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Does the Minimum Wage Bite into Fast-Food Prices?

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Abstract We study the effect of increases in effective minimum wages on the prices of several fast-food items using quarterly city-level data from 1993–2014, a period during much of which the federal minimum wage declined in real value while state-level legislation flourished. For one product, a burger, we find a robust price elasticity of 9 % with respect to the minimum wage. This estimate indicates substantial cost pass-through when contextualized by the effect of minimum-wage increases on restaurant wage bills. Our estimate for pizza is suggestive of a similarly large pass-through rate but is less precisely estimated, and our estimate for fried chicken is near zero, but estimated even less precisely. Taken as a whole, our estimates point toward sizable cost pass-through of minimum wage increases to consumer prices. These results contribute to a mixed literature on the consumer burden of minimum wage increases.

Keywords Minimum wage · Fast food · Restaurants · Pass-through · Prices

JEL Classification J31 · L81

Introduction

A panel appointed by New York governor Andrew Cuomo recently recommended that New York increase the minimum wage paid to fast-food workers who work for

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chains with at least 30 locations, to $15 an hour (McGeehan 2015). Other cities, including Seattle and Los Angeles, have already implemented similar increases. Although there is an extensive literature on the effects of minimum-wage increases on low-skilled workers' wages and employment rates, relatively little attention has been paid to estimating the pass-through of these increases to consumer prices (Neumark and Wascher 2008; Lemos 2008). The elasticity of prices with respect to the minimum wage matters because it has distributional implications and represents a potential channel for inflationary effects of labor policy.

In this paper, we analyze the effects of minimum-wage increases on prices of three fast-food products—burgers, fried chicken, and pizza—using data from the last twenty years, which include significant variation in minimum wages both over time and across locations. We find large point estimates for the first two products: elasticity estimates of 0.09 and 0.08, respectively, both of which imply large cost pass-through. The estimate of the elasticity of the burger price is fairly precise, with a standard error of about 0.03, while the estimate for pizza is much noisier. For the third product, fried chicken, our standard errors are also quite large, and although our point estimate is small and negative, the confidence interval does not rule out a large pass-through effect. We also estimate the price effects of the minimum wage using two other datasets, the food-away-from-home CPI from the Bureau of Labor Statistics and the average price of a meal from the Census of Accommodation and Foodservices, and find similar results.

Earlier papers that address this question include Aaronson (2001), Card and Krueger (1994), and Katz and Krueger (1992). Aaronson (2001), which is most similar to our paper, uses data from 1978–1995 and finds an elasticity of fast-food prices with respect to the minimum wage ranging from 0.07 to 0.16. Katz and Krueger's (1992) point estimates are not statistically significant, leading them to conclude that prices are unaffected by the minimum wage, but their standard errors are large and their point estimates do not rule out large effects. Card and Krueger (1994) report that their results are "mixed" because in some specifications their coefficients are not statistically significant; but again, in these cases their standard errors are quite large and do not rule out substantial cost pass-through. In a related paper, Aaronson et al. (2008) focus on the price effects of the federal minimum-wage increases in 1996-97 and find price elasticities around 0.07. MacDonald and Aaronson (2006) find that pass-through in aggregate prices is quite fast, although individual establishments may not adjust all prices immediately. Finally, in a case study of the early effect of San Francisco's "living wage" legislation, Dube et al. (2007) find a price elasticity of about 0.06 for fast-food outlets.

In the years since those papers were written there was substantial erosion in the federal minimum wage and significant activity at the state level. The federal minimum wage fell more than 25 % in real terms between September 1997 and July 2007. In response, many states increased their minimum wages, providing rich variation for estimating price effects using a full difference-in-difference framework, unlike earlier studies, which are limited by relatively few state-level changes in minimum-wage legislation.

As a result, compared to earlier studies, our dataset is significantly more comprehensive, including five federal minimum-wage increases and over 300 state or local increases. This allows us to estimate flexible difference-in-difference specifications that control for many unobserved factors other studies have had to assume away. This is an advantage in particular over the dataset used by Aaronson (2001), in which identification relies primarily on increases in the federal minimum wage.

To determine the degree of pass-through, we also estimate the effect of the minimum wage on restaurant wage bills. We find that the elasticity of the state-level wage bill of limited-service restaurants with respect to the minimum wage is around 0.16. A back-of-the-envelope calculation suggests that, if the labor share of marginal cost is about 50 %, fast-food restaurants are fully passing through their cost increases to consumer prices.

Data

We obtained minimum-wage data from several sources. Federal minimum-wage rates and enactment dates come from the U.S. Department of Labor's website, which also includes historical state minimum-wage data but without the enactment dates. We corroborated the data with history of state minimum-wage enactment dates from Fiscal Policy Institute (2006) for 1996–2006 as well as from state governments' websites for the remaining years to form a comprehensive dataset with state minimum-wage rates and their enactment dates from 1993-2014. The minimum-wage data are described in detail in Appendix A.1.[1]

We use city-level average-price data for the period 1993–2014 from the Council for Community and Economic Research (C2ER, formerly the American Chamber of Commerce Research Association, or ACCRA). The data are updated quarterly, in the first week of each quarter (in January, April, July, and October). For this analysis, we use C2ER's city-level average prices of three fast-food items over the period 1993–2014. These data are also used in Aaronson's (2001) study. The products are a McDonald's Quarter Pounder ("McD burger"), 13 inch thin-crust regular cheese pizza at Pizza Hut and/or Pizza Inn ("pizza"), and fried chicken drumstick and thigh at Kentucky Fried Chicken and/or Church's Fried Chicken ("KFC fried chicken"); the product definitions are consistent over time and across states. Price surveyors at participating Chambers of Commerce are instructed to survey at least five and up to ten McDonald's, Pizza Hut and/or Pizza Inn, and Kentucky Fried Chicken and/or Church's Fried Chicken establishments in town, if possible. More details on the C2ER data are available in Appendix A.2.[2]

[1]The minimum wage does not apply to all workers. In many states tipped workers' cash wages may fall below the state's regular minimum wage, as long as the sum of cash wages and tips meets the minimum-wage standard. However, tipping is very unusual in the fast-food sector, and we believe our minimum-wage data appropriately capture the relevant wage floor (Even and Macpherson 2014; Allegretto 2013). Jones (2015) provides evidence on the effect of the tipped minimum wage on the wages of restaurant servers.

[2]City-level C2ER data have been used for a variety of economic studies in the past, including studies of supermarket financing (Chevalier 1995; Chevalier and Scharfstein 1996); price convergence and deviations from the "law of one price" (Parsley and Wei 1996; Choi and Wu 2012); inequality (Frankel and Gould 2001); and the impact of retailer entry on prices (Basker 2005; Courtemanche and Carden 2014).

Aaronson (2001) raises several concerns about the ACCRA/C2ER data. First, he notes that C2ER does not aim for consistency in its product definitions over time, focusing instead on cross-sectional consistency; as a result, survey participants vary from quarter to quarter. While the product definitions of the fast-food items in this study have not changed over this period, the specific outlets surveyed may have changed, which could result in spurious variation over time in the average price of a specific item in a given city. Second, the quarterly frequency of C2ER data makes it difficult to determine whether prices respond immediately to a minimum-wage increase. Because C2ER prices are always collected in the first week of the quarter, and minimum-wage increase almost always become effective on the first day of the quarter, a lag in price adjustment of just a few days delays our observation of the price increase by a full quarter.

Aaronson (2001) partially addresses the first concern by smoothing out the price series to remove temporary price changes of more than 5 % that quickly return to their prior levels. We have estimated all our regressions using this smoothing procedure, but as it did not meaningfully change either point estimates or significance levels, we report only the unadjusted regressions.

Like Aaronson (2001), we supplement the price analysis by using the BLS "food-away-from-home" CPI as a second measure of prices, this one at the Metropolitan Statistical Area (MSA) level. Because many of the BLS cities are actually multi-state metro areas (e.g., Washington-Baltimore, DC-MD-VA-WV; New York-Northern New Jersey-Long Island, NY-NJ-CT-PA), and are subject to different minimum wages in different parts of the metro area at any given point in time, we conduct the CPI analysis using two different samples. The first sample includes only MSAs that are entirely inside one state, and the second adds MSAs that span state lines; in the latter case, we use the average minimum wages across the states in the MSA.[3] We also estimate the regressions using two data frequencies: monthly and annual, because many MSAs have data only bimonthly or quarterly. The monthly single-state MSA dataset includes only ten MSAs in eight states, and only one of these (Los Angeles-Riverside-Orange County, CA) has monthly CPI data for the full twenty-year period of our sample. Monthly data are available for at least some months in five additional MSAs that span two or more states. Annual CPI data have somewhat better coverage: 17 MSAs in 13 states contained entirely within a state have an annual "food-away-from-home" CPI for all or part of the time period; and nine additional MSAs that span two ore more states have annual data available.

A final source of price data is the Census of Accommodation and Foodservices (CAF) from 1997, 2002, and 2007. In each of those years, the CAF questionnaire sent to most restaurants asks the restaurant to report the average price of a meal that year at that restaurant. Published reports from the CAF provide, by state, the number of restaurants reporting average prices in several ranges, and the total revenues of

[3]This is less of an issue for Aaronson's analysis, since he focuses on the effect of federal rather than state-level minimum-wage hikes.

restaurants in each of these price-range categories. This information is reported separately for full-service restaurants (NAICS 722110) and limited-service restaurants (NAICS 722211).[4] From this information, we construct the fraction of restaurant revenues earned at restaurants with average meal price below $5, below $10, and below $15. On average across the three years for which we have data, and excluding cells with suppressed information, 3 % of full-service restaurants' revenues are earned by restaurants with an average meal price under $5; 44 % are earned by restaurants with an average meal price under $10; and 71 % by restaurants with average meal price below $15. The respective shares for limited-service restaurants are 44 %, 91 %, and 98 %.

We also use payroll data from state-level County Business Patterns (CBP) data from 1993 to 2012. CBP data are annual and include full-year and first-quarter payroll paid by business establishments, by state and industry. Until 1997, the data are reported using the Standard Industrial Classification (SIC) system, and we use payroll by SIC 5800 establishments (eating and drinking places). Starting in 1998, the reporting is done using the North American Industrial Classification System (NAICS), and provides a breakdown of NAICS 722 (all restaurants and drinking places) into multiple subsectors, including NAICS 722110 (full-service restaurants) and NAICS 722211 (limited-service restaurants).[5]

Because of concerns that state minimum wages are procyclical, which may cause a spurious positive relationship between minimum wages and restaurant payrolls, payroll regressions include the log of current and lagged per-capita state-level GDP (Gross State Product, or GSP) from the Bureau of Economic Analysis in chained 2009 dollars as a control variable. This variable is calculated on an SIC basis to 1996 and on a NAICS basis from 1997. GSP per capita ranges from $25,000 (in 2009 dollars) to $72,000, with an average of about $43,000. Four states, Alaska, Connecticut, North Dakota, and Wyoming, have GSP per capita above $67,000 for one or more years during the sample period; and four others, Arkansas, Mississippi, Montana, and West Virginia, have GSP per capita below $28,000 for one or more years. The year-to-year growth rate of per-capita GSP averages 1.5 % over this sample; eight states experienced growth above 9 % at some point during the sample and five experienced a decline greater than 9 % at some point.

[4]The Census Bureau includes fast-food restaurants in NAICS 722211. This category excludes bars, cafeterias, ice-cream parlors, coffee shops, and food trucks, all of which are classified elsewhere. Data for 2002 and 2007 are available from American Fact Finder at http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml. Data for 1997 are available from the publication "1997 Economic Census: Accommodation and Foodservices: Subject Series," Table 8.

[5]Establishment payroll includes "all forms of compensation, such as salaries, wages, commissions, dismissal pay, bonuses, vacation allowances, sick-leave pay, and employee contributions to qualified pension plans paid during the year to all employees [. . . as well as] amounts paid to officers and executives [of corporations, . . . but excluding] profit or other compensation of [the owner or owners of unincorporated businesses]." Source: http://www.census.gov/econ/cbp/definitions.htm, accessed August 19, 2013. Starting in 2012, full-service restaurants' NAICS changed to 722511 and limited-service restaurants' NAICS code changed to 722513.

Table 1 Fast-food prices as a function of state minimum wages

	Burger	Chicken	Pizza	Burger	Chicken	Pizza
ln(**minwage**$_{t+1}$)				0.0087	−0.0285	−0.0130
				(0.0240)	(0.0532)	(0.0320)
ln(**minwage**$_t$)	0.0932***	−0.0292	0.0780	0.0893**	0.0103	0.0827
	(0.0279)	(0.0591)	(0.0536)	(0.0412)	(0.0579)	(0.0499)
ln(**minwage**$_{t-1}$)				−0.0043	−0.0177	0.0077
				(0.0381)	(0.0740)	(0.0310)
Sum of coeffs				0.0938***	−0.0369	0.0775
Observations	19,937	19,937	19,937	19,718	19,718	19,718

Unit of observation is a city-quarter. Sample includes 311 cities in 50 states

All regressions include city and time FE, and city-specific linear trends

Robust standard errors in parentheses, clustered by state

* $p < 10$ %; ** $p < 5$ %; *** $p < 1$ %

Effect of Minimum Wage on Fast-Food Prices

For each of the three fast-food items, we estimate

$$\ln(\mathbf{price})_{it} = \alpha_i + \delta_t + \beta_i \mathbf{time}_t + \sum_S \gamma_s \ln(\mathbf{minwage}_{is}) + \varepsilon_{it} \tag{1}$$

where $\mathbf{price}_{it}$ is the price in city i at the beginning of quarter t; α_i is a city fixed effect, δ_t is a time (quarter×year) fixed effect, β_i is a city-specific linear trend, and $\mathbf{minwage}_{is}$ is the minimum wage in city i at the beginning of quarter s. We start with a specification that includes only the current minimum wage, $S = \{t\}$, and then add the one-quarter lag and lead of the minimum wage as control variables so that $S = \{t-3, t, t+3\}$.[6] Because we include time fixed effects, we do not control for spatially invariant factors such as the overall CPI or the CPI for specific inputs, such as beef or chicken, as in Aaronson (2001).

Table 1 presents the coefficients γ_s from the above regression.[7] We cluster the standard errors at the state level because, although we have city-level observations, almost all of the variation in the minimum wage occurs at the state level.

[6] An earlier version of this paper included GSP in the price regressions. We omit this variable in the price regressions in the current version of the paper because it is available only to 2013 (and the 2013 values are preliminary) whereas prices are available to 2014. Robustness checks with available data using log GSP as a control variable are extremely similar to the reported regressions in the current version.

[7] We drop cities with fewer than 40 observations from our sample because we worry that dramatic changes in the sample from quarter to quarter could move not only the average price (which we control for with a quarter fixed effect) but also the variance of prices, which affects efficiency. However, the results are not sensitive to this sample selection; for example, the coefficient on minimum wage in the burger-price regression is 0.086, as compared with 0.093 in the restricted sample. Statistical significance is unaffected. Results from the full set of cities are available upon request.

We find that McDonald's burger prices increase by about 0.9 % for every 10 % increase in the effective minimum wage; this coefficient is significant at the 1 % level. We also estimate an increase, of about 0.8 % for a 10 % increase in the effective minimum wage, for the price of pizza, but this effect is not significant at conventional levels. In the case of KFC fried chicken prices, the point estimate is negative, but the standard error is very large and does not preclude positive as well as negative and zero price effects. In an unreported regression we have estimated a single effect for all three products, including both city-level trends and a full set of product$\times$time fixed effects, and find a coefficient of about 0.05 but a standard error of about 0.03.

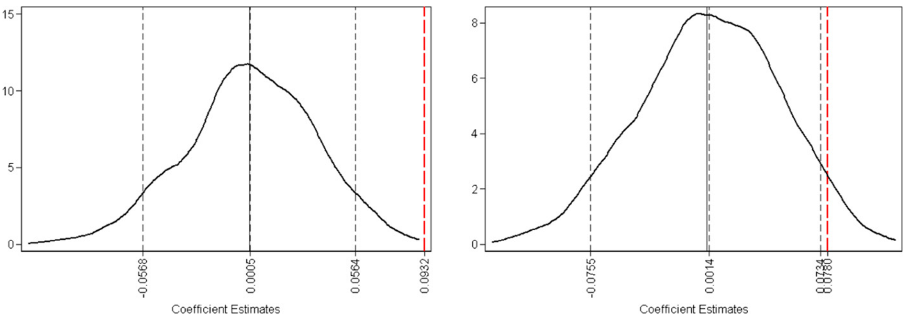
When we add the one-quarter lead and lag of the minimum wage, we find that the increase in McDonald's prices is very concentrated in the quarter of the minimum-wage increase, as is the effect of the minimum wage on pizza prices. The KFC regression does show a (very small) positive correlation between the current minimum wage and the current price, but it is flanked by two negative coefficients in the leading and lagged quarters.

We have extended the leads and lags by one more quarter in supplementary regressions, not shown. These estimates are noisier, but all produce positive contemporaneous-effect coefficients, with point estimates ranging from 0.02 (fried chicken) to 0.09 (burger).

These estimates are broadly consistent with the results of Aaronson (2001) analysis, in which he regressed log prices on the current minimum wage, a one-month lead, and a one-month lag, using year and quarter fixed effects rather than a full set of time effects (interactions of year and quarter), over an earlier period, and with a significantly smaller dataset (roughly 3,000 observations compared to about 20,000 here).

Burger prices are for a single chain, McDonald's, but pizza and fried chicken are a weighted average across two chains, possibly with the weights changing over time in way that we cannot observe but may be correlated with the error term. We do not have information on the identity of the stores surveyed in each city, nor do we have historical data on the locations of the various chains. Instead, we use the February 2014 U.S. locations of both Pizza Inn and Church's Chicken, the two smaller chains, from the companies' websites. Of the 185 Pizza Inn locations in the U.S. in February 2014, 22 were in cities included in the C2ER sample. Removing those 22 cities from the sample had no meaningful effect on the estimated effect of the minimum wage on the price of pizza; the significance level was also unaffected. Church's is a bigger chain, and we had to eliminate 114 of the cities in our sample to eliminate any overlap with Church's locations. When we estimate the chicken-price regression excluding cities in which Church's may have been surveyed, the coefficient on the minimum wage increases from -0.03 to $+0.03$, but it remains imprecisely estimated. We conclude that the confounding of multiple chains is not driving the pizza-price results, but may have contributed to the negative estimate in the chicken-price regressions.

To test whether our results are spurious, we run a placebo exercise in which we assign states' minimum-wage histories randomly, with replacement, following Bertrand et al. (2004). In each of 1,000 simulations, we put probability $1/50$ on each



(a) McDonald's Burger (b) Pizza

Fig. 1 Distribution of coefficient estimates for placebo regressions

of the 50 states, and use the selected state's entire vector of minimum-wage history, then re-estimate Eq. 1. Using the price of a burger on the LHS, the mean of the 1,000 coefficient estimates we obtain is 0.0005, or nearly zero; the range of estimates we obtain in these simulations is -0.1177 to 0.0901: all fall below 0.0932, the point estimate from Eq. 1. A kernel density of these placebo estimates is shown in Fig. 1a. A solid vertical line represents zero; dashed vertical lines are also shown at the 5th percentile, the mean, and the 95th percentile of the distribution; and a bold vertical line is shown at 0.0932. We conclude that the clustered OLS standard errors are not under-estimated, and that the effect we estimate is not spurious. Figure 1b shows the distribution of the placebo coefficients for pizza; the point estimate from the OLS regression, 0.0780, exceeds the 95th percentile of the distribution of placebo coefficients and is in that sense significant at the 10 % level.[8]

As another robustness check, we also estimated the model using the BLS "food-away-from-home" CPI. As noted earlier, we have monthly data for part or all of the sample period from only ten MSAs in eight states that are contained entirely within a single state, and for 15 MSAs altogether. We have annual data for 17 single-state MSA in 13 states, and for 26 MSAs including ones that span state lines. Because of the limited number of observations in this analysis, we estimate a simplified version of Eq. 1, including only MSA and time fixed effects as covariates.

These results are shown in Table 2. Not surprisingly, since we cluster standard errors at the state level, the power in these regressions is quite limited, but they are

[8]The point estimate of the fried-chicken effect is below the mean of the falsification-exercise distribution; to save space we do not include it here. In unreported robustness checks, we have also removed the city-specific trends; the estimated pass-through of the minimum wage to pizza decreases in this specification, from a statistically insignificant 0.08 to a statistically insignificant 0.02; the estimated effect for burger prices increases, from 0.09 to 0.11, and remains significant at the 1 % level. We have also attempted to control for time-varying city-level conditions by including the city's unemployment rate, as reported by the Bureau of Labor Statistics. City-level monthly unemployment rates are available for 280 of the 311 cities in our sample. These results are qualitatively and quantitatively almost identical to the estimates without the additional control.

Table 2 BLS "Food away from home" CPI as a function of state minimum wages

	(1)	(2)	(3)	(4)
ln(**minwage**$_t$)	−0.0002	0.0478	0.0264	0.0436
	(0.0240)	(0.0476)	(0.0280)	(0.0331)
Bootstapped Wald-t p-value[a]	0.9940	0.8470	0.4980	0.4850
Frequency	Monthly	Monthly	Annual	Annual
MSAs	10	15	17	26
Includes multistate MSAs	N	Y	N	Y
Clusters	8	9	13	12
Observations	1,323	2,175	365	563

Unit of observation is a MSA-month or MSA-year

All regressions include MSA and time FE

Robust standard errors in parentheses, clustered by state/multistate area

[a]Two-sided p value bootstrapped to correct for small number of clusters

broadly consistent with the product-level regressions presented earlier.[9] The monthly model with only single-state MSAs, which has only ten MSAs in eight states, generates a near-zero point estimate on the log of the minimum wages, but the estimated elasticities in the other three models—respectively, monthly data for 15 MSAs, annual data for 17 single-state MSAs, and annual data for 26 MSAs—are all positive and in the range of 0.03–0.05. Because clustered standard errors in models with few clusters are known to be biased downwards, we also include in the table the bootstrapped p-values from a percentile-t bootstrap (see Cameron and Miller 2015, for a discussion).

Finally, we use the CAF data to estimate the effect of a minimum-wage increase on the relative number of different types of restaurants. Since we have only three years of data at the state level, we estimate

$$\mathbf{fraction}_{it} = \alpha_i + \delta_t + \gamma \ln(\mathbf{minwage}_{it}) + \varepsilon_{it} \tag{2}$$

where $\mathbf{fraction}_{it}$ is the fraction of restaurant revenues earned by restaurants whose prices fall below \$5, \$10, or \$15, respectively. These results are shown in Table 3. Given the small number of observations per state, the power of this regression is limited, but the results are consistent with our earlier findings. The one statistically significant coefficient (significant at the 5 % level) shows that a 10 % increase in the minimum wage decreases the share of restaurant sales at restaurants charging less than \$10 per meal by about 1 %.

[9]In the regressions that include MSAs spanning state borders, we use the mean of the logged minimum wages of all the states in the MSA as the LHS variable, and we cluster on "super-states," a partition of states constructed so that no MSA crosses super-state lines and no further partition is possible without losing this property. The largest super-state includes 12 states and five MSAs from Washington-Baltimore to Boston-Brockton-Nashua.

Table 3 Share of restaurant sales at restaurants, by average meal price range

	Full-service restaurants			Limited-service restaurants		
	Under \$5	Under \$10	Under \$15	Under \$5	Under \$10	Under \$15
ln(**minwage**$_t$)	0.0529	0.0513	−0.0392	−0.0495	−0.1048**	−0.0207
	(0.0358)	(0.0679)	(0.0442)	(0.0773)	(0.0436)	(0.0215)
Observations	136	136	134	127	127	125

Unit of observation is a state-year. Sample includes 50 states in 1997, 2002, and 2007

All regressions include state and time FE

Robust standard errors in parentheses, clustered by state

* $p < 10$ %; ** $p < 5$ %; *** $p < 1$ %

Pass-Through

We assume that marginal cost is composed of two separable components: a labor cost per unit of output, which depends on the minimum wage, and a cost of supplies (beef, lettuce, etc.), which is independent of the minimum wage. To calculate pass-through, we must first determine the relative importance of these two separate components of marginal cost, and then determine how much the labor portion increases with the minimum wage.

There are no definitive estimates of the labor share of marginal cost, so we approximate these with the labor share of average costs. According to the 2002 Census of Business Expenses (CBE), of a total of nearly \$93 billion in operating expenses for limited-service restaurants (NAICS 7222), payroll accounted for 41.8 % and employer costs for fringe benefits accounted for another 5.9 %, totaling 47.7 %.[10]

For the second task, we use annual data from the CBP, which includes, at the state level, annual and first-quarter payroll figures for various restaurant subsectors. We estimate

$$\ln(\mathbf{pay})_{it} = \alpha_i + \delta_t + \beta_i \mathbf{time}_t + \gamma \ln(\mathbf{minwage}_{it}) + \rho_0 \ln(\mathbf{GSP}_{jt}) + \rho_1 \ln(\mathbf{GSP}_{j,t-1}) + \varepsilon_{it} \tag{3}$$

where $\mathbf{pay}_{it}$ is either real annual or real first-quarter payroll in state i in year t, and δ_t is a year fixed effect. The minimum wage in year t is calculated as the algebraic average of the 12 monthly minimum wages in the state; and the first-quarter minimum wage is calculated as the algebraic average of the three monthly minimum wages in the first quarter.

We estimate this regression separately for all restaurants and drinking places, full-service restaurants, and limited-service restaurants. We have data on the first starting in 1993, but the breakdown by service level is only available starting in 1998. The results are reported in Table 4. Our preferred specification uses first-quarter data

[10]Available at: http://www2.census.gov/retail/releases/benchmark/2002_bes.pdf, Table 21. Accessed December 20, 2014.

Table 4 Restaurant payroll as a function of state minimum wages

	All restaurants		Full-service restaurants		Limited-service restaurants	
	Annual	Q1	Annual	Q1	Annual	Q1
ln(**minwage**$_t$)	0.1347***	0.1402***	0.0955***	0.1061***	0.1303**	0.1607***
	(0.0364)	(0.0320)	(0.0354)	(0.0378)	(0.0488)	(0.0469)
Years	1993–2012	1993–2012	1998–2012	1998–2012	1998–2012	1998–2012
Observations	1000	1000	750	750	748	748

Unit of observation is a state-year

All regressions include state and time FE, state-specific linear trends, and current and lagged gross state product

Robust standard errors in parentheses, clustered by state

* $p < 10$ %; ** $p < 5$ %; *** $p < 1$ %

since the minimum wage is measured with less error in that specification (minimum-wage increases rarely occur within a quarter). We find that total state-wide restaurant payroll increases by 1.4 % for every 10 % increase in the average state effective minimum wage.

When we break down the payroll effect by type of restaurant, it is clear that the effect on full-service restaurants is somewhat smaller—close to 1.1 %—than the effect on limited-service restaurants, which is 1.6 %.[11]

Putting these all together, we can perform the following back-of-the-envelope calculation: If payroll costs at limited-service restaurants increase by 1.6 % for a 10 % increase in the minimum wage, and marginal cost consists of approximately 50 % labor cost, then marginal cost increases by 0.8 % for every 10 % increase in the minimum wage. Our finding that prices increase by approximately that much implies, then, a full pass-through of minimum wages to consumer prices.[12]

One concern about the above calculation is that minimum-wage increases may cause hiring managers to change employment levels, thereby changing the labor share of marginal costs endogenously. To assess the possible magnitude of this effect we have also estimated Eq. 3 replacing log payroll with log restaurant employment on the LHS, again from CBP figures. The estimated elasticity of aggregate restaurant employment with respect to the minimum wage is negative, ranging from

[11]The coefficients on current and lagged gross state product (not shown) are all positive and statistically significant. The elasticity of restaurant payroll with respect to current GSP ranges from 0.27 to 0.29, depending on the specification, and is significant at least at the 5 % level in all specifications. The elasticity of restaurant payroll with respect to lagged GSP ranges from 0.31 to 0.39 and is significant at the 1 % level in all but two specifications.

[12]If minimum-wage increases affect the labor costs of workers further up the supply chain—in the harvesting, warehousing, distributing of the raw food, for example—and are passed through in the cost of raw materials for food production, then our calculation overstates the pass-through of the minimum wage in the fast-food sector.

−0.03 to −0.05, but statistically insignificant. This is consistent with a competitive-labor-market model in which labor demand is very inelastic. Although we cannot extrapolate to the effect of large changes in the minimum wage, within the range of the increases in the 20-year period covered by this study, the effect on employment is very small.

Concluding Remarks

We find robust, economically meaningful, and statistically significant effects of changes in the effective minimum wage on the price of a burger; a slightly smaller and marginally significant estimate of the effect on the price of pizza; and a very imprecise estimate of the effect on the price of fried chicken. In making inferences from these estimates, we place the most weight on the most precise estimate, an elasticity of 9 %.

Our findings imply a full pass-through of that higher costs of production to consumers in the form of higher prices. Even so, from a consumer's standpoint, the price increases are small. Our estimates imply that a 33 % increase in the federal minimum wage, from $7.25/hour to $10.10/hour, as has been proposed, could increase prices of fast-food and similarly unskilled-labor intensive goods by 3 % in the 27 states for which the federal minimum wage is the effective minimum wage (as of December 2014), and by a lesser but still positive amount in the remaining 23 states.

Even with full pass-through, the income effect of this price increase is likely to be very small. The average price of a burger in 2014, according to the C2ER data used in this paper, was approximately $3.77. A 3 % increase in this price amounts to only about 10 cents.[13] At the extreme, consider a minimum-wage earner who eats a McDonald's burger every single day. If the minimum wage increases $7.25/hour to $10.10/hour, her monthly expenditure on burgers will increase by about $3 per month, an increase that is nearly fully offset by the increase in just one hour's earnings.

Moreover, the elasticity we estimate for these products is an upper bound on the overall price impact of the minimum wage. Fast-food products are most likely to be affected by minimum-wage increases because the fast-food sector is low-skilled intensive and many workers in this sector earn the minimum wage. The restaurant sector employs by far the largest percentage of minimum-wage workers; MaCurdy (2015) estimates, using data from the 1996 Survey of Income and Program Participation, that nearly 21 % of minimum-wage jobs and 18 % of minimum-wage hours are in the restaurant sector. Within the restaurant sector, low-skilled and low-wage workers are disproportionately employed in the fast-food sector. In 2011, there were

[13] The predictive power of our estimates is strongest in the range over which we identify these estimates. The real minimum wage, in December 2014 dollars, ranges in our sample from $5.80 to $9.51, with the interquartile range roughly between $6.70 and $7.70. If the minimum wage were to increase dramatically, to $15 per hour, as some have suggested, we expect its effect on all outcome variables to be magnified, but we cannot accurately predict the magnitude of the effect.

more than 200,000 limited-service restaurants in the U.S., accounting for 37 % of all restaurants and bars and for more than 35 % of the sector's employees, but only 30 % of its combined payroll.

The full distributional impact of this finding is indeterminate, because it depends on expenditure shares of different types of earners in sectors differentially reliant on minimum-wage earners.[14] However, our calculations imply that even a full pass-through of minimum wages to prices is unlikely to lead to large upward price pressure. Although consumers are affected by minimum-wage increases, these effects are small relative to the direct wage effects.

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Conflict of interest The authors declare that they have no conflict of interest.

Appendix A: Data

A.1 Minimum Wages

The federal minimum-wage increased five times during the period of our study: October 1, 1996 (from $4.25 to $4.75 per hour); September 1, 1997 (to $5.15); July 24, 2007 (to $5.85); July 24, 2008 (to $6.55); and July 24, 2009 (to $7.25). Figure 2 shows the real federal minimum wage, in December 2014 dollars, over the period of our study; real (CPI-deflated) buying power of the minimum wage decreased by more than 25 % between September 1997 and July 2007, before rising, in steps, to a level higher than that of September 1997.

Table 5 lists the number of states (out of 50; Washington DC is omitted from the data) that are affected by each of the five federal minimum-wage hikes. This variation in the way the federal minimum wage affects states is at the heart of the identification strategy of papers that use federal minimum-wage increases to identify the effect on prices and employment. (To make things more complicated, some states adopted the federal minimum wage of July 24, 2007, 2008, and 2009 effective July 1 of the same year.)

Sandwiched between the federal minimum-wage increases are many instances of state minimum-wage changes. In our analysis, the only minimum-wage changes of economic interest are those where the effective minimum wage in a state changes as a

[14] For example, expenditure on food eaten away from home increases with income, but low-income households may spend disproportionately on fast food. We are not aware of any data set that tracks both consumer demographics and expenditure on food consumed away from home by type of restaurant. The Consumer Expenditure Survey combines expenditures at table-service restaurants, fast-food restaurants, cafes and bars into one question.

Fig. 2 Federal minimum wage, 1993–2014 (December 2014 Dollars)

result of either a federal or a state minimum-wage hike. Figure 3 shows the effective real minimum wage in the median state over the same time period, along with the interquartile range. The median coincides with both the 25th and 75th percentiles of effective minimum wages through 2004. Since January 2005, following increases in the minimum wage in five states (IL, NY, OR, VT, and WA), the 75th percentile has exceeded the median. From January 2007 until mid-2009, the 25th percentile of effective minimum wages fell below the median; the federal minimum-wage hike of July 2009 brought the 25th percentile back to the median.

A federal minimum-wage hike can change the effective minimum wage in a state if (a) the state effective minimum wage is set at the old federal level, in which case it receives the full brunt of the new federal minimum-wage hike; (b) the state's effective minimum wage is between the old and the new federal levels, in which case the effective wage floor increases by less than the full amount of the federal increase; (c) the state's effective minimum wage is at or above the new federal

Table 5 Number of U.S. States affected by federal minimum-wage hikes

Year	Full effect	Partial effect	Peg[a]	Other increase[b]	No effect
1996	39	2	2	1	6
1997	39	4	2	1	4
2007	20	0	0	5	25
2008	18	7	0	5	20
2009	23	8	0	2	17

Excludes Washington, DC

[a]State minimum wage increases automatically to stay above the federal level

[b]Concurrent increase not required to comply with federal increase

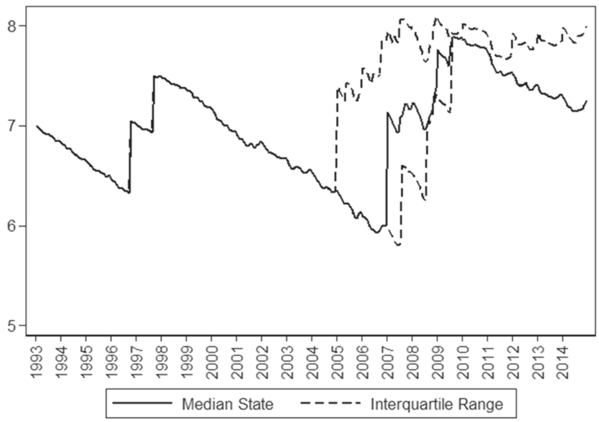


Fig. 3 Effective minimum wage, 1993–2014 (December 2014 Dollars)

level, but state law pegs the state minimum wage at a fixed level above the federal wage.[15] States whose effective minimum wages are at or above the new federal level and have no mandated contemporaneous increase see no minimum-wage spikes following an increase in the federal wage floor. The effective minimum wage in a state also increases when the state raises its minimum-wage level above the federal minimum-wage rate by passing a law to that effect in the state legislature, or when, due to CPI pegging, the minimum wage increases automatically on an annual basis. Since there was no federal minimum-wage hike between 1997 and 2007, some states experienced several minimum-wage changes during this period while others had no minimum-wage increases. We use this periodic variability, along with the additional variation provided by the uneven impact of the federal hikes in 1996, 1997, and the late 2000s, to identify the effects of minimum-wage changes on prices and isolate them from the effects of other variables changing at the same time.

Table 6 lists the number of effective minimum-wage increases by state over the period of our study. A total of 321 instances are listed, two thirds of which are either due to federal minimum-wage increases or take effect within six months (three months before to three months after) of a federal increase. One hundred and one increases in 29 states are completely independent of the federal increases and occur outside the six-month window. Table 7 repeats this analysis by year, excluding the federal hikes. We do not see any minimum-wage increases during 1993; every later year has at least one effective minimum-wage increase, with clusters in years of federal action. On average across all states and months in our data, a state's minimum wage is about 4 % above the federal level, with the median state's minimum wage

[15]This was the case in Alaska and Connecticut in the 1990s. Connecticut law automatically increases the minimum wage to 0.5 % above the federal rate any time the federal minimum wage rate equals or becomes higher than the state minimum.

Table 6 Minimum-wage increases, by State, 1993–2014

State	All		Excluding changes within 6 months of a federal increase		State	All		Excluding changes within 6 months of a federal increase	
	Number of increases	Average percent increase	Number of increases	Average percent increase		Number of increases	Average percent increase	Number of increases	Average percent increase
AK	5	10.6	1	26.5	MT	11	5.9	5	5.6
AL	5	11.3	0		NC	5	11.4	1	19.4
AR	5	11.4	1	21.4	ND	5	11.3	0	
AZ	9	7.5	5	8.0	NE	5	11.3	0	
CA[a]	9	8.7	5	10.4	NH	5	11.3	0	
CO	10	6.9	5	8.6	NJ	5	10.6	3	16.5
CT	13	5.7	9	5.1	NM[a]	6	10.0	0	
DE	10	6.2	5	8.6	NV	7	10.0	2	14.3
FL	11	6.0	6	6.1	NY	7	9.6	4	11.3
GA	5	11.3	0		OH	9	7.6	5	8.3
HI	4	8.4	4	8.4	OK	5	11.3	0	
IA	4	12.7	0		OR	14	4.8	10	3.5
ID	5	11.3	0		PA	5	11.5	1	21.4
IL	8	8.8	3	9.4	RI	9	6.8	7	6.5
IN	5	11.3	0		SC	5	11.3	0	
KS	5	11.3	0		SD	5	11.3	0	
KY	5	11.3	0		TN	5	11.3	0	
LA	5	11.3	0		TX	5	11.3	0	
MA	6	11.1	4	12.4	UT	5	11.3	0	
MD	5	11.4	1	19.4	VA	5	11.3	0	
ME	10	5.9	5	5.6	VT	17	4.4	12	4.7
MI	6	11.9	2	22.5	WA	17	4.8	14	4.9
MN	6	11.2	2	14.9	WI	6	9.4	2	12.4
MO	8	7.6	3	9.9	WV	5	11.3	1	13.6
MS	5	11.3	0		WY	5	11.3	0	
Total						347		126	

Excludes Washington, DC. The state minimum wage is the maximum of the federal and state level

[a]Does not include city minimum-wage increases in San Francisco, Albuquerque, and Santa Fe

set at the federal level. Fourteen states had minimum wages set at or above 130 % of the federal level at some point during the sample period, and Oregon and Washington both exceeded 140 % in the months immediately preceding the July 24, 2007 increase in the minimum wage.

Table 7 Minimum-wage increases, by Year, 1993–2014

Year	All		Excluding changes within 6 months of a federal increase	
	Number of increases	Average percent increase	Number of increases	Average percent increase
1993	0		0	
1994	1	15.3	1	15.3
1995	2	7.6	2	7.6
1996[a]	3	8.0	2	8.7
1997[a]	8	6.9	0	
1998	2	10.4	1	11.7
1999	6	9.5	6	9.5
2000	5	11.0	5	11.0
2001	5	7.5	5	7.5
2002	5	7.3	5	7.3
2003	6	9.1	6	9.1
2004[b,d]	7	4.8	7	4.8
2005[b]	10	11.5	10	11.5
2006[b,d]	15	11.2	15	11.2
2007[a,b]	28	13.8	19	14.2
2008[a,b,c]	21	5.0	0	
2009[a,b,c,d]	15	6.3	0	
2010[b]	5	4.4	2	6.2
2011[b]	7	1.4	7	1.4
2012[b,d]	8	4.2	8	4.2
2013[b,c,d]	10	2.0	10	2.0
2014[b,c,d]	17	5.2	17	4.5

Excludes Washington, DC, federal, and city-level increases

The effective minimum wage is the maximum of the federal and state level

[a] Year with a federal minimum-wage increase

[b] Year with minimum-wage increases in San Francisco, CA

[c] Year with minimum-wage increases in Albuquerque, NM

[d] Year with minimum-wage increases in Santa Fe, NM

For a few cities, we supplement the state and federal data with information on city-level minimum wages. San Francisco enacted a minimum wage in 2004 and has raised it almost every year since. Santa Fe also adopted a city minimum wage of $8.50 an hour in June 2004 (Yelowitz 2005); in 2008, it was expanded to all private employees (prior to that it had only applied to businesses with 25 or more employees), and has since increased on average every other year. Finally, Albuquerque, New Mexico, has had a city minimum wage since 2008.[16]

A.2 Prices

The quarterly C2ER publications are constructed with the help of local Chambers of Commerce in participating cities. Prices are collected by local volunteers in the first week of each quarter. The sample of cities in each quarterly publication varies from issue to issue as participation in the price survey is strictly voluntary. As a result, some cities participate in the survey every other quarter, others miss an occasional survey, and still others only report prices for a few quarters before disappearing from the sample altogether. In 2007, C2ER stopped collecting fourth-quarter prices, so we have price data for a maximum of 74 quarters for each product and city. We do not know which, or even how many, outlets were surveyed in practice in each city.[17,18]

Some cities in the C2ER database are actually composites of several nearby cities (for example Reno-Sparks, NV or Benton Harbor-St. Joseph, MI), but most are stand-alone cities. A few cities, such as Kansas City and St. Louis, straddle state lines; since we do not know the exact locations of establishments surveyed in these cities, we drop them to eliminate ambiguity with respect to the applicable minimum wage.

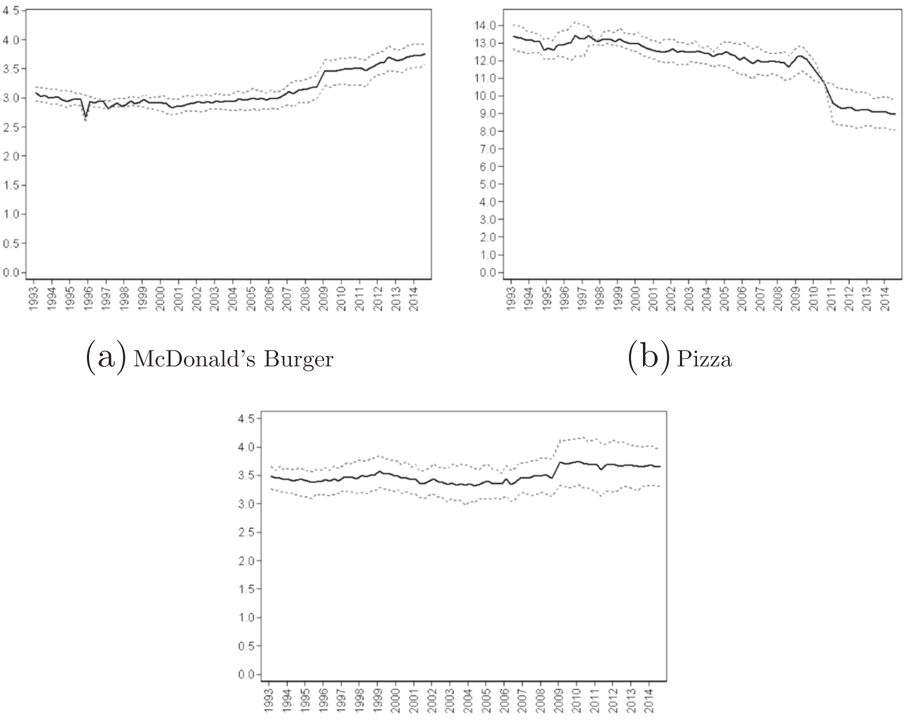
After dropping any city that is included in the survey in fewer than 40 of the possible 80 quarters, we are left with a dataset that includes 311 cities in all 50 states (the District of Columbia is omitted because it is part of a multi-state metropolitan area). Twenty nine cities in 18 states are included in the survey every single quarter, and seven cities in seven states are included for the minimum of 40 quarters. The real (December 2014 dollars) average prices and the cross-sectional inter-quartile range for the three products are shown in the appendix in Fig. 4.[19]

[16] In addition to these cities, Chicago, Oakland, Los Angeles, Seattle, Louisville, Kansas City, and Portland, ME have all adopted higher minimum wage rates that have either taken effect in 2015 or are due to take effect in 2016. Other cities, including Washington, DC, are considering such legislation as well.

[17] According to Info Franchise News, Inc. (2000), Church's Chicken had, at the time, 593 company-owned outlets and 604 franchised outlets; by contrast, KFC had 3,192 company-owned outlets and 6,239 franchised outlets. For this reason we refer to their product as "KFC chicken" although both chains are represented in the data. Pizza Inn is listed as having three company-owned outlets and 500 franchised outlets. Pizza Hut is not listed in Info Franchise News, Inc. (2000), but Yum! Brands' annual report for 2000 lists 7,927 U.S. outlets. Again, we recognize that establishments from both chains are polled, but suspect the sample is heavily biased towards Pizza Hut.

[18] In cities with fewer than five establishments in a given category, all relevant establishments are to be surveyed. In cities with no precise matches (e.g., no McDonald's outlets), the survey includes the price of the item at an establishment most closely matching the described item (if one exists); for example, the instructions say, "If your area doesn't have even one McDonald's restaurant, report the average price at 'fast food' restaurants for a hamburger sandwich with a 1/4-pound (before cooking) all-beef patty, cheese, pickle, onion, mustard, and ketchup" (ACCRA 2003, p. 2.21).

[19] The inter-quartile range of the price of pizza converges to a point in the third quarter of 2010, when just over half the cities – 152 of 303 – quoted a price of $10 for a pizza. This is highly unusual, and appears to be motivated by a chain-wide sale, although we could not find any documentation for it.



(a) McDonald's Burger

(b) Pizza

(c) KFC Fried Chicken

Fig. 4 Mean and inter-quartile range of real price series, by product (December 2014 Dollars)

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