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Abstract

An input-output model is used to analyze price pass-through effects of a minimum wage increase on prices of the food and kindred products and food-service industries. These sectors employ a disproportionate share of minimum wage workers, but results suggest a $0.50 increase in the present minimum wage would increase food prices less than 1 percent for most of the 12 food and kindred products prices and 1 percent at eating and drinking places.

Keywords: Minimum wage, input-output analysis, food and kindred products industries, eating and drinking places

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Summary

We investigated the effects of a minimum wage increase on food and kindred products sector prices for five different scenarios. Our estimated results are directly proportional to the minimum wage increases. We measured, perhaps for the first time, the effect of a full-cost pass-through minimum wage increase on 12 output prices in sectors in the food and kindred products industry and on the output prices of eating and drinking places. The minimum wage increases we analyzed caused only a small increase in the cost of food purchased away from home and less than 1-percent increases for most of the 12 food and kindred products sectors. With full-cost pass-through, increases in the minimum wage raised prices at eating and drinking places by 0.9 percent, the largest percentage increase of the observed industries.

Eating and drinking places have a larger share of minimum-wage workers than other sectors of the food and kindred products industry, and labor costs are relatively large (34 cents of each dollar taken in). Even in the eating and drinking sector, however, a 50-cent minimum wage increase would raise prices by only about 1 percent. While this 1-percent change is slightly larger than the increases we observed in the food and kindred products industries, it is consistent with our overall results.

The Impact of Minimum Wage Increases on Food and Kindred Products Prices

An Analysis of Price Pass-Through

Chinkook Lee and Brian O'Roark

Introduction

When President Clinton signed H.R. 3448, the "Small Business Job Protection Act of 1996," into law, he stated that "this legislation provides a badly needed pay raise for millions of Americans and their families who struggle to make ends meet while working at the minimum wage." The act boosted the minimum wage in two steps—a 50-cent increase from $4.25 to $4.75 an hour that took effect October 1, 1996, followed by an additional 40-cent rise to $5.15 an hour on September 1, 1997. President Clinton proposed a $1 increase in February 1998, a move that was rejected on September 22, 1998. On January 19, 1999, the Fair Minimum Wage Act was introduced. This would raise the minimum wage by $1 over the next 2 years, essentially setting the national wage floor at $6.15 by the year 2000.

The debate of the merits of increasing the minimum wage has since re-intensified. Of particular interest to USDA's Economic Research Service are the effects an increase in the minimum wage might have on food prices, including prices of food away from home. Because the eating and drinking places industry (restaurants) employs many workers at or near the minimum wage, a logical question is whether raising the minimum wage would significantly increase prices of food away from home.

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Aside from the question of its effects on food prices, supporters of the minimum wage increase usually argue that a higher minimum wage would raise the earnings of low-income workers and primarily benefit the poorest working families [15].[1] On the other hand, opponents [such as 6] assert that the increase would lead to widespread job losses among the very workers the legislation was intended to help. Opponents argue that the basic law of supply and demand suggests that raising the minimum wage will increase the price of labor, and firms will naturally hire fewer workers. Although this debate has sparked interest in the empirical research on the potential minimum wage effects on employment,[2] little work has been done on the effect of minimum wage increases on prices in general and on food prices in particular. Our purpose is to examine the "pass-through" effects of a minimum wage increase on output prices in the food and kindred products industry and the food-service industry (eating and drinking places).[3]

[1] Numbers in brackets represent literature cited in the References section.

[2] For example, studies done by Card and Krueger [2,4], Kennan [8], Katz and Krueger [9], and Newmark and Wascher [12] deal with employment effects of the minimum wage increases while Smith and Vavrichek [14] concentrate on the effects of minimum wages on incomes and poverty. Wessels [23] analyzes employment effects of minimum wage in relation to tipped servers, and Whitener and Parker [24] examine the effects of the minimum wage increases on rural workers.

[3] The present law may exempt some small food and kindred products firms and food-service firms and some tipped employees [22].

Analysis of Price Pass-Through

The pass-through method is based on the observation that in a perfectly competitive market with constant returns to scale, average cost equals marginal cost, which in turn equals output price. Thus, any increase in labor costs (wages) will add to the industry's output price by the affected labor's share of operating cost. The higher labor cost is thereby passed through, ultimately to be paid by the industry's consumers.[4] An increase in the minimum wage creates an opportunity for understanding how exogenous wage increases affect either an industry's employment or output prices or both. In other words, if firms do not respond to increases in the minimum wage by reducing employment levels, then conventional wisdom suggests that they would respond by raising prices to cover the higher labor costs. This idea assumes that firms attempt to maintain the same profit level after a minimum wage hike as before. In this case, firms want to "pass-through" the increased cost of labor to the consumer. Because food-related industries' share of labor with lower wage, unskilled workers is larger than other industries, an examination of the increases in the minimum wage on output prices in these industries is appropriate and timely.

Researchers have studied the pass-through method in reference to changes in prices due to exchange rate fluctuations. For example, Gron and Swenson [7] find less than a full pass-through of automobile industry prices relative to exchange rate movements because automobile producers transfer their production process across national borders to deal with exchange rate fluctuations. Yang [25] analyzed exchange rate pass-through on changes in industrywide costs and concluded that pass-through is generally smaller when products are highly substitutable, implying that product differentiation plays a key role in exchange rate pass-through. Lee and Wills [10] used an input-output (I/O) analysis to evaluate dollar depreciation pass-through on agricultural prices and income and found that whether there will be a full or partial pass-through depends on agricultural market structure and the exchange rate regime.

The best known study of the price pass-through of the minimum wage effect on prices of meals was done by Card and Krueger [2,4]. They estimated the effect of the minimum wage increase on the prices of meals at fast-food restaurants as a full pass-through (proportional to the share of minimum wage labor in total factor cost). For example, the average restaurant in New Jersey initially paid about half its workers less than the new minimum wage. If wages rose by 15 percent for these workers, and if labor's share of total costs is 30 percent, Card and Krueger estimated that prices would rise by 2.2 percent (= 0.15*0.3*0.5). Card and Krueger could not determine whether firms tended to raise all their output prices together in response to an increase in the minimum wage, or whether they absorbed the cost increase and accepted lower profits. However, they point toward price increases that would cover the higher cost of labor associated with the rise in the minimum wage in their results. They surveyed 410 fast-food restaurants in New Jersey and eastern Pennsylvania before and after New Jersey's 80-cent minimum wage increase in April 1992 and found that, in New Jersey, average prices rose enough to cover the costs of the higher minimum wage [4; p. 390]. Aaronson [1] also explored the price effect of minimum wage hikes in Canada and the United States using a competitive market price pass-through method. He analyzed an industrywide increase in the price of labor on prices of food away from home and found that prices rose about equally with changes in the wage bill in the short run, but that the price effect dissipated over time. His regression analyses suggest a 1.2- to 1.6-percent increase in hamburger and chicken prices for every 10-percent increase in the minimum wage [1; p.14].

In this study, we used an I/O model to analyze a pass-through to output prices of all costs incurred due to a minimum wage increase just as firms in a perfectly competitive market equate their price to average and marginal cost. Thus, our analysis assumes a full pass-through and has to be interpreted as "upper bounded" estimates of the price effects of minimum wage increases.

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[4] There is a parallel between these pass-through studies and incidence of taxes in the public finance literature. Both approaches generally oversimplify reality. The tax incidence studies recognize the effects of different market elasticities faced by the firm liable for the tax and how these effects ultimately affect the incidence of the tax. These studies gain this insight at the expense of being able to assess the effect of the tax, several stages away from the original tax assessment. The input/output-based "pass-through" method can assess these different effects on related sectors, but does so at the expense of being able to consider differing market elasticities faced by firms. We assumed that all of these effects face unitary elasticity.

Overview of the Structure of the U.S. Food and Kindred Products Industry

Examining the effects of a minimum wage increase on food prices is best contemplated within the context of the continuous structural changes in the U.S. food and kindred products industry. We therefore began by reviewing the changing patterns of employment and cost structures of the industry. We analyzed the industry structure by examining changing patterns of intermediate and primary inputs. For this purpose, we disaggregated the food and kindred products industry (SIC 20) into 11 I/O sectors [17, 1998] and roughly three-digit 1987 Standard Industrial Classification [5] sectors. Furthermore, although food and kindred products is a manufacturing industry while eating and drinking places are in the retail and service industry, from the demand perspective, eating and drinking places (SIC 58) are closely related to the food and kindred products industry. Therefore, we included eating and drinking places together with the food and kindred products industry in our analysis. The food and kindred products industry includes establishments that manufacture or process food and beverages for human consumption, including certain related products, such as manufactured ice, chewing gum, vegetable and animal oils, and prepared feeds for animals and fowl. Eating and drinking places include retail establishments selling prepared food and drink for consumption on the premises, and they include fast-food places.

Changing Patterns of Employment Structure

Some sectors and some occupations are more likely than others to pay wages at or near the minimum wage. These differences are apparent in table 1, which shows the Bureau of Labor Statistics' Occupational Employment Statistics (OES) data [20] by occupational group and by sectors of the food and kindred products industry. The OES data classify the workforce into seven aggregate summaries of occupational divisions.[5] The table shows that the food and kindred products industry has a significantly different occupational structure than the national average. For example, in the food and kindred products industry, 75.6 percent (1,274,000 of 1,685,000) of workers were in production, construction, operating, maintenance, and materials handling while only 23.5 percent (2,778,000 of 117,963,000) of workers are in this category for the Nation as a whole. The percentage of employment in the managerial and professional occupations was substantially smaller than national average (4.4 percent and 3.4 percent vs. 7.5 percent and 20.5 percent), as was the percentage of employment in the sales and clerical occupations (3.7 and 7.5 percent vs. 12.5 and 17.8 percent). Thus, the food and kindred products industry has a larger proportion of production workers than the U.S. average. As expected, eating and drinking places (SIC 58) have a large share of workers (82.6 percent) in the service occupations.

One contrasting feature of the occupational employment pattern is that, among the seven OES occupational divisions, the meat products sector (SIC 201) has the largest share (84 percent, 408,000) in the "production" category. In contrast, the eating and drinking places sector has the largest share (82 percent, 6,225,000) of employment in the "service" category. This difference reflects the fact that the meat products sector is specialized in production and processing activities while the eating and drinking places industry is specialized in serving people.

The lower portion of table 1 shows the mean wage rates per occupational group. The lowest mean wage rate in the eating and drinking places is $6.00 per hour for sales and related occupations followed by $6.10 per hour for service occupations. These mean wage rates support the conventional wisdom that the lowest paid occupations are in the fast-food industry. In addition, the food-service sector had the lowest mean wage for all occupational categories. BLS's occupational employment data [20:B, not shown in this report, but the table shows ranges of average wages by occupation, 1996] report that there were only two occupations, service (3.3 percent of the industry) and agricultural workers (5 percent), whose range of average (mean) wages was under $5.75 per hour in 1996.

Tables 2 and 3 show the number of wage and salary jobs across all occupational groups, by selected food and kin-

[5] BLS OES data [20] classify seven occupational division as (1) managerial and administrative occupations (OES series 10,000); (2) professional, paraprofessional, and technical occupations (OES series 20,000 and 30,000); (3) sales, related occupations (OES series 40,000); (4) clerical and administrative support occupations (OES series 50,000); (5) service occupations (OES series 60,000); (6) agricultural, forestry, fishing, and related occupations (OES series 70,000); and (7) production, construction, operations, maintenance, and material handling (OES 80,000).

Table 1—Distribution and mean wages by SIC number in the food and kindred products industry and eating and drinking places

Occupation	Standard Industrial Classification											
	Total	20	201	202	203	204	205	206	207	208	209	58
	Percent											
Managerial and administrative	7.5	4.4	2.7	4.3	4.9	7.5	4.5	3.4	6.7	5.7	5.2	6.1
Professional	20.5	3.4	2.2	4.4	4.0	7.2	2.2	3.9	4.9	4.6	2.2	.5
Sales and related occupations	12.5	3.7	1.3	3.4	1.2	2.6	8.0	3.2	1.9	9.6	3.8	6.6
Clerical and administrative support	17.8	7.5	4.5	9.2	7.6	11.0	8.2	8.7	8.2	9.4	8.4	1.7
Service occupations	16.9	3.7	3.2	2.5	4.9	2.9	6.0	3.9	1.1	2.0	4.3	82.7
Agricultural, forestry, and fishing	1.3	1.7	2.3	.6	3.1	1.1	1.7	.8	8.5	1.8	1.0	0
Production, construction, and others	23.5	75.6	83.8	75.6	74.3	67.7	69.4	76.1	68.7	66.9	75.1	2.4
	Mean wage (dollars per hour)											
Total	n/a	11.7	9.2	12.5	11.5	13.8	12.8	12.5	13.1	15.5	10.4	6.7
Managerial and administrative	“	28.0	26.1	26.9	29.8	28.1	27.2	30.4	28.6	28.3	28.6	14.3
Professional	“	18.1	15.4	14.7	17.9	21.8	18.0	20.1	17.7	19.2	18.3	11.8
Sales and related occupations	“	14.8	16.7	13.7	20.2	19.0	13.2	9.5	20.3	14.9	15.6	6.0
Clerical and administrative support	“	10.8	9.3	11.0	10.9	10.7	11.3	11.3	11.0	12.0	10.4	10.1
Service occupations	“	9.1	8.0	9.7	8.5	10.6	10.8	9.0	8.7	9.5	8.0	6.1
Agricultural, forestry, and fishing	“	8.8	8.9	13.4	7.9	9.2	8.8	7.2	10.5	9.2	7.6	8.1
Production, construction, and others	“	10.6	8.4	11.8	10.2	11.9	12.1	11.8	11.6	15.1	8.8	6.4

n/a = not available.

SIC 20=food and kindred products; SIC 201=meat products; SIC 202=dairy products; SIC 203=canning and preserving; SIC 204=grain mills; SIC 205=bakery products; SIC 206=refined sugar; SIC 207=oil mills; SIC 208=beverage; SIC 209=miscellaneous food; SIC 58=eating and drinking places.

Source: Occupational Employment Statistics— December 16, 1997 [18].

Table 2—Wage and salary jobs in food-related sectors for selected years

Industry	1987 SIC number	1972	1977	1982	1987	1992	1996
		Thousands					
Meatpacking	2011-13	304.2	302.7	277.5	308.2	303.2	336.9
Poultry and egg	2015-17	42.8	49.0	69.4	77.1	129.9	144.4
Dairy plant	2021-26	216.6	187.5	166.4	160.5	153.3	143.7
Canning and preserving	2032-38	244.2	242.7	229.1	231.9	247.3	237.2
Flour milling	2041-48	172.4	184.1	173.8	157.3	157.7	158.0
Bakery product	2051-53	261.7	240.5	223.0	214.7	208.3	210.1
Sugar processing	2061-63	57.1	45.5	40.8	29.0	31.5	29.6
Oil mills	2074-79	68.7	79.4	64.5	66.4	54.7	55.6
Confectionery	2064-68	62.7	68.3	61.3	67.8	73.4	69.0
Beverage	2082-87	227.5	227.5	230.3	203.4	175.6	178.5
Fish and seafood	2091-92	4.9	15.9	9.7	19.9	12.8	13.0
Miscellaneous	2095-99	77.2	63.5	87.0	79.6	114.8	116.8
Food and kindred products	20.0	1,740.0	1,706.6	1,632.8	1,615.8	1,662.5	1,692.7
Eating and drinking	58.0	2,860.2	3,948.6	4,829.4	6,085.7	6,609.3	7,499.4
U.S. total	N/A	75,136.9	84,983.4	91,863.4	104,253.3	110,915.8	121,684.0

N/A: Not applicable.
Source: BLS [19].

dred product sectors (table 2) and the changes in numbers (table 3) for selected years reported by the Bureau of Labor Statistics (BLS). We selected 1972, 1977, 1982, 1987, and 1992 to correspond with the years the Bureau of Economic Analysis (BEA) published U.S. I/O tables that are used in our analysis. Data for 1996 reflect the latest information reported by BLS on jobs at the level that we need for our analysis.

Several noticeable facts emerge from these two tables. First, both tables 2 and 3 show that, in general, employment in meatpacking plants fluctuated over the period, declining 8.8 percent during 1972-82 (from 304,200 to 277,500), and rising 11 percent during 1982-87 and 9.2 percent during 1982-92 (to 303,200), or 11 percent during 1992-96. In the meantime, poultry plants increased employment 203.5 percent during 1972-92 (from 42,800 to 129,900), rising 62.1 percent in 1972-82 (from 42,800 to 69,400) and another 87.3 percent during 1982-92. Dairy plants, bakery products, refined sugar, and oil mills all lost employment over the period. The fish and seafood sector gained 96.5 percent during 1972-82 (from 4,900 to 9,700), 32 percent during 1982-92 (to 12,800), and overall 159.2 percent during 1972-92. The miscellaneous food sector also increased employment during the two decades. Employment in the food and kindred products industry as a whole remained around 1.6 to 1.7 million jobs throughout these years.

The fluctuations in sector employment, however, reflect the trend of the industry's outputs as consumer demand for processed food changed. For example, the eating and drinking places industry steadily increased in employment, 68 percent (from 2.86 million to 4.829 million) during 1972-82 and 37 percent (to 6.609 million) during 1982-92. Overall increases were 131 percent during 1972-92. Schluter, Lee, and LeBlanc report that "consumer spending for food consumed away from home has grown faster than consumer spending for food consumed at home, nearly twice as fast from 1980 to 1996" [13].

Compared with the U.S. average employment growth, which increased 22.3 percent and 20.7 percent during 1972-82 and 1982-92, employment in the eating and drinking places sector grew faster during this period. On the other hand, employment in the food and kindred products industry fell 6.2 percent (from 1.74 million to 1.63 million) during 1972-82 then gained slightly, 1.8 percent (to 1.7 million), during 1982-92. During 1972-92, jobs for wage and salaried workers increased in 5 out of 12 food and kindred product sectors. The larger increases were shown in poultry (203 percent) and fish and seafood (159.2 percent) sectors. Of the seven sectors showing decreases, the biggest loss was in the sugar-processing sector (45 percent). In total, the food and kindred products industry lost 4.5 percent of its jobs

Table 3—Changes in wage and salary jobs in food-related sectors, selected years

Industry	1972-77	1977-82	1982-87	1987-92	1992-96
			Percent		
Meatpacking	-0.48	-8.33	11.07	-1.64	11.13
Poultry and egg	14.39	41.69	11.07	68.61	11.13
Dairy plant	-13.43	-11.25	-3.55	-4.49	-6.26
Canning and preserving	-.61	-5.60	1.22	6.64	-4.08
Flour milling	6.79	-5.59	-9.49	.25	.19
Bakery products	-8.10	-7.28	-3.72	-2.98	.86
Sugar processing	-20.32	-10.28	-28.89	8.37	-6.10
Oil mills	15.58	-18.79	2.92	-17.59	1.70
Confectionery	8.95	-10.28	10.61	8.37	-6.10
Beverage	0	1.23	-11.68	-13.67	1.65
Fish and seafood	222.55	-39.09	105.83	-35.90	1.70
Miscellaneous	-17.70	37.04	-8.52	44.22	1.70
Food and kindred products	-1.92	-4.32	-1.04	2.89	1.82
Eating and drinking	38.05	22.31	26.01	8.60	13.47
U.S. total	13.10	8.10	13.49	6.39	9.71

	1972-82	1982-92	1972-92
Meatpacking	-8.77	9.24	-.34
Poultry and egg	62.07	87.27	203.52
Dairy plant	-23.18	-7.87	-29.22
Canning and preserving	-6.18	7.94	1.27
Flour milling	.81	-9.26	-8.53
Bakery products	-14.79	-6.59	-20.41
Sugar processing	-28.52	-22.94	-44.92
Oil mills	-6.14	-15.18	-20.39
Confectionery	-2.25	19.87	17.17
Beverage	1.23	-23.75	-22.81
Fish and seafood	96.45	31.94	159.20
Miscellaneous	12.79	31.94	48.81
Food and kindred products	-6.16	1.82	-4.45
Eating and drinking	68.85	36.86	131.08
U.S. total	22.26	20.74	47.62

Source: BLS [19].

during 1972-92 while the eating and drinking places sector gained 131 percent, well above the average gain in the United States (47.6 percent).

Changing Patterns of Cost Structure

Past employment patterns suggest that the food and kindred products industry and the eating and drinking places sector may react differently to a higher minimum wage. For example, the eating and drinking places sector faces growing demand and swelling employment. The food and kindred products industry, on the other hand, is a mature industry with slowly growing demand that must compete on the basis of cost.

Under perfectly competitive conditions, a sector's output price equals its average cost. Because labor cost is a part of the average costs faced by an industry, an increased minimum wage affects labor cost, which in turn affects food prices. Table 4 shows average costs accounted for by intermediate inputs and by primary factors of production. Intermediate input purchases from other sectors are presented in five subsectors to better summarize the input structure of the sector's production. In this approach, each intermediate input and primary factor share contributes to the unit value of a given sector's output. In 1992, for example, the meatpacking sector's unit value ($1.00) consisted of 2.7 cents of imported inputs, 73.6 cents of domestic farm and processed food products, 2.6 cents of domestically manufactured

goods, 3.2 cents of trade and transportation services, and 4.4 cents of other services, totaling 86.5 cents for total intermediate input costs. Returns to wage earners in terms of compensation were 9.9 cents and the remaining 3.6 cents was residual income.

The last two columns show costs for each sector in terms of payment to wage earners (seventh column: wages and salaries) and residual income (the last column). The residual income includes income such as profit, interest, and depreciation allowances. The wages and salaries column shows that the shares of wage earners were highest in the bakery and confectionery sectors (28 cents) and smallest in the oil mills sector (6.2 cents). The residual income share is highest in the beverage sector (34.8 cents) and smallest in meatpacking plants (3.6 cents). The food and kindred products industry as a whole spent 4.1 cents on imported inputs and 38.6 cents on domestic farm and processed food. Manufactured inputs, trade and transportation services, and other services were 9.6, 8.4, and 9 cents, respectively. Adding all these inputs resulted in total intermediate inputs equaling 69.6 cents. Compensation to wage earners and returns to residual incomes were 13.5 and 16.9 cents, respectively.

By comparison, eating and drinking places spent 4.7 cents on imported inputs, 21.2 cents on food processing inputs, 0.5 cent on manufactured inputs, and 19.6 cents on the other services sector. Total intermediate input costs, however, are far less for the eating and drinking places sector than for the food and kindred products industry (52 cents vs. 69.6 cents). As one might expect, the share accounted for by compensation to wage earners was far more in the eating and drinking sector (34 cents vs. 13.5 cents), while residual income was slightly less (14 cents vs. 16.9 cents).

The first column of the table shows that the fish and seafood sector used the greatest share of imported inputs, with 40.1 cents of imported purchases, the most import-dependent sector in 1992. The canning and preserving sector was second with 6.4 cents. The poultry sector spent almost nothing on imported inputs. The second column shows purchases of domestic farm and food products. Those purchases are usually larger than the other input values because of the nature of the food and kindred products industry as a processor of raw farm products. The third column shows that the beverage sector used the most (19.4 cents) manufactured inputs,

Table 4—Cost shares of output prices, by industry, 1992

Industry	Imported goods	Domestic agricultural and food products	Manufactured goods	Transportation and trade services	Other services	Total intermediate	Wages and salaries	Residual income
				Dollars				
Meatpacking	0.0272	0.7355	0.0260	0.0315	0.0442	0.8644	0.0993	0.0364
Poultry and egg	.0062	.6070	.0374	.0340	.0603	.7449	.2023	.0528
Dairy plant	.0146	.5525	.0769	.0612	.0691	.7743	.1025	.1231
Canning and preserving	.0637	.1699	.1560	.1062	.0951	.5909	.1540	.2551
Flour milling	.0310	.4230	.0839	.1469	.1195	.8044	.0936	.1020
Bakery products	.0234	.2068	.0838	.0683	.1071	.4894	.2794	.2312
Sugar processing	.0408	.5340	.0413	.1130	.0838	.8129	.1299	.0572
Oil mills	.0464	.5864	.0260	.1383	.0694	.8665	.0618	.0717
Confectionery	.0234	.2068	.0838	.0683	.1071	.4894	.2794	.2312
Beverage	.0454	.1310	.1936	.0748	.1028	.5476	.1050	.3475
Fish and seafood	.4010	.1245	.0601	.1186	.0721	.7763	.1649	.0588
Miscellaneous	.0377	.1433	.1423	.1268	.1524	.6025	.1528	.2447
Food and kindred products	.0405	.3862	.0958	.0837	.0903	.6963	.1351	.1686
Eating and drinking	.0472	.2117	.0046	.0608	.1961	.5203	.3393	.1404
U.S. total	.0392	.0333	.1225	.0515	.1867	.4334	.3300	.2364

Source: [16:1998].

followed by miscellaneous food (14.2 cents). These two sectors used more packaging and plastic bottles than other sectors in the food and kindred products industry. Oil mills, miscellaneous food, seafood, and flour milling sectors were relatively heavy users of trade and transportation and other services, as shown in the fourth and fifth columns.

In sum, the food and kindred products industry used more domestically produced farm and processed food as their inputs (38.6 cents in 1992) than did the eating and drinking places (21.1 cents) and U.S. industry as a whole (3.3 cents). On the other hand, the food and kindred products industry and eating and drinking places used less manufactured inputs (9.6 cents and less than a penny, respectively) than the U.S. industry as a whole (12.2 cents). Overall, both the food and kindred products industry and eating and drinking places used more intermediate inputs (69.6 cents and 52 cents) than the U.S. industry average (43.3 cents). Wages were a lower share for the food and kindred products industry (13.5 vs. the U.S. average of 33 cents) as were residual incomes (16.8 cents and 14 cents) vs. the U.S. average (23.6 cents).

Similar statistics for 1972, 1977, 1982, and 1987 are in appendix tables 1 through 4. These tables reflect a changing pattern of cost structure over time. For example in 1972, meatpacking plants used 1.5 cents for imported inputs, compared with 2.7 cents in 1992. The fish and seafood sector spent only 18 cents in 1972 for imported inputs, but 40 cents in 1992. For the food and kindred products industry as a whole, imported inputs grew over time from 2.7 cents in 1972 to 4 cents in 1992. The inputs of domestically produced farm and processed foods declined slightly from 43.5 cents in 1972 to 38.6 cents in 1992 and increased slightly for inputs of other services, from 7.2 cents in 1972 to 9 cents in 1992. Overall, the costs of total intermediate inputs were slightly less (69.6 cents vs. 71.3 cents) in 1992 than in 1972. Cost of labor was slightly less in 1992 than in 1972 (13.5 cents vs. 14.2 cents), but returns to residual income in 1992 (16.9 cents) were higher than in 1972 (14.4 cents). Of interest to this study is the slight shift to a lower share for labor costs in the industry cost structure.

Input/Output Model for Analysis

Leontief's Input-Output (I/O) model, which we used in our research, is an empirical representation of the U.S. production economy. Leontief's production scheme, however, is a special case in the sense that there exist fixed proportions in all production processes. This special fixed-proportion production function allows no substitution among the inputs. That is, the model assumes that in any given period of time, with existing production capacities in each sector, there is always one combination of resources that firms consider optimal. Therefore, the unit cost of production consists of the fixed cost of intermediate inputs and fixed direct primary factor costs. Thus, the unit value of an output consists of the unit values of its commodity services inputs, each weighted by the contribution to the output of the commodity, plus the value of the labor and capital inputs per dollar of output. In equilibrium, the unit value of the j-th sector output price P_j just exhausts the values of the intermediate inputs and the primary factors of production as

(1) $P_q = \boldsymbol{A'} * P_a + R + W$

where P_q is a vector of sector output prices (P_j's), P_a is a vector of input prices (P_i's), R and W are vectors of returns to residual and wage incomes (P_l*L) respectively, and $\boldsymbol{A}$ is the matrix of input-output technical coefficients-sector purchasing per dollar of output. Residual income is what remains from revenue after the payment of inputs' costs and wages. The input prices are a weighted sum of import prices and domestic output prices. Thus,

(2) $P_a = \boldsymbol{b} * P_m + (I - \boldsymbol{b}) * P_q$

where P_m is a vector of import prices (P_i's), $\boldsymbol{b}$ is a diagonal matrix vector of weights, *b*. If we assume that the weights, *b*, are the proportions in which imports supply domestic demand ($m + q - x$) and are constant irrespective of the type of domestic demand, then

(3) $b = (\boldsymbol{m + q - x})^{-1} * m$

where *m* is a vector of imports (m), *q* is a vector of output q, and *x* is a vector of exports. Bolded letters denote a diagonal matrix of vectors, *m, q, and x.* Equations 1 through 3 yield

(4) $P_q = [\boldsymbol{I - A'} * \boldsymbol{(I - b)}]^{-1} * (\boldsymbol{A'} * \boldsymbol{b} * P_m + R + W)$.

Here P_q is the vector of new prices necessary to maintain the same residual incomes after the minimum wage increases. We can use equation 4 to calculate the new sector output prices if the new sector wage compensations after the minimum wage hike are fully passed through. The calculation obviously assumes there is no upsurge in unit costs other than those due to a minimum wage increase. Thus, the expected new output prices due to a minimum wage increase are based on the assumption that the producers can pass through the higher input cost caused by increases in minimum wage as

(5) $dP_q = [\boldsymbol{I - A'} * \boldsymbol{(I - b)}]^{-1} * (\boldsymbol{A'} * \boldsymbol{b} * P_m + R + dP_l * L)$, where $P_l * L = W$.

If food and kindred product markets are perfectly competitive such that they equate output prices to average cost and marginal cost, then they may be able to vary output prices as the result of higher input costs from a minimum wage hike. Equation 5 can also be used in this instance to obtain the extent by which producers' profit margins may diminish if they absorb the price increases in labor inputs. Again, the above equation states that commodity output prices are equal to unit factor costs (direct and indirect) and output prices move together with factor costs. The expression $[\boldsymbol{I - A'} * \boldsymbol{(I - b)}]^{-1}$ shows by how much the particular price P_q would go up (or down) for every dollar added to (or subtracted from) the wage rate, assuming no changes in import prices (P_m) and residual income (R) occur.

If, for example, the workers between the current minimum wage and a proposed higher wage make up 10 percent of an industry's employment and wages are 80 percent of compensation, then increasing their average wage by 15 percent would increase industry total wage costs by 1.2 percent (=.15*.8*.10).[6] We then introduce this direct 1.2-percent increase in compensation into our I/O model to estimate both direct and indirect cost increases due to the minimum wage increase.

[6] We are indebted to Darryl Wills on this point of wage share of total compensation. A Ph.D. candidate at MIT, he worked as a labor economist at the Council of Economic Advisors in 1994, when the minimum wage issue was prominent. He noted that the components of total compensation, wages and salaries, and supplemental compensation such as fringe benefits were not uniform across industries. Supplemental compensation has increased more than the wage and salary compensations in some industries, while the opposite is true for others. Thus, we used the 1992 Census of Manufactures to separate benefits and wage and salary payroll components of total compensation.

The prices derived through equation 5 are sector output prices at point of production. To express these prices in terms of purchasers' prices, the I/O tables adopt the convention of "margin." This convention is characterized by unbundling (recording the value of the trade and transportation margins separately, rather than incorporating it in the value of the merchandise) and forward shifting (showing the margins as being used directly by the user of the merchandise). The producer's price represents the basic value at the production point, and adding various margins brings the good from the producer to the user's cost. Therefore, to express producer's price in purchaser's prices, we establish a link between producer's price and purchaser's prices through the bridge matrix that contains "margins." The bridge table was derived from the unpublished BEA bridge tables, reflecting bridges between producer prices and purchaser's prices based on the transportation and wholesale and retail trade margins. In other words, let B be an 80 by 3 bridge matrix where each row will show percentage sectoral distributions of the output price (first column) and transportation and trade margins in the second and third columns, respectively. Then,

$$(6)\quad P_r = P_q * B[.,1] + P_t * B[.,2] + P_{tr} * B[.,3]$$

where P_r is a vector of purchaser's price and P_q is an 80 by 80 diagonal matrix of producer's prices (P_q) derived from equation 5. B[.,1] is a column vector (the first column of the matrix B), showing the percentage distribution of the output prices, P_t and P_{tr} are 80 by 80 diagonal matrices of the producer prices of transportation and wholesale and retail trade respectively, and B[., 2] and B[., 3] are vectors showing the percentage or share of the transportation and trade margins respectively. The percentage distribution of output prices, transportation, and trade margins for the food and kindred products industry is shown in table 5.

The practical significance for our study of this treatment of retail prices is that if minimum wage legislation affects transportation and wholesale and retail trade less than food processing (either $P_q > P_t$, or $P_q > P_{tr}$ or both), then the estimated effect of an increase in the minimum wage on food prices is softened from what we observe at the food processor level. If the retail food price is not a linear combination of independent prices at the food processor level and at the sector level of the margin industries providing trade and transportation services, but food retail prices are set as a markup over delivery prices at the store, then producer and retail prices are dependent. If this dependency exists, a minimum-wage-induced price shock at the processor level may be reflected at the retail level on a higher scale than we estimate.

Table 5—Input cost shares, by industry, 1992

Industry	Share of producer prices	Share of transportation	Share of trade
Meatpacking	0.6735	0.0285	0.2980
Poultry and egg	.7013	.0041	.2946
Dairy plant	.6876	.0093	.3030
Canning and preserving	.6359	.0273	.3368
Flour milling	.6005	.0199	.3795
Sugar processing	.6075	.0291	.3634
Oil mills	.6728	.0495	.2777
Confectionery	.6631	.0120	.3249
Bakery product	.6881	.0389	.2731
Beverage	.5703	.0147	.4150
Fish and seafood	.5930	.0113	.3957
Miscellaneous	.6698	.0111	.3191
Eating and drinking places	1.0000	0	0

Source: [16:1998].

Data and Employment Distributions

To use the I/O model for wage impact analysis, a wage distribution is needed. We wanted to break down the employed population into industry sectors and then divide those employed within these industries into wage categories. This action allows us to test the effect of a minimum wage increase on the food and kindred products industry by noting the pass-through effects of the wage increase on prices. The wage categories are of particular interest because we can easily view the number of individuals in each of our categories and how many workers move into and out of each category as the minimum wage increases.

For this study, we used the earnings file of the Current Population Survey (CPS). This microdata file "consists of all records from the monthly quarter-samples of CPS households that were subject to having . . . questions on hours worked and earnings asked during the year" [16]. The CPS permits us to create a distribution of wage groups by the 3-digit industry classification codes. That distribution in turn allows us to examine the breakdown of how many people are making the minimum wage in each of the 991 industries covered in the CPS. We can then condense this 991-sector distribution into our 80-sector I/O model.

"Each household entering the CPS is interviewed for 4 months, then ignored for 8 months, then interviewed again for 4 more months. … Since 1979 only households in months 4 and 8 have been asked their usual weekly earnings/usual weekly hours. These are the outgoing rotation groups, and each year the BLS gathers all these interviews together into a single file called the Annual Earnings File" [11]. The CPS details the labor force status of the civilian, noninstitutionalized population over the age of 16. About 47,000 households are involved each month. From these households, information is collected on roughly 94,000 individuals.

We took the usual earnings per week reported in the CPS, and divided it by the usual hours worked per week to arrive at the implicit amount earned per hour. We excluded those who reported themselves as self-employed, employed without pay, or as never having worked. This calculation yielded a total work force of approximately 112 million workers. That number is consistent with BLS reports for 1992. The measure of the confidence interval can be seen in the appendix.

The resulting real wage distribution is broken down into categories to demonstrate the effect of a minimum wage increase on these divisions. The first classification consisted of the wages less than or equal to the minimum

Table 6—Input-output sector wage distributions, 1992

	Hourly wages				
Industry	$4.25 or less	$4.26-$4.75	$4.76-$5.25	$5.26-$5.75	$5.76 or more
Meatpacking	0.1092	0.0303	0.0699	0.0418	0.7488
Poultry and egg	.1092	.0303	.0699	.0418	.7488
Dairy plant	.1058	.0248	.0519	.0274	.7901
Canning and preserving	.1635	.0345	.0462	.0244	.7313
Flour milling	.0544	.0165	.0139	.0203	.8948
Sugar processing	.1314	.0096	.0612	.0162	.7816
Oil milling	.1704	.0377	.0749	.0314	.6855
Confectionery	.0947	.0228	.0318	.0198	.8308
Bakery products	.0947	.0228	.0318	.0198	.8308
Beverage	.0462	.0073	.0512	.0085	.8868
Fish and seafood	.1704	.0377	.0749	.0314	.6855
Miscellaneous	.1704	.0377	.0749	.0314	.6855
Food and kindred products	.1058	.0248	.0519	.0274	.7901
Eating and drinking places	.2341	.1734	.1446	.0637	.3842

Source: Derived from 1992 annual earnings file [10].

wage for the year in question. We increase the bounds of the categories in 50-cent increments. This calculation allows us to examine the impact of a spillover effect. Thus, adding 50 cents to the first group makes the range for the second group for 1992 $4.26 to $4.75. The third division goes from $4.76 to $5.25, the fourth from $5.26 to $5.75, and the final is $5.76 and above. The resulting distribution for 1992 is shown in table 6.

The distribution for 1997 shown in table 7 is similar to that for 1992. The difference is that the lower and upper levels of each range are indexed to 1992 dollars using the CPI-U. For instance, the ultimate $5.15 minimum wage in 1997 is $4.50 in 1992 dollars. We condensed these wage distributions developed for the 3-digit industry classifications into our 80-sector I/O model.

Table 7—Input-output sector wage distributions, 1997 (in 1992 dollars)

	Hourly wages				
Industry	$4.25 or less	$4.51-$4.94	$4.95-$5.38	$5.39-$5.81	$5.82 or more
Meatpacking	0.1251	0.0254	0.0669	0.0372	0.7454
Poultry and egg	.1251	.0254	.0669	.0372	.7454
Dairy plant	.1210	.0147	.0516	.0250	.7877
Canning and preserving	.1797	.0238	.0508	.0144	.7313
Flour milling	.0628	.0081	.0167	.0264	.8860
Sugar processing	.1373	.0157	.0492	.0162	.7816
Oil milling	.1988	.0093	.0749	.0359	.6810
Confectionery	.1146	.0030	.0359	.0177	.8289
Bakery products	.1146	.0030	.0359	.0177	.8289
Beverage	.0510	.0081	.0488	.0053	.8868
Fish and seafood	.1988	.0093	.0749	.0359	.6810
Miscellaneous	.1988	.0093	.0749	.0359	.6810
Food and kindred products	.1210	.0147	.0516	.0250	.7877
Eating and drinking places	.3508	.0751	.1376	.0556	.3809

Source: Derived from 1992 annual earnings file [10].

Empirical Results

Four key factors influence how a minimum wage increase might affect the prices of food and kindred products. First is the percentage increase in the minimum wage itself, resulting from legislation. Second is the distribution of workers in the minimum wage bracket. We derived this number from the CPS. Third is the share of wages and salaries in the total cost. For this purpose, we use the most recent (1992) disaggregated U.S. input-output (I/O) tables [17;1998]. Fourth is the share of wage and salary cost in total employee compensation. When the minimum wage is raised, total compensation does not necessarily increase proportionately. Thus, we need to determine the share of the wage and salary portion of total compensation. We derived these mainly from the Census of Manufactures, 1992 [18] (table 8).

Two issues are also apparent, in the literature, for the analysis of the minimum wage effects on prices. The first issue is the importance of substitution effects. As the cost of labor rises, firms will try to move to cheaper inputs such as capital equipment. Our analysis assumed that such substitution is not possible in the short run. Second is the issue of spillover effects. When the minimum wage increases, there should be an effect on the sector's wage distribution somewhere between the increased compensation at the lower level and a level on which there is no impact as the whole wage structure shifts upward. Card and Krueger [4, pp. 160-66] suggest that while a minimum wage increase boosts incomes of some workers, the wages of workers who already were earning slightly more than the minimum wage may increase as well:

"Restaurants with higher starting wages prior to the April 1991 minimum wage increase were more likely to grant raises to workers who were already earning $4.50 per hour. Among restaurants with the lowest initial starting wages, only 9 percent granted wage increases to workers earning $4.50 per hour when the minimum wage rose to $4.25. Among restaurants with higher starting wage rates, the corresponding fractions are high-

Table 8—Food and kindred products distribution of payroll and supplemental benefits, 1992

Industry	Employment	Total compensation	Payroll	Share of total	Benefits	Share of total
	Thousands	*$million*		*Percent*	*$million*	*Percent*
Meatpacking	207.9	5,657.0	4,479.1	79.2	1,177.9	20.8
Poultry and egg	193.8	3,868.2	3,091.5	79.9	776.8	20.1
Dairy plant	137.3	4,826.4	3,776.5	78.2	1,049.8	21.8
Canning and preserving	214.3	6,174.2	4,768.9	77.2	1,405.4	22.8
Flour milling	107.4	4,243.2	3,379.7	79.6	863.4	20.3
Bakery products	215.0	7,459.5	5,600.1	75.1	1,859.4	24.9
Sugar processing	19.4	755.3	583.5	77.3	171.9	22.8
Confectionery products	71.8	2,374.6	1,819.4	76.6	555.2	23.4
Beverage	144.3	6,150.5	4,784.8	77.8	1,365.7	22.2
Oil milling	27.9	996.9	778.5	78.1	218.5	21.9
Fish and seafood	48.3	1,090.3	893.8	82.0	196.5	18.0
Miscellaneous	117.5	3,540.4	2,821.3	79.7	719.1	20.3
Food and kindred products	1,504.9	47,136.5	36,777.1	78.0	10,359.6	22.0
Eating and drinking places*	6,548.0	65,712.5	55,855.6	85.0	9,856.9	15.0
	Millions	*$billion*		*Percent*	*$billion*	*Percent*
U.S. total*	119.0	3,645.0	2,970.0	82.0	675.0	18.0

* Distribution derived from *Survey of Current Business*, November 1994.
Source: compensation [17] and employment [18].

er. Thus, there is some evidence of wage spillovers for workers who were earning more than the new minimum wage"[p.161-2].

Spillover effects occur because, since an increase in the minimum wage increases the wages of some workers, employers may proportionally increase the wages of workers who already were earning slightly more than the minimum wage, to maintain wage parity. However, because this is an individual firm's decision, there is no empirical evidence of a specific rate of wage increases due to potential spillover effects. We allowed for 3-percent and 1-percent spillovers into the next two wage categories.

For the empirical analysis, we used equations 5 and 6. We aggregated the 524-sector U.S. I/O sectors into an 80-sector model, and similarly aggregated the 991-sector CPS data into the same I/O model. Keeping our dollar valuations in 1992 terms, we increased the 1992 minimum wage by 50 cents — from $4.26 to $4.75 (or 12-percent) in scenario 1. We then allowed for a 3-percent spillover effect into the next wage category in scenario 2 in addition to scenario 1. We also looked at an additional 1-percent spillover into the third wage category in scenario 3. In scenario 4, we assumed a 12-percent increase in both wage and salary and supplemental compensations. In scenarios 1 through 3, we increased only wage and salary compensation by 12 percent, leaving supplemental compensation unchanged. In scenario 5, we increased the 1997 minimum wage by 50 cents from $5.15 to $5.65 (or 9.7 percent), arranged the wage categories, and indexed everything to 1992 dollars. The same spillover conditions were imposed yielding the data we imported into the I/O model.

The scenarios above are restated as follows:

Scenario 1: a 50-cent increase (12 percent) over the 1992 minimum of $4.25 for wage and salary compensations.

Scenario 2: Scenario 1 plus a 3-percent spillover effect on the second wage category.

Scenario 3: Scenario 2 plus an additional 1-percent spillover effect on the third wage category.

Scenario 4: Scenario 3 with increases in total compensation (wage and salary plus supplemental) over the 1992 minimum.

Scenario 5: Same as scenario 4 but a 50-cent increase (9.7-percent) over the 1997 minimum of $5.15 in 1992 dollar terms (from $4.50 to $4.94).

The results are shown in table 9. The percentage changes from the unit base year price to the new price for the particular scenarios are shown in columns 1 though 5. The first column, for example, shows the percentage changes in sector prices in the food and kindred products industries and the eating and drinking places industry with an increase in the minimum wage of 50 cents (scenario 1). Percentage changes in sector prices of food and kindred products range between 0.18 percent in beverages and 0.44 percent in the fish and seafood sectors. These differences occur because, as the cost shares of output prices shown in table 4 for 1992 indicate, the share of total costs accounted for by wage compensation was relatively smaller (10.5 cents) for beverages and relatively larger for fish and seafood (17 cents). Second, the share of minimum-wage workers in 1992 (table 6) also shows a relatively smaller share (4.6 percent) for the beverage sector and relatively larger share for fish and seafood (17 percent). Third, the share of wage and salary cost of total compensation was smaller (78 percent) for the beverages sector than for the fish and seafood sector (82 percent), as shown in table 8. Thus, overall, percentage changes in output prices with an increase in minimum wage by 50 cents (12 percent) in the food and kindred products industry were less than 1 percent.

We should note, however, that the eating and drinking places industry is more affected than the food and kindred products sectors by a minimum wage increase, 0.9 percent (last row, table 9).[7] This difference can be explained with the same argument made above. In 1992: (1) the share of wage and salary compensation in total cost of production was relatively large (34 cents; table 4), (2) the distribution of workers in the minimum wage range (table 6) was also relatively large, 23.4 percent, and (3) the share of the wage and salary of total compensation (table 8) was still larger (85 percent).

A comparison of the sixth column with the first column shows that purchasers' prices rose less than base-year producers' prices in all the food and kindred products

[7] Note that Aaronson [1] estimates that a price elasticity of roughly 0.6 and 0.7, suggesting a 12-percent increase in the minimum wage from $4.25 to $4.75 would increase prices by 0.7 to 0.82 percent. These estimates are a bit lower than the 0.89 to 1.04 (scenario 1 and 2) estimates reported in table 9.

Table 9—Change in prices due to a minimum wage increase

	Producers' prices					Purchasers' prices				
	col. 1	col. 2	col. 3	col. 4	col. 5	col. 6	col. 7	col. 8	col. 9	col. 10
Industry	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Meatpacking	0.353	0.389	0.413	0.497	0.497	0.288	0.315	0.332	0.408	0.399
Poultry and egg	.317	.345	.380	.459	.628	.267	.290	.315	.389	.497
Dairy plant	.360	.383	.405	.497	.453	.295	.314	.329	.412	.372
Canning and preserving	.407	.442	.446	.571	.517	.314	.340	.343	.445	.399
Flour milling	.202	.221	.234	.288	.264	.181	.198	.206	.263	.236
Bakery product	.351	.394	.397	.517	.492	.284	.315	.314	.418	.391
Sugar processing	.327	.340	.361	.445	.402	.258	.271	.284	.359	.327
Oil mills	.326	.355	.361	.450	.421	.270	.293	.298	.378	.348
Confectionery	.351	.394	.397	.517	.492	.284	.315	.314	.418	.391
Beverage	.184	.200	.214	.263	.242	.171	.182	.192	.246	.221
Fish and seafood	.437	.466	.487	.601	.540	.321	.342	.355	.443	.400
Miscellaneous	.383	.415	.418	.593	.491	.307	.331	.334	.431	.393
Food and kindred products	.360	.383	.405	.497	.453	.295	.314	.329	.412	.372
Eating and drinking places	.893	1.045	1.084	1.364	1.479	.893	1.045	1.084	1.364	1.479

Scenario 1: A 50-cent increase (12-percent) over 1992 minimum wage ($4.25) with no increase in supplemental compensation.
Scenario 2: Scenario 1 plus a 3-percent spillover effect on the second wage category.
Scenario 3: Scenario 2 plus a 1-percent spillover effect on the third wage category.
Scenario 4: Scenario 3 but with 100-percent increases in total compensation.
Scenario 5: Scenario 4 but a 50-cent (9-percent) increase over the 1997 minimum wage $5.15 ($4.50 in 1992 prices) to $5.64 ($4.94).

sectors. Purchasers' prices rose less because they include a proportionate share of the effects of minimum wage increases on the trade and transportation sectors, which are not greatly affected by price effects from minimum wage increases. For example, in scenario 1, while the transportation sector price increased 0.18 percent and the trade sector price increased 0.15 percent, the meatpacking price increased 0.35 percent. Using the weights from table 5, the purchaser price could be expected to increase 0.29 percent. The purchasers' prices are a weighted average of sector producers' prices. The 0.35-percent increase effect on meatpacking prices receives a weight of 0.6735, the 0.18-percent increase effect on transportation prices receives a weight of 0.0285, and the 0.15-percent increase effect on wholesale and retail prices receives a weight of 0.298. The transportation and trade sectors are affected less by an increase in the minimum wage because the share of workers earning minimum wage or less was small (0.016 percent and 0.018 percent). While workers in some segments of the retail industry receive low wages, the I/O table convention of having one retail and one wholesale sector forces all retail workers into one aggregate, combining higher and lower wage workers. The effects of commissions on retail worker compensation could well mask some of this sector's potential vulnerability to the effects of changes in the minimum wage. Because the eating and drinking places industry delivers its services directly to its customers, there is no margin between producers' and purchasers' prices and hence no differences between the producers' and purchasers' prices.

When the 3-percent spillover effect is taken into account, the percentage change increases as the number of workers affected by the minimum wage increases. In scenario 2 (columns 2 and 7 for the producers' prices and for purchasers' prices), the percentage increases in the food and kindred products industry range from 0.20 percent in the beverage sector to 0.48 percent in the fish and seafood sector. The eating and drinking places industry shows a 1.04-percent increase. As a wider spillover is allowed, obviously more workers are affected. This effect is shown in scenario 3 (columns 3 and 8), where larger effects on sector prices are observed. As scenarios 4 and 5 portray, the larger the minimum wage increase, the larger the impact on food prices. For example, in scenario 4, meatpacking (column 4) shows a 0.50-percent increase in price when the minimum wage is increased 50 cents with all spillover effects and with both wage and salary compensation and other benefits increased. This jump is a 39-percent increase over the estimated effect in scenario 1 (0.35-percent increase). The difference between the scenarios is the level at which the minimum is set: for scenario 1, the minimum wage is $4.25 with a 50-cent increase whereas scenario 4 includes scenario 1 plus 3-percent spillover in the next wage category, 1-percent increase in the third wage category, and assumes that the increase in minimum wage affects not only wage and salary compensation but also other supplemental fringe benefits. Thus, as the minimum wage increases, the subsequent wage hikes in total compensation are likely to decrease. The fifth column is for scenario 5 but with a 50-cent increase from $4.50 to $4.94 (1992 prices for a $5.15 to $5.65 minimum hourly wage in 1997).

These price increases, of course, assume that food and kindred products sectors continue to use the same level of employment and hours worked in the shortrun production process. As expected, all sectors show higher output prices necessary to maintain their original residual incomes, with most increases between 0.4 percent and 1.5 percent. Thus, our empirical results indicate that, even with a full cost pass-through, a 50-cent increase in minimum wage will increase food prices by about 1 percent.

Conclusions

The methodology we used assumes a full pass-through; that is, the increase in cost of labor is fully passed on to the consumer in the form of higher prices, so our estimates are probably best considered as upper bounds. We found that (1) within the food and kindred products industry, the share of workers in the minimum wage category is relatively small (less than 10 percent in most cases); (2) the share of labor cost in the total cost is also relatively small for most of the sectors in the food and kindred products industry; and (3) although total compensation is composed of both wage and salary and supplemental compensation, the minimum wage increase would affect only the wage and salary share of total compensation. In most cases, the wage and salary share of compensation is 80 to 85 percent of the total compensation. This study is based on the assumption that if the number of workers and hours is fixed in the short run, the expected reaction on the part of businesses that wish to maintain their profit level is to raise the price of their goods or services. Using transportation and trade margins, we transformed the producers' prices to purchasers' prices and showed that the minimum wage increase usually affects transportation and wholesale and retail trade sectors less than food processing sectors. Thus, the estimated effect of increased minimum wages on retail food prices was softened from what we observed at the food processor level.

There are several proposals for future research to refine the analysis in this report. First of all, a resectoring of our detailed breakdown of the food and kindred products industry more in line with sector prices in retail (CPI) food prices would facilitate comparison with familiar retail food prices indices. This research could be a major project, considering the fact that I/O sector prices implicitly include all product prices in the base year while CPI prices are representative sector commodity prices. Second, more research is needed to empirically examine the spillover effects. Third, the change in compensation for wages and salaries versus other fringe benefits needs to be empirically examined to have empirical examinations closer to their actual changes. While these points are discussed often in the literature, no empirical tests or estimates of magnitudes have been conducted thus far. Finally, given the expected higher share of food expenditures in food stamp recipients' total budget, this study could be expanded to examine how the increase in food prices, due to a minimum wage increase, could affect food stamp recipients and welfare recipients in general.

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Appendix

The procedure we used to check the standard errors and confidence intervals came from the Bureau of Labor Statistics (BLS). For 1992-93, BLS reports the approximate sample size for the year in question, n, as 140,000. The y value is the nonweighted observations for the wage distribution. This yields the level estimate of a characteristic. For example, the y value for the observations in the beverage industry is 17.

The BLS method used here is specific for when frequencies are under 5 percent of the total sample. Using the nonweighted estimation of the beverage industry and dividing it by n gives us its proportion of the total sample size, p.

$$p=y/n$$

$$p=17/140,000$$

$$=0.00012143$$

The variance can be approximated by the following equation:

$$var=1.45*((p*(1-p))/n)$$

where 1.45 is the design effect factor that takes into account that the CPS sample is statistically a bit worse than a simple random sample. Inserting the numbers yields

$$var=1.45*((.00012143*(1-.00012143))/140,000)$$

$$=1.2575E-09$$

The standard error is the square root of the variance:

$$se=0.000035$$

The coefficient of variation, cv, is the ratio of the standard error to the proportion of the total sample size.

$$cv=.000035/.00012143$$

$$=28.82\%$$

The standard error of x is then

$$se(x)=x*cv$$

$$=2,896.73$$

The confidence interval is computed by multiplying the factor for 90-percent confidence, 1.645 by the standard error.

$$ci=x\pm(1.645* se)$$

Thus, the confidence interval for the beverage industry is

$$= 10,050\pm(1.645*2,896.73)$$

$$= [5,284.88, 14,815.12]$$

According to the BLS, the key factor is that the cv is below 40 percent. If true, then the sample can be considered statistically significant. Using the method outlined above, all of the food and kindred products industry sectors, as well as the eating and drinking places, were determined to have cv's of 40 percent or less. They are therefore significant within the 90-percent confidence interval.

Appendix table 1—Cost shares of output prices, by industry, 1972

Industry	Imported goods	Agricultural and food products	Manufactured goods	Transportation and trade services	Other services	Total intermediate	Wage and salary	Residual income
				Percent				
Meatpacking	0.0152	0.7704	0.0249	0.0440	0.0177	0.8722	0.0985	0.0292
Poultry and egg	.0045	.6548	.0426	.0640	.0293	.7952	.1449	.0600
Dairy plant	.0123	.5770	.0944	.0516	.0525	.7878	.1037	.1086
Canning and preserving	.0275	.2361	.2132	.1357	.0809	.6934	.1704	.1362
Flour milling	.0210	.5140	.0703	.1032	.0585	.7669	.0983	.1348
Bakery products	.0342	.2532	.0907	.0659	.0942	.5382	.2815	.1802
Sugar processing	.1193	.4858	.0298	.0580	.0451	.7380	.1558	.1062
Oil milling	.0239	.6590	.0452	.0760	.0434	.8475	.0660	.0865
Confectionery	.0342	.2532	.0907	.0659	.0942	.5382	.2815	.1802
Beverage	.0246	.1238	.2131	.0490	.0869	.4974	.1604	.3423
Fish and seafood	.1791	.0316	.3884	.1363	.0509	.7863	.1248	.0889
Miscellaneous	.0376	.1329	.1366	.0910	.2739	.6720	.1364	.1916
Food and kindred products	.0277	.4352	.1086	.0704	.0718	.7137	.1421	.1443
Eating and drinking places	.0187	.3200	.0247	.0769	.1282	.5685	.2948	.1367
U.S. total	.0216	.0543	.1648	.0469	.1441	.4317	.3353	.2328

Appendix table 2—Cost shares of output prices, by industry, 1977

Industry	Imported goods	Agricultural and food products	Manufactured goods	Transportation and trade services	Other services	Total intermediate	Wage and salary	Residual income
				Percent				
Meatpacking	0.0146	0.7449	0.0335	0.0468	0.0235	0.8633	0.1055	0.0313
Poultry and egg	.0050	.6943	.0427	.0318	.0392	.8130	.1322	.0547
Dairy plant	.0106	.5892	.0830	.0390	.0487	.7705	.1121	.1174
Canning and preserving	.0273	.2722	.2099	.1172	.0844	.7110	.1607	.1284
Flour milling	.0184	.4757	.0833	.1104	.0652	.7532	.1039	.1429
Bakery products	.0257	.2332	.0827	.0715	.1184	.5315	.2857	.1828
Sugar processing	.1327	.4588	.0544	.0874	.0539	.7872	.1265	.0862
Oil milling	.0222	.6367	.0736	.1071	.0492	.8888	.0482	.0631
Confectionery	.0257	.2332	.0827	.0715	.1184	.5315	.2857	.1828
Beverage	.0288	.1425	.2369	.0560	.0774	.5416	.1463	.3122
Fish and seafood	.2868	.0353	.1588	.1753	.1084	.7646	.1374	.0979
Miscellaneous	.0430	.1073	.1264	.1382	.3179	.7328	.1111	.1562
Food and kindred products	.0286	.4238	.1138	.0756	.0791	.7209	.1393	.1398
Eating and drinking places	.0277	.2840	.0378	.0736	.1334	.5565	.3030	.1405
U.S. total	.0351	.0485	.1642	.0492	.1475	.4444	.3250	.2303

Appendix table 3—Cost shares of output prices, by industry, 1982

Industry	Imported goods	Agricultural and food products	Manu-factured goods	Transportation and trade services	Other services	Total intermediate	Wage and salary	Residual income
				Percent				
Meatpacking	0.0148	0.7514	0.0294	0.0458	0.0497	0.8911	0.0977	0.0111
Poultry and egg	.0048	.6760	.0436	.0256	.0601	.8101	.1750	.0148
Dairy plant	.0106	.6752	.0767	.0400	.0620	.8645	.0954	.0402
Canning and preserving	.0724	.2158	.1986	.1125	.0878	.6871	.1649	.1481
Flour milling	.0163	.4808	.1024	.1282	.0809	.8086	.0919	.1093
Bakery products	.0171	.1897	.0791	.0560	.1069	.4488	.2834	.2677
Sugar processing	.0673	.5297	.0527	.0914	.0760	.8171	.1257	.0571
Oil milling	.0427	.6359	.0571	.1269	.0490	.9116	.0685	.0199
Confectionery	.0171	.1897	.0791	.0560	.1069	.4488	.2834	.2677
Beverage	.0273	.1417	.2357	.0696	.1089	.5832	.1331	.2837
Fish and seafood	.3337	.0111	.2308	.0850	.0777	.7383	.2018	.0600
Miscellaneous	.0382	.1033	.2149	.1551	.2320	.7435	.1363	.1202
Food and kindred products	.0292	.4234	.1173	.0794	.0889	.7382	.1375	.1241
Eating and drinking places	.0257	.2663	.0351	.0660	.1593	.5524	.3207	.1268
U.S. total	.0297	.0461	.1508	.0471	.1652	.4389	.3372	.2235

Appendix table 4—Cost shares of output prices, by industry, 1987

Industry	Imported goods	Agricultural and food products	Manu-factured goods	Transportation and trade services	Other services	Total intermediate	Wage and salary	Residual income
				Percent				
Meatpacking	0.0193	0.7811	0.0196	0.0551	0.0291	0.9042	0.0924	0.0034
Poultry and egg	.0059	.6308	.0328	.0485	.0441	.7621	.1942	.0437
Dairy plant	.0121	.5857	.0705	.0543	.0541	.7767	.1096	.1136
Canning and preserving	.0324	.2098	.1611	.1087	.0824	.5944	.1550	.2507
Flour milling	.0218	.5173	.0790	.1163	.0660	.8004	.0998	.0998
Bakery products	.0182	.1761	.0706	.0538	.1150	.4337	.2484	.3179
Sugar processing	.0358	.5653	.0417	.0814	.0586	.7828	.1245	.0928
Oil milling	.0199	.6232	.0438	.1068	.0567	.8504	.0656	.0840
Confectionery	.0182	.1761	.0706	.0538	.1150	.4337	.2484	.3179
Beverage	.0354	.1324	.2179	.0609	.0959	.5425	.1192	.3385
Fish and seafood	.4199	.1265	.0093	.1261	.1223	.7855	.1354	.0791
Miscellaneous	.0362	.1062	.1484	.1084	.1925	.5917	.1474	.2609
Food and kindred products	.0304	.4103	.0954	.0760	.0792	.6914	.1343	.1743
Eating and drinking places	.0336	.2129	.0191	.0548	.1600	.4805	.3912	.1284
U.S. total	.0319	.0385	.1301	.0507	.1887	.4399	.3300	.2300