stores and restaurants.

Figure 16: Bracket specific income subsidy over inequality neutral policy



Notes: The figure isolates the impact of gains from minimum wage increases on inequality from the level effect. We decompose nominal gains, gains net of price increases in grocery stores, and net of price increases in grocery stores and restaurants into an inequality neutral part and a bracket specific subsidy using equation 13.

Tables

Table 1: Summary statistics for minimum wage increases and minimum wage legislation

	Changes in implemented MW		Changes in legislation	
	Mean	SD	Mean	SD
Log size of increase	0.0816	(0.0560)	0.201	(0.116)
Events per state	4.049	(1.974)	1.512	(0.746)
Months to last event	13.86	(7.028)	23.32	(16.76)
Months hike to legislation / legislation to first hike	15.65	(9.823)	8.742	(8.014)
Share federal hike	0.361	(0.482)	0.419	(0.497)
Share indexed hike	0.235	(0.425)		
Share 2001–2005	0.157	(0.365)	0.242	(0.432)
Share 2006–2008	0.542	(0.500)	0.742	(0.441)
Share 2009–2012	0.301	(0.460)	0.0161	(0.127)
Share January	0.458	(0.500)	0.452	(0.502)
Share July	0.434	(0.497)	0.0484	(0.216)
Number of Events	166		62	

Notes: The table lists descriptive statistics for our two main exogenous variables: Changes in implemented and legislated minimum wages. The legislated minimum wage is the highest future minimum wage set in current law. The data on state-level binding minimum wages is provided by the Institute for Research in Labor and Employment at UC Berkeley. We collected data on legislative events ourselves from media sources and legislative records.

Table 2: Consumption expenditure shares on grocery stores' products by household income

	All households	1st Quintile lowest	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile highest
2001 - 2005	11.1	15.3	13.6	12.1	11.1	9.1
2006 - 2009	10.7	14.3	12.7	11.4	10.7	9.0
2010 - 2012	11.0	14.4	12.8	11.6	10.8	9.4

Notes: Data are from the Consumer Expenditure Survey. Grocery products include: Food at Home, Household Supplies, Alcoholic Beverages, Personal Care Products and Services. Shares are calculated for each year and quintile of household incomes and then averaged over all years in a period.

Table 3: The cost structure of grocery stores

	Variable Cost			Fixed Cost		
	Labor Cost	COGS	Other Variable Cost	Buildings and Equipm.	Purchased Services	Other Operating Exp.
				Share in Total Cost		
2007	14.7	75.1	0.6	5.5	1.9	2.3
	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)
2012	14.1	75.4	0.6	5.4	1.8	2.7
	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.1)
				Share in Variable Cost		
2007	16.3	83.1	0.7	0.0	0.0	0.0
	(0.1)	(0.6)	(0.0)	(0.0)	(0.0)	(0.0)
2012	15.6	83.7	0.7	0.0	0.0	0.0
	(0.2)	(0.6)	(0.0)	(0.0)	(0.0)	(0.0)
				Share in Revenues		
2007	13.9	71.1	0.6	5.2	1.8	2.1
	(0.0)	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)
2012	13.6	72.7	0.6	5.2	1.7	2.6
	(0.1)	(0.2)	(0.0)	(0.0)	(0.0)	(0.1)

Notes: Data are from the BLS Annual Retail Trade Survey (ARTS). All numbers are in %. A breakdown of operating expenses into categories is published every 5 years. Labor Cost includes salaries, fringe benefits and commission expenses. Cost Of Goods Sold (COGS) is calculated as nominal annual purchases minus nominal year-on-year changes in inventory. Other Variable Cost includes transport and packaging cost. Buildings and Equipment includes rents, purchases of equipment, utilities and depreciation. Purchased Services includes maintenance cost, advertisement, etc. Other Operating Expenses includes taxes and the residual operating expenses category. We illustrate shares in three different denominators. Total cost includes all cost. Variable Cost includes Labor Cost, COGS and Other Variable Cost. Estimates of the shares and SE in parentheses are based on Taylor expansions using the coefficients of variation published in the ARTS.

Table 4: Features of regular prices

	2001-2006		2007-2012	
	Mean	Median	Mean	Median
Frequency of price change	0.117	0.103	0.132	0.122
Implied median duration	8.037	9.200	7.064	7.686
Frequency of price increase	0.067	0.060	0.078	0.074
Frequency of price decrease	0.050	0.040	0.054	0.043
Share of price increases in changes	0.605	0.576	0.623	0.602
Absolute size of price change	0.154	0.114	0.144	0.105
Absolute size of price increase	0.147	0.105	0.140	0.100
Absolute size of price decrease	0.184	0.146	0.166	0.132
SD log price	0.152	0.154	0.150	0.151
Monthly inflation	0.0007	0.0008	0.0016	0.0015

Notes: To construct these measures, we first calculate the frequency and size of price changes for each product in each store separately. For frequencies, we count changes and divide them by the number of observations for which we also observe a lagged price. We also calculate the standard deviation of the logarithm of prices within each state for each unique product. We then construct expenditure weighted means and medians for each category for the periods 2001 to 2006 and 2007 to 2012. Finally, we take expenditure weighted means over all 31 broad product categories. To summarize inflation rates, we take the weighted mean or median of our store-level inflation rates for the same periods.

Table 5: Cumulative elasticities for our baseline estimates

Dep. variable: Store inflation	Separate estimation (1) Baseline	(2) Div.-time	(3) Chain-time	(4) Baseline	(5) Div.-time	(6) Chain-time	Joint estimation (7) Baseline	(8) Div.-time	(9) Chain-time
Legislation									
E_0^{leg}	0.011***	0.009***	0.006				0.011***	0.013***	0.007**
	(0.004)	(0.003)	(0.004)				(0.003)	(0.002)	(0.004)
E_2^{leg}	0.017***	0.014***	0.010***				0.015***	0.019***	0.011**
	(0.006)	(0.005)	(0.004)				(0.005)	(0.004)	(0.005)
E_4^{leg}	0.021***	0.014**	0.013***				0.019***	0.021***	0.015**
	(0.007)	(0.006)	(0.004)				(0.007)	(0.005)	(0.006)
Implementation									
E_0^{inc}				0.001	-0.003	-0.006	0.002	-0.003	-0.007
				(0.006)	(0.005)	(0.005)	(0.006)	(0.006)	(0.005)
E_2^{inc}				0.007	-0.000	-0.004	0.011	-0.000	-0.002
				(0.009)	(0.005)	(0.005)	(0.011)	(0.007)	(0.007)
E_4^{inc}				0.011	0.004	-0.003	0.016	0.006	-0.000
				(0.011)	(0.007)	(0.007)	(0.013)	(0.009)	(0.008)
Estimation Summary									
$E_4^{leg}+E_4^{inc}$							0.036**	0.026**	0.015
							(0.014)	(0.011)	(0.011)
$\sum$ All	0.019	0.019	0.013	0.037**	0.015	0.010	0.046*	0.033	0.021
	(0.016)	(0.017)	(0.013)	(0.015)	(0.013)	(0.012)	(0.024)	(0.024)	(0.016)
$\sum$ Pre-event	-0.002	0.002	0.003	0.025*	0.008	0.010	0.010	-0.007	0.001
	(0.007)	(0.010)	(0.008)	(0.014)	(0.009)	(0.007)	(0.016)	(0.019)	(0.012)
N	191568	191568	190768	191568	191568	190768	191568	191568	190768
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Division time FE	NO	YES	NO	NO	YES	NO	NO	YES	NO
Chain time FE	NO	NO	YES	NO	NO	YES	NO	NO	YES

Notes: The table lists cumulative elasticities E_R, R months after legislation or implementation. The dependent variable is the store-level monthly inflation rate. Baseline controls are the unemployment rate and house price growth. Columns 1–3 show results of separate estimation of effects at legislation. Columns 4–6 show results of separate estimation of effects at implementation. Columns 7–9 show results of joint estimation of effects at implementation and legislation. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Interaction between price response and initial wage in a county

Dep. variable: Store inflation	(1) Baseline	(2) Chain-time	(3) Baseline	(4) Chain-time
		Legislation		
$\text{wage}_q \times \Delta\text{leg}_{q-1}$	-0.012	0.005		
	(0.010)	(0.010)		
$\text{wage}_q \times \Delta\text{leg}_q$	-0.028**	-0.031**		
	(0.014)	(0.013)		
$\text{wage}_q \times \Delta\text{leg}_{q+1}$	0.003	0.004		
	(0.013)	(0.010)		
		Implementation		
$\text{wage}_{q-2} \times \Delta\text{mw}_{q-1}$			-0.026	-0.006
			(0.035)	(0.028)
$\text{wage}_{q-2} \times \Delta\text{mw}_q$			0.012	0.036
			(0.035)	(0.023)
$\text{wage}_{q-2} \times \Delta\text{mw}_{q+1}$			-0.016	0.010
			(0.028)	(0.025)
		Estimation Summary		
Observations	84741	84503	84748	84512
Controls	YES	YES	YES	YES
Store FE	YES	YES	YES	YES
State time FE	YES	YES	YES	YES
Chain time FE	NO	YES	NO	YES

Notes: The dependent variable is the store-level inflation rate. This specification is estimated at quarterly frequency. Baseline controls are unemployment rate and house price growth. wage is the log county-level average weekly wage in grocery stores relative to the state minimum wage. The listed coefficients are the interaction between minimum wage increases and the local wage at legislation or 2 quarters prior to implementation. SE are clustered at the county level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Robustness checks for separate estimation of effect at legislation

Dep. variable: Store inflation	(1) Weighted	(2) No Controls	(3) No store FE	(4) Seasonal	(5) No salesfilter	(6) Winsorized
			Legislation			
E_0^{leg}	0.009**	0.011***	0.012***	0.009**	0.018***	0.009***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.003)
E_2^{leg}	0.016***	0.017***	0.017***	0.016***	0.022***	0.014***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.007)	(0.004)
E_4^{leg}	0.022***	0.021***	0.022***	0.020***	0.024***	0.019***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.006)
			Estimation Summary			
$E_4^{leg}+E_4^{inc}$	0.022***	0.021***	0.022***	0.020***	0.024***	0.019***
	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)	(0.006)
$\sum$ All	0.022*	0.019	0.021	0.018	0.036***	0.014
	(0.013)	(0.016)	(0.018)	(0.016)	(0.013)	(0.013)
$\sum$ Pre-event	-0.002	-0.002	-0.001	-0.001	0.014	-0.004
	(0.006)	(0.007)	(0.008)	(0.008)	(0.010)	(0.006)
N	191568	191641	191568	191568	191568	191568
Controls	YES	NO	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	NO	YES	YES	YES
Seasonality	NO	NO	NO	YES	NO	NO
Weights	Obs	NO	NO	NO	NO	NO

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. (1) presents the baseline estimates for the effects at legislation. (2) uses observation (UPC) weights. (3) uses observation weights and adds division-time fixed effects. (4) does not contain the control variables. (5) does not contain store fixed effects. (6) accounts for state-specific calendar month fixed effects. (7) does not correct for temporary price changes. (8) uses a winsorized outcome (98% winsorization). $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * p $<$ 0.1, ** p $<$ 0.05, *** p $<$ 0.01.

Table 8: Robustness checks for joint estimation

Dep. variable: Store inflation	(1) Weighted	(2) No Controls	(3) No Store FE	(4) Seasonal	(5) No Sales-filter	(6) Winsorized
			Legislation			
E_0^{leg}	0.008**	0.011***	0.011***	0.009**	0.018***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.002)
E_2^{leg}	0.014***	0.015***	0.016***	0.015***	0.026***	0.013***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.004)
E_4^{leg}	0.019***	0.019***	0.021***	0.019***	0.031***	0.017***
	(0.006)	(0.007)	(0.007)	(0.006)	(0.009)	(0.005)
			Implementation			
E_0^{inc}	0.008	0.002	0.001	0.002	-0.004	0.003
	(0.007)	(0.006)	(0.007)	(0.006)	(0.008)	(0.006)
E_2^{inc}	0.016	0.012	0.011	0.011	0.013	0.012
	(0.011)	(0.011)	(0.012)	(0.011)	(0.009)	(0.011)
E_4^{inc}	0.024*	0.017	0.015	0.018	0.022*	0.015
	(0.013)	(0.013)	(0.014)	(0.013)	(0.011)	(0.012)
			Estimation Summary			
$E_4^{leg}+E_4^{inc}$	0.042***	0.036**	0.036**	0.037**	0.053***	0.033**
	(0.015)	(0.014)	(0.016)	(0.014)	(0.015)	(0.013)
$\sum$ All	0.058***	0.046*	0.046	0.046*	0.041	0.040*
	(0.020)	(0.024)	(0.028)	(0.025)	(0.027)	(0.021)
$\sum$ Pre-event	0.014	0.010	0.008	0.008	-0.004	0.004
	(0.013)	(0.016)	(0.018)	(0.016)	(0.018)	(0.014)
N	191568	191641	191568	191568	191568	191568
Controls	YES	NO	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	NO	YES	YES	YES
Seasonality	NO	NO	NO	YES	NO	NO
Weights	Obs	NO	NO	NO	NO	NO

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. (1) presents the baseline estimates for the joint estimation of the effects at implementation and legislation. (2) uses observation (UPC) weights. (3) uses observation weights and adds division-time fixed effects. (4) does not contain the control variables. (5) does not control for store fixed effects. (6) accounts for state-specific calendar month fixed effects. (7) does not correct for temporary price changes. (8) uses a winsorized outcome (98% winsorization). $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Further robustness checks for joint estimation

Dep. variable: Store inflation	(1) Balanced panel	(2) County trends	(3) Short window	(4) Long window	(5) Pre-2007	(6) Only first hike
			Legislation			
E_0^{leg}	0.008***	0.011***	0.011***	0.012**	0.012***	0.011**
	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)
E_2^{leg}	0.010**	0.015***	0.015***	0.017**	0.018***	0.020***
	(0.004)	(0.005)	(0.005)	(0.007)	(0.005)	(0.006)
E_4^{leg}	0.014**	0.019***	0.018***	0.022**	0.024***	0.025***
	(0.006)	(0.006)	(0.006)	(0.009)	(0.006)	(0.008)
			Implementation			
E_0^{inc}	0.002	0.002	-0.000	0.003	0.000	0.002
	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)
E_2^{inc}	0.017	0.011	0.005	0.012	0.010	0.010
	(0.011)	(0.011)	(0.010)	(0.010)	(0.009)	(0.011)
E_4^{inc}	0.024*	0.015	0.008	0.015	0.017	0.017
	(0.013)	(0.012)	(0.012)	(0.011)	(0.011)	(0.013)
			Estimation Summary			
$E_4^{leg}+E_4^{inc}$	0.038***	0.035**	0.027*	0.037**	0.040***	0.042***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)
$\sum$ All	0.024	0.045*	0.026	0.040	0.044**	0.031
	(0.024)	(0.022)	(0.021)	(0.040)	(0.021)	(0.021)
$\sum$ Pre-event	-0.003	0.010	0.005	-0.005	0.000	-0.011
	(0.016)	(0.016)	(0.012)	(0.022)	(0.014)	(0.014)
N	73646	191568	206477	176822	108217	186151
Controls	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	YES	YES	YES	YES
County trends	NO	YES	NO	NO	NO	NO

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. (1) presents the baseline estimates for the joint estimation of the effects at implementation and legislation. (2) focuses on stores that are present in all 142 periods of our sample. (3) adds county-specific time trends in the inflation rate. (4) uses an event window of length $k \pm 6$. (5) uses an event window of length $k \pm 12$. (6) restricts on the 2002–2007 periods. (7) computes the price effects by only exploiting the first minimum wage hike in each state in the sample period. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 10: State-level estimations

Dep. variable: State inflation	Separate estimation (1) Baseline	(2) Weights	(3) Baseline	(4) Weights	Joint estimation (5) Baseline	(6) Weights
			Legislation			
E_0^{leg}	0.005	0.006*			0.004	0.005
	(0.004)	(0.003)			(0.004)	(0.003)
E_2^{leg}	0.013*	0.014**			0.010	0.012*
	(0.007)	(0.005)			(0.007)	(0.006)
E_4^{leg}	0.019**	0.020***			0.016*	0.016**
	(0.008)	(0.007)			(0.009)	(0.007)
			Legislation			
E_0^{inc}			0.008	0.008	0.007	0.008
			(0.007)	(0.006)	(0.007)	(0.006)
E_2^{inc}			0.009	0.011	0.009	0.011
			(0.010)	(0.009)	(0.010)	(0.010)
E_4^{inc}			0.013	0.015	0.013	0.016
			(0.012)	(0.011)	(0.012)	(0.012)
			Estimation Summary			
$E_4^{leg}+E_4^{inc}$	0.019**	0.020***	0.013	0.015	0.029*	0.032*
	(0.008)	(0.007)	(0.012)	(0.011)	(0.017)	(0.016)
$\sum$ All	0.018	0.021	0.044**	0.048**	0.051*	0.057**
	(0.015)	(0.013)	(0.022)	(0.019)	(0.026)	(0.023)
$\sum$ Pre-event	-0.003	-0.002	0.024**	0.026**	0.014	0.016
	(0.006)	(0.006)	(0.010)	(0.010)	(0.010)	(0.011)
N	5330	5330	5330	5330	5330	5330
Controls	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	YES	YES	YES
Weights	NO	Var	NO	Var	NO	Var

Notes: The dependent variable is the state-level inflation rate. Baseline controls are the state unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. Estimations with "Var" weights use the inverse of the variance of the state-level price series as weight to account for the fact that inflation series in states with few stores are more noisy. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 11: Effects for income specific price indices

Dep. variable: Store inflation w. different weights	Separate estimation (1) Low income	(2) Medium income	(3) High income	(4) Low income	(5) Medium income	(6) High income	Joint estimation (7) Low income	(8) Medium income	(9) High income
					Legislation				
E_0^{leg}	0.009***	0.008***	0.010***				0.013***	0.014***	0.015***
	(0.003)	(0.003)	(0.003)				(0.004)	(0.004)	(0.004)
E_2^{leg}	0.014***	0.013***	0.014***				0.020***	0.019***	0.019***
	(0.003)	(0.003)	(0.003)				(0.004)	(0.004)	(0.004)
E_4^{leg}	0.013**	0.013**	0.014***				0.021***	0.021***	0.021***
	(0.005)	(0.006)	(0.005)				(0.005)	(0.005)	(0.006)
					Implementation				
E_0^{inc}				-0.002	-0.002	-0.002	-0.004	-0.004	-0.003
				(0.005)	(0.005)	(0.005)	(0.007)	(0.006)	(0.006)
E_2^{inc}				-0.002	-0.001	-0.001	-0.006	-0.004	-0.002
				(0.007)	(0.006)	(0.006)	(0.009)	(0.008)	(0.008)
E_4^{inc}				0.009	0.010	0.008	0.006	0.007	0.008
				(0.009)	(0.009)	(0.009)	(0.012)	(0.012)	(0.011)
					Estimation Summary				
$E_4^{leg}+E_4^{inc}$	0.013**	0.013**	0.014***	0.009	0.010	0.008	0.027*	0.029*	0.029**
	(0.005)	(0.006)	(0.005)	(0.009)	(0.009)	(0.009)	(0.015)	(0.015)	(0.014)
$\sum$ All	0.013	0.010	0.010	0.013	0.017	0.021	0.021	0.023	0.028
	(0.013)	(0.012)	(0.012)	(0.016)	(0.015)	(0.014)	(0.025)	(0.024)	(0.023)
$\sum$ Pre-Event	-0.006	-0.008	-0.008	0.005	0.007	0.010	-0.018	-0.018	-0.014
	(0.008)	(0.006)	(0.007)	(0.008)	(0.008)	(0.008)	(0.017)	(0.017)	(0.017)
N	146815	146739	146739	146739	146739	146739	146739	146739	146739
Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Division time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

Notes: The dependent variable is the store-level inflation rate with expenditure weights for different HH income brackets. Low: $< 25k$. Medium: $25k - 75k$. High: $> 75k$. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * p < 0.1, ** p < 0.05, *** p < 0.01.

Table 12: Earnings and employment elasticities to the minimum wage, by industry

	Grocery stores		Retail trade		Acc. and food services	
	(1) Baseline	(2) Trend	(3) Baseline	(4) Trend	(5) Baseline	(6) Trend
Panel A: Dep. variable: Labor cost per worker						
log MW	0.108**	0.083***	0.048*	0.038	0.151***	0.147***
	(0.043)	(0.027)	(0.026)	(0.024)	(0.024)	(0.025)
N	80,722	80,759	124,000	124,000	98,056	98,080
Only Right-To-Work states						
log MW	0.165***	0.159***	0.064	0.096	0.246***	0.238***
	(0.056)	(0.050)	(0.070)	(0.063)	(0.062)	(0.070)
N	40,385	40,385	71,583	71,583	56,322	56,322
Panel B: Dep. variable: Employment						
log MW	-0.010	0.089**	-0.002	-0.003	-0.042	-0.046*
	(0.048)	(0.036)	(0.027)	(0.017)	(0.033)	(0.027)
N	80,722	80,759	124,000	124,000	98,056	98,080
Panel C: Dep. variable: Number of establishments						
log MW	-4.30	-1.66	46.57	6.06	-25.51	4.29
	(3.98)	(3.96)	(36.85)	(14.22)	(24.58)	(14.37)
N	114,000	114,000	125,000	125,000	118,000	118,000
Controls	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Linear state trends	N	Y	N	Y	N	Y

Notes: The table shows elasticities to state-level minimum wages in the 2001–2012 period by industry, estimated using county-level panel data for 41 states used in our price regressions. The data are based on the QCEW. Retail trade corresponds to NAICS codes 44–45, grocery stores to NAICS code 4451, and accommodation and food services to NAICS code 72. The outcome in panel A is log average earnings by industry. The outcome in Panel B is the log employment in an industry, computed as the average employment in the three months in the respective quarter. The controls are the log of county population and the log of total employment in private industries per county. Standard errors are clustered at the state level.

Table 13: Implied cost pass-through for various specifications

	(1) Baseline	(2) Division-time FE	(3) Chain-time FE
		Pass-through at legislation	
Implied cost pass-through	1.103	1.171	0.843
p-value PT = 1	0.780	0.531	0.651
		Pass-through at legislation and implementation	
Implied cost pass-through	2.026	1.491	0.836
p-value PT = 1	0.208	0.433	0.788

Notes: The table illustrates the implied cost pass-through. Pass-through at legislation is the ratio of the elasticity of prices E_4^{leg} 5 months after legislation and the estimated elasticity of marginal cost. Pass-through at legislation and implementation reports the same ratio including the insignificant effects at implementation of minimum wage increases. p-values for a test of full pass-through are computed using standard errors for the pass-through ratio calculated using the Delta method.

Appendix

A.1 Determining regular prices

We follow an algorithm applied by Kehoe and Midrigan (2015) to determine "regular prices". Regular prices in our case are "permanent prices". Stores charge this price during long time periods, but often deviate from it during temporary sales. The regular price determined by the algorithm is based on the modal price for a product during a running window. For completeness, we reproduce a slightly edited description of the algorithm given in the web appendix to Kehoe and Midrigan (2015):

1. Choose parameters: $l = 2$ (size of the window: the number of weeks before and after the current period used to compute the modal price), $c = 1/3$ (=cutoff used to determine whether a price is temporary), $a = 0.5$ (=the share of non-missing observations in the window required to compute a modal price).

2. Let p_t be the price in week t and T the length of the price series. Determine the modal price for each time period $t \in (1 + l, T - l)$:

   - If the number of weeks with available data in $(t - l, \ldots, t + l)$ is larger than or equal $2al$, then $p_t^M = mode(p_{t-1}, \ldots, p_{t+l})$ and $f_t =$ the fraction of periods with available data where $p_t = p_t^M$.
   - Else $f_t = .$ and $p_t^M = .$ (missing)

3. Determine the first-pass regular price for $t = 1, ..., T$:

   - Initial value: If $p_{1+l}^M \neq .$, then $p_{1+l}^R = p_{1+l}^M$. Else, set $p_{1+l}^R = p_{1+l}$.
   - For all other $t = l+1, \ldots, T$: If $p_t^M \neq .$ and $f_t > c$ and $p_t = p_t^M$, then $p_t^R = p_t^M$. Else: $p_t^R = p_{t-1}^R$.

4. Make sure regular prices are updated at the right times. Repeat the following procedure l times (this adjusts the timing of regular price changes to the first occurrence of a new modal price).

   (a) Let $R = \{t : p_t^R \neq p_{t-1}^R \,\&\, p_{t-1}^R \neq 0 \,\&\, p_t^R \neq 0\}$ be the set of weeks with regular price changes

   (b) Let $C = \{t : p_t^R = p_t \,\&\, p_t^R \neq 0 \,\&\, p_t \neq 0\}$ be the set of weeks in which a store charges the regular price

   (c) Let $P = \{t : p_{t-1}^R = p_{t-1} \,\&\, p_{t-1}^R \neq 0 \,\&\, p_{t-1} \neq 0\}$ be the set of weeks in which a store's last week's price was the regular price

(d) Set $p^R_{\{R\cap C\}-1} = p_{\{R\cap C\}}$. Set $p^R_{\{R\cap P\}} = p_{\{R\cap P\}-1}$.

A.2 Additional Regression Tables

Table A.14: Effects for small and large stores

Dep. variable: Store inflation	(1) Small (revenue)	(2) Small (prod. range)	(3) Large (revenue)	(4) Large (prod. range)
		Legislation		
E_0^{leg}	0.015***	0.012**	0.007**	0.007***
	(0.005)	(0.005)	(0.003)	(0.003)
E_2^{leg}	0.013**	0.008	0.016***	0.018***
	(0.005)	(0.005)	(0.005)	(0.005)
E_4^{leg}	0.006	0.003	0.020***	0.022***
	(0.006)	(0.006)	(0.006)	(0.006)
		Implementation		
E_0^{inc}	-0.010	-0.008	0.004	0.003
	(0.008)	(0.008)	(0.005)	(0.005)
E_2^{inc}	-0.007	-0.000	0.006	0.003
	(0.007)	(0.007)	(0.007)	(0.007)
E_4^{inc}	-0.007	-0.002	0.015	0.013
	(0.008)	(0.008)	(0.010)	(0.009)
		Estimation Summary		
$E_4^{leg}+E_4^{inc}$	-0.000	0.001	0.034**	0.035***
	(0.011)	(0.012)	(0.013)	(0.013)
$\sum$ All	0.001	0.000	0.042*	0.047**
	(0.015)	(0.018)	(0.022)	(0.021)
$\sum$ Pre-event	0.011*	0.006	0.004	0.010
	(0.006)	(0.008)	(0.010)	(0.010)
N	95077	103473	111400	103004
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Store FE	YES	YES	YES	YES
Division time FE	YES	YES	YES	YES

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.15: Effects for cheap and expensive stores

Dep. variable: Store inflation	(1) Cheap (state)	(2) Cheap (county)	(3) Expensive (state)	(4) Expensive (county)
		Legislation		
E_0^{leg}	0.012***	0.013***	0.003	0.003
	(0.003)	(0.003)	(0.005)	(0.006)
E_2^{leg}	0.015***	0.015***	0.008	0.004
	(0.004)	(0.005)	(0.007)	(0.009)
E_4^{leg}	0.014***	0.013**	0.008	0.013
	(0.005)	(0.005)	(0.009)	(0.009)
		Implementation		
E_0^{inc}	-0.002	-0.001	-0.001	-0.004
	(0.005)	(0.006)	(0.006)	(0.007)
E_2^{inc}	0.003	0.003	-0.000	-0.009
	(0.006)	(0.006)	(0.008)	(0.011)
E_4^{inc}	0.007	0.010	0.012	0.005
	(0.008)	(0.008)	(0.010)	(0.014)
		Estimation Summary		
$E_4^{leg}+E_4^{inc}$	0.021**	0.023**	0.020	0.018
	(0.010)	(0.010)	(0.013)	(0.017)
$\sum$ All	0.024	0.034*	0.046**	0.037
	(0.016)	(0.017)	(0.022)	(0.032)
$\sum$ Pre-event	0.005	0.015*	0.030**	0.018
	(0.007)	(0.008)	(0.013)	(0.017)
N	155518	126557	50959	32658
Controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Store FE	YES	YES	YES	YES
Division time FE	YES	YES	YES	YES

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.16: Effects for large and small, regional and national brands

Dep. variable: Store inflation	(1) Small Chain	(2) Regional Chain	(3) Large Chain	(4) National Chain
		Legislation		
E_0^{leg}	0.011***	0.010**	0.007***	0.006*
	(0.004)	(0.004)	(0.002)	(0.004)
E_2^{leg}	0.018***	0.016***	0.007*	0.008
	(0.005)	(0.005)	(0.004)	(0.006)
E_4^{leg}	0.018***	0.016**	0.005	0.009
	(0.006)	(0.007)	(0.005)	(0.008)
		Implementation		
E_0^{inc}	0.003	0.004	-0.009	-0.012
	(0.005)	(0.005)	(0.008)	(0.009)
E_2^{inc}	0.006	0.005	-0.005	-0.006
	(0.007)	(0.007)	(0.007)	(0.009)
E_4^{inc}	0.013	0.011	-0.005	-0.006
	(0.008)	(0.009)	(0.010)	(0.012)
		Estimation Summary		
$E_4^{leg}+E_4^{inc}$	0.031**	0.027**	0.001	0.003
	(0.011)	(0.013)	(0.012)	(0.016)
$\sum$ All	0.037**	0.037*	0.003	-0.004
	(0.018)	(0.020)	(0.017)	(0.019)
$\sum$ Pre-event	0.007	0.012	0.003	-0.004
	(0.007)	(0.009)	(0.010)	(0.011)
N	108336	131959	98141	74518
controls	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Store FE	YES	YES	YES	YES
Division time FE	YES	YES	YES	YES

Notes: The dependent variable is the store-level inflation rate. Baseline controls are unemployment rate and house price growth. The table lists cumulative elasticities E_R, R months after legislation or implementation. $\sum$ All is the sum of all lead and lag coefficients. $\sum$ Pre-event is the sum of all coefficients up to $t-2$. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

A.3 The minimum wages elasticity of marginal cost

In our setting $Q = F(L, X)$, $L = G(L_1, L_2, \dots, L_N)$, with factor prices $P_x, W_1, W_2, \dots W_N$. F is assumed to be homogeneous of degree h and G is assumed to be linearly homogeneous. We assume competitive labor markets. We derive the elasticity of marginal cost to minimum wages keeping output constant.

Deriving the correct labor cost index

First, we are interested in the correct factor price index $\overline{W}$ that represents the marginal cost of increasing L. The firm minimizes labor cost LC:

$$LC(L, W_1, W_2, \dots, W_N) = \min_{L_1, L_2, \dots, L_N} W_1 L_1 + W_2 L_2 + \cdots + W_N L_N$$
$$\text{s.t. } L = G(L_1, L_2, \dots, L_N)$$

The FOC for any L_i is that $\lambda G'_i = W_i$. λ_i is the Lagrange multiplier and equal to marginal labor cost LC_L. Because G is homogeneous of degree one, it follows that:

$$LC(L, w_1, w_2, \dots, w_N) = \lambda \sum_{i=1}^{N} G'_i L_i = \lambda L$$

Since λ is equal to marginal cost of increasing labor inputs, we can plug in $\lambda = LC_L$ and solve the resulting differential equation $LC = LC_L L$ to get that $LC = \overline{W} L$ for some $\overline{W}$ that is constant in L. As a result, marginal cost equals average cost, both are independent of the overall level of L, and $\overline{W} = LC/L$:

$$\overline{W}(W_1, W_2, \dots, W_N) = \sum_{i=1}^{N} \frac{W_i L_i^*}{L}$$

Deriving an expression for the elasticity

We can express the overall cost function as $C(\overline{W}, P_x, Q)$ and the overall marginal cost function as $C_Q(\overline{W}, P_x, Q)$. The derivative of marginal cost w.r.t. minimum wages can be written as:

$$\frac{\partial C_Q}{\partial MW} = \frac{\partial \frac{\partial C}{\partial Q}}{\partial \overline{W}} \frac{\partial \overline{W}}{\partial MW} = \frac{\partial L}{\partial Q} \frac{\partial \overline{W}}{\partial MW}$$

The last step uses Shepard's Lemma. Converting the derivative to an elasticity:

$$\frac{\partial C_Q}{\partial MW}\frac{MW}{C_Q} = \underbrace{\frac{\overline{W}L}{C}}_{(1)}\underbrace{\frac{\partial \overline{W}}{\partial MW}\frac{MW}{\overline{W}}}_{(2)}\underbrace{\frac{AC}{MC}}_{(3)}\underbrace{\frac{\partial L}{\partial Q}\frac{Q}{L}}_{(4)}$$

The minimum wage elasticity of marginal cost is given by the product of: (1) The cost share of labor cost in total variable cost; (2) the minimum wage elasticity of the average wage; (3) the ratio of average to marginal cost; (4) the output elasticity of labor demand.

Final step

We now show that $\frac{AC}{MC}\frac{\partial L}{\partial Q}\frac{Q}{L} = 1$ when F is homogeneous of degree h. If $h = 1$, both $\frac{AC}{MC} = 1$ and $\frac{\partial L}{\partial Q}\frac{Q}{L} = 1$. More generally, if F is homogeneous of degree h, we can write the cost function as $C = Q^{\frac{1}{h}}\omega$, where ω is constant in Q and typically depends on factor prices. As a result:

$$\frac{AC}{MC} = \frac{Q^{\frac{1}{h}-1}\omega}{\frac{1}{h}Q^{\frac{1}{h}-1}\omega} = h$$

and applying Shepard's Lemma:

$$\frac{\partial L}{\partial Q}\frac{Q}{L} = \frac{\partial \frac{\partial C}{\partial \overline{w}}}{\partial Q}\frac{Q}{\frac{\partial C}{\partial \overline{w}}} = \frac{\partial (Q^{\frac{1}{h}}\frac{\partial \omega}{\partial \overline{w}})}{\partial Q}\frac{Q}{Q^{\frac{1}{h}}\frac{\partial \omega}{\partial \overline{w}}} = \frac{1}{h}Q^{\frac{1}{h}-1}Q^{1-\frac{1}{h}} = \frac{1}{h}$$

As a result $\frac{AC}{MC}\frac{\partial L}{\partial Q}\frac{Q}{L} = 1$, and

$$\frac{\partial C_Q}{\partial MW}\frac{MW}{C_Q} = \frac{\overline{W}L}{C}\frac{\partial \overline{W}}{\partial MW}\frac{MW}{\overline{W}}$$

The minimum wage elasticity of marginal cost is equal to the minimum wage elasticity of the average wage, times the labor share in cost. However, recall that we derive the elasticity of marginal cost at constant output. While this distinction does not matter under constant returns to scale, under increasing or decreasing returns to scale any variation in output goes along with changes in marginal cost that we do not take into account.

A.4 Further evidence on the earnings elasticity in grocery stores

We first present some additional statistics on minimum wage employment in the grocery sector. Table A.17 presents the share of workers below 110% and 130% of the local minimum wage in employment, hours and earnings of grocery stores. We also compare the share to other relevant industries. These statistics complement the full wage distribution in grocery store employment presented in Figure 4. The shares in hours are lower than in employment—as minimum wage workers are more likely to work part-time—and in earnings, as minimum wage workers have the lowest hourly wages.

Table A.17: Statistics on minimum wage employment in grocery stores and other relevant sectors

	Employment		Hours		Earnings	
	$\leq$ 110%	$\leq$ 130%	$\leq$ 110%	$\leq$ 130%	$\leq$ 110%	$\leq$ 130%
			2001 - 2005			
Grocery Stores	12.1	29.6	9.0	23.0	4.5	13.1
Other Retail Trade	7.6	18.5	5.6	14.1	2.2	6.5
Restaurants	31.7	50.2	26.1	42.0	13.1	25.0
Other sectors	4.0	8.5	3.1	6.8	0.9	2.3
			2006 - 2009			
Grocery Stores	20.7	38.8	16.1	31.4	8.9	19.0
Other Retail Trade	11.6	25.0	8.5	19.3	3.6	9.4
Restaurants	39.5	58.3	32.9	50.1	18.3	31.9
Other sectors	5.2	11.1	4.1	9.0	1.2	3.2
			2010 - 2012			
Grocery Stores	25.1	48.8	19.2	40.3	11.1	25.4
Other Retail Trade	15.9	34.8	11.8	27.4	5.3	13.9
Restaurants	45.2	66.5	37.9	58.1	22.5	39.4
Other sectors	6.5	14.7	5.1	12.0	1.6	4.4

Notes: Based on CPS ORG data. Retail trade corresponds to NAICS 44–45, grocery stores to NAICS 4451, and restaurants to NAICS 722. Wages are computed using reported hourly wages for workers paid by the hour, and weekly earnings divided by weekly hours for other workers. Shares are calculated first for each state and year and subsequently averaged over all states and years in a period. All statistics are calculated using the CPS earnings weight.

In the main part of the paper (Section 6) we report regressions that show that earnings in grocery stores are strongly affected by minimum wage hikes. This section discusses several extensions to this result. In Table A.18 we first look into the dynamics of the wage effects by including leads and lags of the minimum wage to the regression. We find that the earnings effect of the minimum wage hike are concentrated in the period when the hike is implemented. The leads and lags are generally not statistically significant. Second, the table also reports the results of specifications that account for Census-division period fixed effects (columns 2, 5, 8) and that weight the regressions with county average total employment (columns 3, 6, 9). The results are similar as in our baseline table reported in the main part of the paper.

In Table A.19, we study how the estimated earnings elasticity varies with the bindingness of the minimum wage in a county. We expect larger earnings effects in counties where the difference between the new minimum wage and the initial prevailing wage is larger. For each county, industry and each minimum wage hike, we thus compute the difference between the new minimum wage after the hike and the prevailing average wage in the respective industry four quarters before the hike.[22] For each county and industry, we then average these differences over all hikes in a county. We use this average difference to assign counties into four groups in terms of the bindingness of the minimum wage, based on the county's position in the distribution of differences between prevailing wage and new minimum wage. If it belongs to the first quartile of this distribution, the county is considered a county where the minimum wage has low bindingness in the respective sector. If it belongs to the top quartile of the distribution, the minimum wage is considered to be strongly binding. Table A.19 reports separate earnings elasticities for the four categories of counties. In the case of grocery stores, the earnings elasticity is larger than our baseline elasticity in counties in which the minimum wage is strongly binding. We find no differences within the remaining three groups of counties. In each of them, the elasticity is slightly lower than our baseline estimate.

[22]The difference is estimated by computing a rough measure for the quarterly earnings of a full-time minimum wage worker. We do this by multiplying the hourly minimum wage by eight hours and $22 * 3$ days per quarter.

Table A.18: Robustness: Earnings and employment elasticities to the minimum wage

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Retail trade			Grocery stores			Acc. and food services		
Panel A: Earnings									
t-4	0.011			0.004			-0.019		
	(0.020)			(0.035)			(0.027)		
t-3	0.022			0.043			0.037*		
	(0.015)			(0.039)			(0.019)		
t-2	-0.021*			-0.024			-0.042		
	(0.012)			(0.037)			(0.026)		
t-1	-0.003			-0.001			0.057*		
	(0.010)			(0.030)			(0.030)		
t	0.039**	0.075***	0.048*	0.056*	0.062*	0.108**	0.046*	0.171***	0.151***
	(0.015)	(0.020)	(0.026)	(0.029)	(0.036)	(0.043)	(0.027)	(0.027)	(0.024)
t+1	0.011			0.011			0.073***		
	(0.018)			(0.037)			(0.022)		
t+2	0.009			0.021			-0.011		
	(0.013)			(0.034)			(0.030)		
t+3	-0.003			-0.008			0.057*		
	(0.010)			(0.027)			(0.029)		
t+4	-0.013			0.036			-0.029		
	(0.015)			(0.034)			(0.024)		
Obs	124,000	124,000	124,000	80,722	80,722	80,722	98,056	98,056	98,056
Panel B: Employment									
t-4	0.026			-0.076			-0.035		
	(0.021)			(0.050)			(0.034)		
t-3	-0.018**			0.010			0.054**		
	(0.007)			(0.016)			(0.021)		
t-2	0.021*			0.005			0.031		
	(0.011)			(0.014)			(0.022)		
t-1	0.007			0.002			-0.001		
	(0.010)			(0.010)			(0.024)		
t	-0.017*	0.029*	-0.002	-0.018	0.072**	-0.010	-0.055**	-0.008	-0.042
	(0.009)	(0.016)	(0.027)	(0.018)	(0.036)	(0.048)	(0.024)	(0.026)	(0.033)
t+1	-0.012			0.018			0.022		
	(0.007)			(0.014)			(0.021)		
t+2	0.017			0.005			0.013		
	(0.011)			(0.014)			(0.023)		
t+3	0.014			0.003			-0.019		
	(0.011)			(0.014)			(0.028)		
t+4	-0.033*			0.034			-0.069**		
	(0.016)			(0.041)			(0.026)		
Obs	124,000	124,000	124,000	80,722	80,722	80,722	98,056	98,056	98,056
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Div.-time FE	N	Y	N	N	Y	N	N	Y	N
Weights	N	N	Y	N	N	Y	N	N	Y

Notes: The table shows elasticities to state-level minimum wages in the 2001–2012 period by industry, estimated using county-level panel data from the QCEW for the 41 states used in our price regression. Retail trade corresponds to NAICS 44–45, grocery stores to NAICS 4451, and accommodation and food services to NAICS 72. The outcome in panel A is log the average earnings by industry. The outcome in Panel B is the log of the number of workers by industry, computed as the average employment of the three months in the respective quarter. Controls are log of county population and the log of total employment in private industries per county. SE are clustered at the state level.

Table A.19: Earnings elasticities by bindingness of the minimum wage

	(1) Strongly binding	(2) Moderately binding	(3) Weakly binding	(4) Very weakly binding
		Grocery stores		
log MW	0.155***	0.081**	0.083*	0.079
	(0.045)	(0.033)	(0.042)	(0.067)
N	16,567	19,200	21,406	19,851
		Retail trade		
log MW	0.081***	0.026	0.010	0.007
	(0.024)	(0.025)	(0.026)	(0.033)
N	28,606	30,840	32,216	32,139
		Accomodation and food services		
log MW	0.168***	0.183***	0.184***	0.079***
	(0.026)	(0.022)	(0.033)	(0.028)
N	21,242	23,724	25,076	25,880

Notes: The table shows elasticities to state-level minimum wages in the 2001–2012 period by industry, estimated using county-level panel data from the QCEW for the 41 states used in our price regression. Retail trade corresponds to NAICS 44–45, grocery stores to NAICS 4451, and accommodation and food services to NAICS 72. The outcome is log the average earnings by industry. Controls are log of county population and the log of total employment in private industries per county. SE are clustered at the state level. The minimum wage bindingness is the average county-level difference between the industry-specific wage (4 quarters before a subsequent hike) and the new minimum wage, averaged across all hikes in a county. The four categories correspond to quartiles of the distribution of this gap.

A.5 Details on potential increases in COGS

In this section we expand the discussion of section 6.4. First, we present the predicted elasticity of producer prices based on equation 10 in Table A.20. We use the domestic requirements table for 389 disaggregated industries provided by the BEA. We predict the elasticity for 26 manufacturing industries that are relevant for grocery stores. All calculations are based on data from 2007. Columns 2 and 3 present the direct cost elasticity, which captures the impact of minimum wage workers employed in the sector itself. These elasticities are quite small. Columns 4 and 5 present the final elasticities, which also capture predicted price increases of inputs. These elasticities are substantially larger. The difference is driven by low wages in the sectors that deliver primary inputs to food manufacturing sectors. We present both measures for minimum wage shares based on workers earning below 110% and 130% of the local minimum wage.

Table A.20: Predicted MW elasticities of producer prices in grocery manufacturing

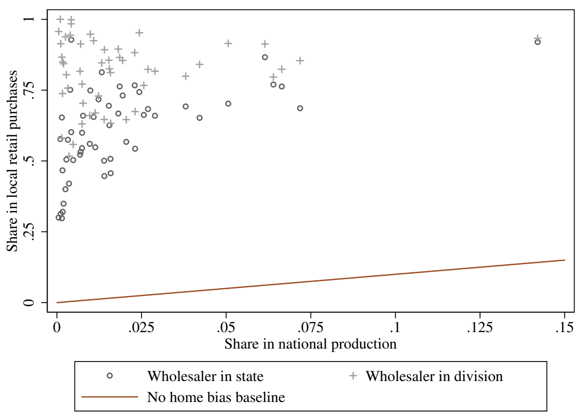
Manufacturing Sector	Direct cost elasticity		Final cost elasticity	
MW worker definition:	< 110%	< 130%	< 110%	< 130%
Breakfast cereal	0.003	0.005	0.019	0.029
Sugar and confectionery	0.006	0.009	0.020	0.030
Frozen food	0.006	0.009	0.019	0.029
Fruit and vegetable canning, pickling, and drying	0.005	0.008	0.018	0.026
Fluid milk and butter	0.003	0.005	0.018	0.026
Cheese	0.002	0.003	0.017	0.024
Dry, condensed, and evaporated dairy	0.002	0.003	0.015	0.022
Ice cream and frozen dessert	0.004	0.005	0.018	0.026
Animal slaughtering, rendering, and processing	0.005	0.008	0.022	0.033
Poultry processing	0.007	0.012	0.020	0.030
Seafood product preparation and packaging	0.009	0.013	0.020	0.031
Bread and bakery	0.012	0.018	0.017	0.026
Cookie, cracker, pasta, and tortilla	0.008	0.012	0.019	0.029
Snack food	0.008	0.012	0.029	0.042
Coffee and tea	0.008	0.012	0.017	0.025
Flavoring syrup and concentrate	0.013	0.019	0.024	0.035
Seasoning and dressing	0.011	0.016	0.026	0.039
All other food	0.011	0.016	0.011	0.018
Soft drink and ice	0.002	0.003	0.008	0.012
Breweries	0.001	0.002	0.013	0.021
Wineries	0.002	0.004	0.004	0.007
Distilleries	0.001	0.002	0.004	0.006
Tobacco	0.001	0.001	0.022	0.033
Sanitary paper	0.004	0.005	0.011	0.016
Soap and cleaning compound	0.002	0.003	0.006	0.010
Toilet preparation	0.002	0.003	0.006	0.010
Output weighted average	0.005	0.008	0.016	0.024
Average	0.005	0.008	0.018	0.026

Second, we discuss the extent to which these increases may be captured by our estimates. This depends crucially on the extent to which wholesale groceries are traded between states. If groceries are perfectly tradeable, our estimates would not pick up any retail price increases that result from wholesale price increases due to the inclusion of time fixed effects.

We analyze the origin composition of products sold in retail using data on intrastate trade flows from wholesalers for groceries, farm products, alcoholic beverages and drugs (subsequently summed up under the term "groceries") provided in the 2007 Commodity Flow Survey. The Commodity Flow Survey data are subject to some important limitations. First, it counts flows originating from manufacturers, but also from distribution centers and similar establishments. The latter may not be produced locally. Second, the flows capture all flows originating from merchant wholesalers, irrespective of the destination industry. Merchant wholesalers are defined by selling to retail establishments, but the flows in the CFS capture not just flows to grocery stores but also other retail establishments. The numbers we calculate here should be interpreted as very suggestive evidence.

Let Y_{ij} be the flow of groceries from state i to state j. We calculate "production" of state s valued at wholesale prices as the sum of all flows originating in state s, $\sum_j Y_{sj}$. We can calculate "consumption" of state s as all flows with destination in state s, $\sum_i Y_{is}$. The share of locally produced products in grocery consumption of state s is then given by $Y_{ss}/\sum_i Y_{is}$. The exposure of state s to cost increases in another state S can be calculated as $Y_{Ss}/\sum_i Y_{is}$.

Figure A.17: Home bias in grocery wholesale-to-retail flows



Our results suggest that the share of local products in grocery consumption is higher than the state's share in national grocery production. For example, California has a 14% share in the national production of groceries and 91% of groceries consumed in California are produced locally. Vermont accounts for a mere 0.1% of US grocery production, yet 30% of groceries consumed in Vermont are produced locally. This suggests a substantial home bias in US grocery consumption, a fact that has been documented for interstate trade as a whole in Wolf (2000). We document this relationship in Figure A.17.

Table A.21: Summary of wholesale-to-retail flows between states

	Share in National Total		Share in Consumption		Flows from other states		
	Consumption	Production	Production in State	Production in Division	Mean Consumption Share	Max Consumption Share	Max Origin
California	0.134	0.142	0.92	0.933	0.002	0.013	New Jersey
Florida	0.06	0.061	0.866	0.913	0.003	0.044	Georgia
Texas	0.067	0.064	0.77	0.796	0.005	0.039	Tennessee
Washington	0.021	0.023	0.767	0.883	0.005	0.063	Oregon
Minnesota	0.019	0.019	0.763	0.865	0.005	0.061	Illinois
Illinois	0.052	0.066	0.763	0.824	0.005	0.093	Missouri
Nebraska	0.008	0.01	0.749	0.948	0.005	0.094	Kansas
Michigan	0.029	0.024	0.743	0.953	0.005	0.083	Ohio
North Carolina	0.02	0.019	0.731	0.855	0.005	0.047	Georgia
Arizona	0.014	0.012	0.717	0.73	0.006	0.2	California
New Jersey	0.039	0.051	0.702	0.915	0.006	0.145	New York
Iowa	0.016	0.015	0.695	0.856	0.006	0.065	Illinois
Ohio	0.039	0.038	0.692	0.799	0.006	0.092	Pennsylvania
New York	0.074	0.072	0.686	0.854	0.006	0.135	New Jersey
Massachusetts	0.026	0.027	0.683	0.823	0.006	0.1	New York
Wisconsin	0.021	0.018	0.668	0.895	0.007	0.215	Illinois
Tennessee	0.017	0.026	0.663	0.767	0.007	0.094	Kentucky
Missouri	0.023	0.029	0.66	0.817	0.007	0.137	Kansas
Utah	0.007	0.008	0.66	0.704	0.007	0.112	Arkansas
Oregon	0.011	0.011	0.655	0.925	0.007	0.179	Washington
Vermont	0.001	0.001	0.653	0.867	0.007	0.14	New Hampshire
Pennsylvania	0.041	0.042	0.652	0.841	0.007	0.104	New Jersey
Kansas	0.015	0.016	0.626	0.825	0.007	0.15	Missouri
Oklahoma	0.009	0.007	0.6	0.771	0.008	0.152	Texas
New Mexico	0.004	0.003	0.575	0.757	0.009	0.17	Texas
Louisiana	0.033	0.02	0.568	0.646	0.009	0.107	Illinois
Alabama	0.012	0.01	0.56	0.661	0.009	0.131	Georgia
Georgia	0.025	0.023	0.543	0.674	0.009	0.147	Tennessee
South Carolina	0.01	0.007	0.532	0.913	0.009	0.189	Georgia
Mississippi	0.007	0.007	0.522	0.817	0.01	0.147	Tennessee
Virginia	0.021	0.016	0.508	0.812	0.01	0.205	Maryland
Idaho	0.004	0.003	0.505	0.805	0.01	0.262	Utah
Connecticut	0.012	0.014	0.501	0.646	0.01	0.188	New York
Maryland	0.016	0.016	0.457	0.633	0.011	0.139	Pennsylvania
Indiana	0.016	0.014	0.447	0.893	0.011	0.266	Illinois
West Virginia	0.004	0.004	0.42	0.517	0.012	0.222	Pennsylvania
Maine	0.005	0.003	0.4	0.938	0.012	0.442	Massachusetts
New Hampshire	0.003	0.002	0.349	0.843	0.013	0.285	Massachusetts
Rhode Island	0.003	0.002	0.32	0.849	0.014	0.364	Massachusetts
DC	0.002	0.001	0.313	0.914	0.014	0.384	Maryland
Delaware	0.002	0.001	0.298	0.581	0.014	0.284	Maryland
Mean	0.023	0.023	0.607	0.811	0.008	0.158	

Table A.21 documents trade flows for all states. The share of local grocery products in consumption (Destination) is systematically higher than the share of states' products in national production (Origin). Flows from other states are small on average. Even in small states like Delaware or Rhode Island, the average flow from other states amounts to below 1.5% of consumption. However, for individual state pairs there is potential for substantial spillovers. For example, Rhode Island imports 36% of its groceries from Massachusetts, while the District of Columbia imports 38% of its groceries from Maryland. Overall, it seems that some effects of local wholesale price changes would be captured in our estimation. However, as we cannot determine the place of production with certainty these numbers should be interpreted with caution.

A.6 Details on welfare calculations

Our calculation of the nominal gains of a hypothetical 20% increase in all binding minimum wages is based on the joint distribution of hours worked and wages (from the CPS Monthly Outgoing Rotation Group) and household incomes and weeks worked during a year (from the Annual Socioeconomic Supplement). We use the ASEC and MORG files provided by the NBER. We first calculate wages for the March 2011 MORG. For workers paid by the hour, we use reported hourly wages. For workers not paid by the hour, we use weekly earnings divided by usual weekly hours to calculate the hourly wage. We then merge the March 2011 ASEC to the March 2011 MORG. For every person i in the MORG, we calculate the distance of the hourly wage to the local binding minimum wage $W_i/MW_{s(i)}$. We then construct a counterfactual labor income as described in equation 12. We set hours and wages to zero for all workers that are not coded as "non-self-employed workers for pay". When the $weeks_i$ variable is missing, but weekly earnings and annual labor income is observed, we impute weeks based on this information and cap it at 52. If we cannot calculate labor income for one household member, we exclude the entire household from the analysis.

In Table A.22, we report some additional statistics relevant to our calculations. We compare annualized labor earnings based on the March 2011 MORG and reported weeks worked to actual reported labor income in the ASEC. Our calculation fits reported earnings quite well for households between 20,000 and 70,0000 USD annual income. The annualized measure is larger than reported labor earnings for poorer and smaller for richer households. Two factors could explain this discrepancy. First, labor market conditions were improving in March 2011 after the through of the recession in 2010. Hours and wages of poor households could thus be higher in March 2011 than during 2010. Furthermore, the discrepancy for rich households could be due to differences in top-coding between the MORG and the ASEC. Furthermore, we present summary statistics on wages, hours, weeks worked and the size of households in different brackets. In Table A.23 we present summary statistics of minimum wage workers in the different brackets. There are some

Table A.22: Summary statistics for different income brackets

	MORG labor income	ASEC labor income	Labor income share	Hourly Wage	Hours worked	Weeks worked	HH size	MW share	Number of HH
less than 10k	2.1	1.5	26.7	12.7	4.7	6.9	1.7	5.8	947.0
10 - 19.99k	6.6	5.5	37.1	11.2	9.1	14.1	1.8	8.4	1764.0
20 - 29.99k	13.3	12.9	52.0	12.4	13.0	20.8	2.1	8.7	1737.0
30 - 39.99k	22.5	22.2	64.4	14.5	16.9	26.2	2.2	7.8	1486.0
40 - 49.99k	29.5	29.7	66.8	15.6	18.9	28.6	2.3	6.4	1287.0
50 - 69.99k	40.9	44.9	76.0	17.0	21.6	32.7	2.6	6.9	2199.0
70 - 79.99k	55.4	59.5	80.2	20.4	24.5	36.3	2.5	6.5	953.0
80 - 99.99k	63.8	72.7	81.7	21.2	25.3	37.1	2.7	6.5	1386.0
100 - 119.99k	79.2	90.4	83.3	24.4	26.2	37.5	2.8	6.1	1053.0
120 - 149.99k	91.2	109.0	82.4	26.8	26.4	39.0	2.8	4.0	892.0
more than 150k	124.5	186.2	82.5	37.3	25.1	38.2	2.9	4.3	1258.0

Notes: MORG labor income is equal to $hours \times wage \times weeks$. Wage and hours are from the MORG, weeks from the ASEC. ASEC labor income is annual labor income reported in the ASEC. The Labor income share is the share of labor in total household income (both from ASEC). Wages, Hours and Weeks worked are unweighted averages over household members, then averaged over households using HH weights.

important differences between minimum wage workers in poor and rich households. Most importantly, minimum wage workers in richer households tend to be the children of the CPS reference person. In poorer households, minimum wage workers are more likely to be female.

Finally, we report the numbers corresponding to Figures 14a, 14b, **??** and 15 in Tables A.24 and A.24b. The Tables do not contain any information not depicted in the Figures, but provide a more readable summary of the results.

Table A.23: Characteristics of minimum wage workers in different income brackets

	Relation to Reference Person (RP)					Other characteristics			
	Female RP	Male RP	Child of RP	Other family	Not family	Hours worked	Weeks worked	Age	Female
less than 10k	37.7	13.3	9.1	1.8	38.1	24.7	28.6	31.0	0.7
10 - 19.99k	34.9	21.1	8.6	5.2	30.2	31.4	41.2	34.5	0.6
20 - 29.99k	34.3	15.0	13.6	7.2	29.9	30.6	42.9	37.4	0.6
30 - 39.99k	33.2	15.3	17.3	5.3	28.9	29.6	40.7	37.4	0.6
40 - 49.99k	31.9	9.5	21.5	10.6	26.5	30.3	37.8	31.8	0.6
50 - 69.99k	27.3	18.6	34.5	5.3	14.3	29.2	42.7	32.8	0.6
70 - 79.99k	27.9	15.1	37.8	3.9	15.2	29.6	40.3	31.5	0.6
80 - 99.99k	21.3	18.2	39.2	7.8	13.6	29.0	40.8	32.6	0.4
100 - 119.99k	21.0	9.7	56.4	8.0	4.9	27.0	37.7	27.7	0.5
120 - 149.99k	12.9	8.4	62.6	3.8	12.2	23.6	36.8	27.0	0.5
more than 150k	15.1	6.8	71.4	3.5	3.2	26.8	40.0	26.0	0.4

Notes: The table breaks down minimum wage workers by relationship to the reference person in their household. Minimum wage workers are all workers earning less than 110% of the local minimum wage. Data from MORG (wages) and ASEC (for income brackets).

Table A.24: Nominal gains and Equivalent Variation of grocery price increases after a 20% increase in the minimum wage

(a) Taking into account price effects in grocery stores

	in USD			in % of HH income			$\frac{100 \cdot E_h \Delta P}{\Delta Y_h^L}$
	ΔY_h^L	$E_h \Delta P$	Net	ΔY_h^L	$E_h \Delta P$	Net	
less than 10k	135.95	−13.29	122.66	2.17	−0.21	1.96	−9.77
10 - 19.99k	409.16	−13.86	395.3	2.76	−0.09	2.67	−3.39
20 - 29.99k	557.47	−15.17	542.3	2.25	−0.06	2.18	−2.72
30 - 39.99k	516.27	−18.94	497.33	1.49	−0.05	1.44	−3.67
40 - 49.99k	489.88	−18.17	471.71	1.1	−0.04	1.06	−3.71
50 - 69.99k	565.3	−22.5	542.8	0.96	−0.04	0.92	−3.98
70 - 79.99k	482.66	−26.18	456.48	0.65	−0.04	0.62	−5.42
80 - 99.99k	454.74	−27.52	427.22	0.51	−0.03	0.48	−6.05
100 - 119.99k	385.13	−31.96	353.17	0.35	−0.03	0.33	−8.3
120 - 149.99k	338.96	−34.19	304.77	0.26	−0.03	0.23	−10.09
more than 150k	337.25	−43.14	294.12	0.15	−0.02	0.13	−12.79

(b) Taking into account price effects in grocery stores and restaurants

	in USD			in % of HH income			$\frac{100 \cdot E_h \Delta P}{\Delta Y_h^L}$
	ΔY_h^L	$E_h \Delta P$	Net	ΔY_h^L	$E_h \Delta P$	Net	
less than 10k	135.95	−28.37	107.59	2.17	−0.45	1.72	−20.86
10 - 19.99k	409.16	−30.49	378.67	2.76	−0.21	2.55	−7.45
20 - 29.99k	557.47	−35.79	521.68	2.25	−0.14	2.1	−6.42
30 - 39.99k	516.27	−44.84	471.43	1.49	−0.13	1.36	−8.69
40 - 49.99k	489.88	−45.73	444.14	1.1	−0.1	1.0	−9.34
50 - 69.99k	565.3	−58.21	507.08	0.96	−0.1	0.86	−10.3
70 - 79.99k	482.66	−71.05	411.61	0.65	−0.1	0.55	−14.72
80 - 99.99k	454.74	−76.69	378.06	0.51	−0.09	0.42	−16.86
100 - 119.99k	385.13	−93.35	291.78	0.35	−0.09	0.27	−24.24
120 - 149.99k	338.96	−106.16	232.8	0.26	−0.08	0.18	−31.32
more than 150k	337.25	−131.14	206.11	0.15	−0.06	0.09	−38.88

Notes: The tables shows the nominal gains and Equivalent Variation (EV) of price increases in response to increasing all binding minimum wages in the US by 20%. Table A.24 uses Equivalent Variation of price increases in grocery stores. Table A.24b uses Equivalent Variation of price increases in grocery stores and restaurants. See section 7 for a more detailed description of the calculations involved. We show the mean nominal gains and EV for each income bracket in USD and in % of HH income. ΔY_h^L is the increase in nominal household incomes. $E_h \Delta P$ is the EV of the predicted increase in prices at grocery stores. Net is the remaining welfare effect. $100 \cdot E_h \Delta P / \Delta Y_h^L$ illustrates the % of nominal income gains that is offset by price increases.

A.7 Effects of minimum wages on output

Table A.25 presents the results of equation 4 estimated with quantities and revenues as dependent variables. Quantity indices are constructed the same way as the price index. Log revenues are total store revenues. We find no significant impact. Both outcome variables have a substantially higher variance than price indices. Note that the gap between quantity indices and revenues is insignificant but largely consistent with the price response we estimate.

Table A.25: Effects of minimum wages on output and revenues

	(1) Quantity index	(2) Log revenues	(3) Quantity index	(4) Log revenues	(5) Quantity index	(6) Log revenues
			Legislation			
E_0^{leg}	-0.031	0.014			-0.026	0.012
	(0.026)	(0.025)			(0.035)	(0.029)
E_2^{leg}	-0.036	0.019			-0.039	0.000
	(0.029)	(0.029)			(0.038)	(0.037)
E_4^{leg}	-0.039	0.001			-0.033	-0.014
	(0.045)	(0.041)			(0.045)	(0.047)
			Implementation			
E_0^{inc}			0.022	0.024	0.006	0.013
			(0.042)	(0.046)	(0.043)	(0.052)
E_2^{inc}			-0.036	-0.013	-0.028	-0.001
			(0.041)	(0.056)	(0.051)	(0.073)
E_4^{inc}			-0.056	-0.044	-0.041	-0.020
			(0.055)	(0.056)	(0.064)	(0.067)
			Estimation Summary			
$E_4^{leg}+E_4^{inc}$	-0.039	0.001	-0.056	-0.044	-0.073	-0.034
	(0.045)	(0.041)	(0.055)	(0.056)	(0.086)	(0.088)
$\sum$ All	-0.116*	-0.125	-0.090	-0.028	-0.093	-0.085
	(0.068)	(0.077)	(0.074)	(0.086)	(0.103)	(0.093)
$\sum$ Pre-event	-0.012	-0.054	-0.084	-0.018	-0.022	-0.024
	(0.035)	(0.036)	(0.059)	(0.066)	(0.068)	(0.074)
N	201973	201578	201973	201578	201973	201578
Controls	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	YES	YES	YES	YES

A.8 Comparison to Ganapati and Weaver (2017) and Leung (2016)

Two closely related contemporaneous papers also study the effects of minimum wages on prices in grocery stores. Ganapati and Weaver (2017) and Leung (2016) both use scanner data provided by Nielsen that covers a shorter time period but a larger number of stores. Despite using the same data, the two papers reach different conclusions: Leung (2016) finds much larger elasticities than we do, while Ganapati and Weaver (2017) find no effects of the minimum wage on grocery prices.

There are two main differences to the paper of Leung (2016) and three to the paper of Ganapati and Weaver (2017). Most importantly, both contemporaneous papers study the effects of minimum wage increases at the time of implementation, our main effect occurs at the time legislation is passed. We thus document a robust effect at legislation that they overlook. Second, our econometric approach is different to both Leung (2016) and Ganapati and Weaver (2017). We estimate pass-through regressions in first differences, which relate inflation to changes in the minimum wage and include fixed effects that control for differential inflation trends. Both other papers estimate level regressions and therefore control for a different set of fixed effects. Moreover, the leads and lags in the pass-through regressions allow us to study the timing of the effect in detail.

Leung (2016) finds large minimum wage elasticities of prices of around 0.06. He focuses on what we call the implemented minimum wage. His elasticity estimates are about 3 times our estimate at the time of legislation. There are various explanations for this difference. First, Leung's data cover a different time period, from 2006–2015. As we show in 4, minimum wages are considerably more binding toward the end of our sample period, and as Leung shows, his elasticity estimates are especially higher than ours during the later years of the Nielsen data that our dataset does not cover. Second, his estimation does not control for differential trend inflation rates in different stores. In Table A.26 we replicate a specification similar to his baseline and also find larger elasticities. However, as shown in the table, including store-level linear time trends—that are captured by store fixed effects in our baseline first difference regressions— reduces these estimates to similar values as in our baseline first difference specification. Third, when including the legislated minimum wage in these regressions, it becomes clear that this variable, rather than the implemented minimum wage is driving the results. Finally, we want to highlight that the table suggests that our first-difference specification is more efficient. The level coefficients including linear trends are of a similar magnitude, but less precisely estimated. This is to be expected. Both prices and minimum wages are not stationary in levels. Furthermore, the price level is highly autocorrelated due the stickiness of prices, and this suggests that the first difference estimation is the better way, even though including trends in the level estimation results in similar point estimates as the first difference specification.

Table A.26: Baseline results using the price level

Dep. variable: log store price level	(1) Baseline	(2) Trend	(3) Baseline	(4) Trend	(5) Baseline	(6) Trend	(7) Chain time FE	(8) Division time FE
log MW	0.040	0.018			0.006	0.010	0.007	-0.003
	(0.039)	(0.019)			(0.031)	(0.017)	(0.016)	(0.011)
log Legisl. MW			0.059*	0.024	0.056**	0.022	0.016*	0.011**
			(0.029)	(0.016)	(0.021)	(0.014)	(0.009)	(0.004)
Observations	222166	222166	222166	222166	222166	222166	222166	221318
Controls	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Store FE	YES	YES	YES	YES	YES	YES	YES	YES
Store trend	NO	YES	NO	YES	NO	YES	YES	YES
Chain time FE	NO	NO	NO	NO	NO	NO	NO	YES
Division time FE	NO	NO	NO	NO	NO	NO	YES	NO

Notes: The dependent variable is the store-level price level. MW is the binding minimum wage. The Legislated MW is the highest future minimum wage set in current law. The regressions control for the county unemployment rate, state-level house prices, and county-level population. SE are clustered at the state level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Ganapati and Weaver (2017) have a very different empirical approach than Leung (2016) and our paper and their results are thus more difficult to compare to ours. Instead of constructing store-level price indices, they draw a 1% sample of 5000 unique products from their data, collapse prices to the county-product level, and estimate the effects with county-product combinations as their unit of observation. All of their specifications include product-time fixed effects and thus absorb potential wholesale price changes. Many grocery products are chain- or region- specific and their baseline specification thus absorbs some variation that we absorb through chain-time or division-time fixed effects. Overall, our results are compatible with their findings: there is no robust effect of minimum wage increases on prices at the time that they are implemented. However, since we find effects at the time of legislation, our conclusions are different from the ones they draw.

Some differences in details may arise compared to Ganapati and Weaver (2017) through several substantial differences in their approach to the data compared to our work. We choose stores instead of products as the unit of observation for several reasons. First, we view it as ex ante desirable to weight products by their importance to both consumers and grocery stores. Moreover, entry and exit rates at the product-store level are very high in retail, since low-volume products are frequently introduced and discontinued, and may also go unsold in for extended time periods due to stock-outs, seasonality or low demand. Indeed, when Ganapati and Weaver (2017) only use a subset of products to form a balanced panel, their sample size shrinks by 75%. Using revenue weights in index construction has the attractive side effect of assigning low weights to products that are likely to exit or to have frequent gaps in their price series. Entry and exit is much less pronounced at the store level. Moreover, we find large heterogeneity in effects at the store level (see Section 5.4.2), but not at the level of products (see Section 5.4.3). Overall, one may argue about the better approach. Both, Ganapati and Weaver (2017) and Leung (2016) discuss the advantages and disadvantages of using indices versus product-county level prices at length in the appendices to their papers.