THE EROSION OF THE ENTRY-LEVEL JOB MARKET

Minimum Wage Increases and their Impact on Minimum Wage Workers

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This paper is taken in part from the doctoral thesis of the first author, which was written under the supervision of the second author. The views and conclusions expressed in this paper are those of the authors alone and do not necessarily represent or reflect the opinions or policies of Workers Compensation Research Institute (WCRI) or of the Institute's research sponsors.

Executive Summary

Economic research has extensively documented that teen jobs are lost as an unintended consequence of a higher minimum wage. When labor costs increase due to a wage hike, employers who have to pay this new higher wage to train low-skilled, minimum wage workers find a way to do more with less. That might mean reductions in customer service or an increased reliance on automation.

But not all businesses are bound by the minimum wage. For instance, many small and medium–sized businesses are exempt from the federal minimum wage under the Fair Labor Standards Act. These exempt employers serve as an alternate employment option and absorb inexperienced teens that would otherwise find themselves priced out of a job when the binding minimum wage increases.

New research from Drs. Nicole Coomer (Workers Compensation Research Institute) and Walter Wessels (North Carolina State University) demonstrates how minimum wage increases have a disproportionately harmful impact on those working minimum wage jobs, and suggests that states who aggressively expand their own minimum wage may be doing more harm than good.

The authors find that minimum wage workers are often young, inexperienced, and working part-time. They're often employed in low-margin industries like food preparation and service. An increase in the minimum wage causes a dramatic increase in labor costs that these employers can't reasonably absorb. Instead it's offset with reductions that mean fewer jobs for the country's teens.

The difference between total job loss and minimum wage job loss is dramatic. Coomer and Wessels find that when the minimum wage is increased by 10 percent, employment for 16-to-19-year-olds in minimum wage jobs falls by as much as 11.1 percent. Looking specifically at 16-to-17-year-olds, employment losses rise to 13 percent.

The total job loss is moderated somewhat by the existence of businesses that aren't covered by the minimum wage. Displaced teens and other minimum wage workers can find jobs with employers who can legally pay them a wage commensurate with their skills. As a result, a 10 percent minimum wage increase results in a total teen employment loss of 2.3 percent.

An important implication is that teen employment losses could be greater in states that choose to expand the coverage of the minimum wage. With no alternative employment options available—very few businesses, large or small, are exempt from a higher state minimum wage—teens who were previously working at minimum wage jobs are confronted with larger employment losses.

Supreme Court Justice Louis Brandeis famously called states the "laboratories of democracy." But this research suggests that, with state wage mandates, these experiments could have unfortunate unintended consequences.

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Introduction: The Two–Sector Model

Current studies on the effect of increasing the minimum wage examine how increases change total employment, including jobs both covered and uncovered by the minimum wage.[1] Because some workers losing their job in the covered sector will take jobs in the uncovered sector, the change in total employment will understate how many jobs an increase in the minimum wage causes to be lost. To estimate the true job loss caused by the minimum wage, this paper examines the effect of the minimum wage on the employment of covered workers. This paper shows that the effect of the minimum wage on covered employment is indeed larger than the effect on total employment. The measured decrease is even larger (or not smaller) after correcting for possible errors in classifying workers.

Some states have minimum wage laws extending coverage to firms not covered by the federal law. As a consequence, these states will likely have a smaller uncovered sector. This effectively reduces the jobs available to workers losing their covered job when the minimum wage is increased. The results from this paper suggest that employment will be reduced more in these states.

In the standard two-sector model, one sector is covered by the minimum wage while the other is not.[2] (Appendix A of this paper provides a detailed examination of the make-up of the uncovered and low-wage workforce.) The minimum wage constrains the wages of employers in the covered sector. When the minimum wage is increased, workers in the covered sector may lose their jobs. Some of the workers losing their covered jobs spill over into the uncovered sector and find jobs there. As a consequence, the decrease in total employment will understate the loss of jobs in the covered sector. For example, if 100 covered workers lose their jobs and 20 take jobs in the uncovered sector, total employment will go down by 80 while covered employment falls by 100.

If the two-sector model is correct, the impact of minimum wages on workers in the covered sector will be greater than the impact on all workers.[3]

Appendix A describes who the covered and uncovered workers are and the nature of their jobs. Appendix B shows that the methods used in this paper accurately measure (or at worst understate) the loss in covered jobs.

Review of the Literature

There is a long–standing debate over whether or not the minimum wage affects employment levels. Brown et al. (1982) surveyed the literature and found most studies put the elasticity of teenage employment to the minimum wage between -0.1 and -0.3 (meaning that a 10 percent increase in the minimum wage decreased teenage employment by 1 to 3 percent). Almost three decades later, Neumark and Wascher (2008), in their survey of

[1] The term minimum wage refers to the binding minimum wage defined as the higher of the state or federal minimum wage.

[2] Two of the earliest papers were written by Harris and Todaro (1970) and Welch (1974). The model is also examined by Brown, Gilroy, and Kohen (1982) as well as by Card and Krueger (1995).

[3] The implications of the two-sector model of Harris and Todaro (1970) and Mincer (1976) can be different. If the minimum wage dramatically raises the total wages paid in the covered sector, it may draw some of the uncovered workers into the covered sector to seek jobs. While there are fewer covered jobs, the jobs that do exist may make entering the covered labor pool worthwhile. In this case, uncovered employment would decrease along with covered employment.

the literature, found a wider range of estimates, with most studies finding a negative effect.

However, studies such as that by Card and Krueger (1994) show that the minimum wage does not decrease employment. In a study of the 1988 increase in the California minimum wage, Card (1992b) finds that the change in the minimum wage increased the earnings of low-wage workers and did not affect teenage employment. Similar results were found for teenagers with respect to the 1990 increase in the federal minimum wage (Card 1992a). Controlling for the business cycle, Burnette, Holmes and Hutton (2007) show no minimum wage effect on teenage employment when compared to older cohorts.

Still, the empirical case that the minimum wage reduces employment has been made by many, some of whom we will cite here. Deere, Murphy and Welch (1995) show that the minimum wage does have an effect on low-wage employees. Examining 16-to-19-year-olds, Neumark (2001) presents results that are most consistent with the minimum wage having disemployment effects. Using the fraction of teenagers earning at or below the minimum wage, Wessels (2001) finds that, even with controls for the business cycle, minimum wage hikes decrease the labor force participation of teens. Changes in the minimum wage account for 7 to 10 percent of the variation in teen employment rates (Williams and Mills, 2001). The minimum wage has been shown to have small negative effects on teenage employment with an elasticity ranging from -0.09 (Currie and Fallick, 1996) to -0.2 (Neumark and Wascher, 1992). Burkhauser, Couch and Wittenburg (2000) found larger effects, with up to a 4 percent decrease in employment for a 10 percent increase in the minimum wage. Sabia and Burkhauser (2010) found a 10 percent increase in the minimum wage reduced the employment of minimum wage workers without a high school diploma by 6 percent, while it reduced other minimum wage workers employment by only 2 percent (this is for workers aged 16 to 29).

Models that analyze the minimum wage most often use typical estimation techniques, including logit, ordinary least squares, feasible generalized least squares, instrumental variables, vector autoregression, autoregression, normit and difference-in-difference techniques.[4] A simple time-series estimation model is a standard seen in the minimum wage literature:

$$E_t = \alpha_0 + \alpha_1 MW_t + X_t \beta + \varepsilon_t$$

where t is the subscript for time, E_t is the log of the employment to population ratio, MW_t is a minimum wage variable[5], X_t is a vector of state characteristics and in some cases economic indicators, and ε_t is a normally distributed error term (Wessels, 2001; Neumark and Wascher, 1992; Williams and Mills, 2001). Teenagers are often examined, as any effect the minimum wage may have can be better discerned in a group where many earn at or near the minimum wage (Card, 1992a).

Studies that use the CPS typically include prime-age male unemployment and the proportion of the group being analyzed that is in the working-age population. The purpose is to control for aggregate economic activity and supply variation respectively (Neumark, 2001). Other control variables include year and state dummies (Neumark, 2001; Neumark and Wascher 1992), year effects (Deere et al, 1995), school enrollment (Neumark and Wascher, 1992; Williams and Mills, 2001), a dummy for whether the state minimum wage is higher than the federal minimum wage (Wessels, 2001), lags of the dependent variable (Wessels, 2001), the Kaitz index, average manufacturing wage, share of teenagers in the armed forces, and the share of teenagers aged 16 to 17 (Williams and Mills 2001).

Data

The primary data in this study are from the monthly Current Population Survey (CPS) and the Merged Outgoing Rotation Group (MORG) of the CPS. CPS data are taken from 1987-2001. These years were chosen to encompass the changes in the minimum wage in 1990, 1991, 1996, and 1997. Quarterly data were constructed from the monthly CPS for the teenage proportion of the population, the teenage employment ratio, the adult unemployment rate, the average adult hourly wage, and the per capita income. Summary statistics are presented in Table 1.

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[4] See Burnette et al. (2007), Currie and Fallick (1996), Wessels (2001), Card (1992-1), Card and Krueger(1995) and Williams and Mills (2001) for examples.

[5] Some studies use lagged minimum wages, but we do not to be consistent with most studies. Also, it is likely that some firms, in anticipation of a future increase, will adjust employment before the increase. In this case, a forward lagged minimum wage variable could be used. As a result, our results may understate the full effects of minimum wages.

[6] The smallest sample is for February 1993 with 38 observations. The largest sample is for March 1990 in California with 716 observations. Fifty percent of the state/month cells have fewer than 104 observations, 75 percent have fewer than 136 observations, and 90 percent have less than 336 observations.

Table 1: Summary Statistics	
CPS MORG	
Age	17.72
Hours	24.85
Hourly Wage	$5.31
Married	2.86%
Never Married	96.57%
Divorced	0.58%
Female	50.58%
Metro Residence	76.97%
Full-Time	31.02%
Less than High School	55.24%
High School Grad	28.99%
More than HS	15.77%
Head of Household	5.36%
White	87.45%
Black	9.22%
Other	3.33%
Union Member	3.64%
CPS	
Adult Unemployment	3.40%
Adult Wage 30-39 years	$10.46
Teenage Employment Rate	47.2%
Per Capita Income	$ 21,552.72
Sampling weights used in all calculations.	

It is possible to use monthly or annual data in place of quarterly data. The choice of quarterly data was made for several reasons. The monthly sample size for each state can be quite small; thus, aggregating to the quarter increases the sample size for each state.[6] The larger sample size should result in more accurate estimation. Annual data would only allow 13 observations per state; thus, quarterly data again allows greater precision in estimation. Further, the effect of the change in the minimum wage may dissipate over the course of a year, leading to false conclusions. The use of quarterly values will minimize this dissipation. In most cases, it is straightforward to use the hourly wage to determine whether a worker is covered or not. However, special attention needs to be paid to restaurant wait staff and retail workers. Nearly all states allow a tip credit for restaurant employees.[7] This allows the restaurant to pay employees, typically bartenders, waiters and their assistants, less than the standard minimum wage.[8] Instead of using the tipped minimum wage, we used the standard minimum wage to classify tipped restaurant workers as covered or uncovered. The reasoning is as follows: restaurants in states allowing tipped minimum wages will act like uncovered firms.

To illustrate this point, suppose a restaurant is paying $4 per hour to tipped employees and the minimum wage is raised from $5.85 to $6.55, but the tipped minimum wage is left unchanged. Workers unable to get covered jobs may now seek restaurant employment. This would allow the restaurant to lower its hourly wage (for example, to $3.85) and increase employment (alternatively, it could increase employment such that tips per worker decrease). Even though the restaurant is legally covered, it is acting as an uncovered firm. However, this will not be true in the states not allowing tipped offsets: in these states, tipped workers must get an hourly wage equal to or in excess of the standard minimum wage. Dynamically, they are covered workers since their wage will go up when the minimum wage is increased.

Retail workers often receive a sales commission that counts towards the minimum wage. The reported hourly wage in the CPS does not include overtime, tips or commissions. Thus, for retail workers an estimated hourly wage is derived by dividing usual weekly earnings by usual weekly hours. The higher of the reported hourly wage and estimated hourly wage is used to classify retail workers.

Baseline Effects of the Minimum Wage

We begin with regressions on covered employment, as defined above. The employment regression, Equation 1, is estimated following Card and Krueger (1995). The dependent variable, E_{st}, is the log of the ratio of quarterly teenage covered employment to the teenage population (the subscript s stands for state and t

[7] The states without tip-offsetting are Alaska, California, Minnesota, Montana, Nevada, Oregon, and Washington.

[8] Federal laws impose a tipped minimum wage of $2.13 for restaurant employees. States may impose their own tipped minimum wage. The higher of the two is binding. The federal minimum wage has remained relatively unchanged through time. In the 1980s, the tipped minimum wage was $2.01 and currently the tipped minimum wage is $2.13.

[9] Adults aged 30 to 39 were selected as a group that is close to teenagers but whose wages are only slightly affected by the minimum wage.

for time period). Teenage covered employment is calculated as described above. The independent variables, in X_{st}, include a set of year dummies, a set of state dummies, the log of the higher of the state or federal minimum wage, the log of adult wages (30-to-39-year olds), the log of per capita income, the log of the real gross domestic product (GDP), the log of the GDP deflator, the fraction of teenagers in the population, and the unemployment rate of white males, aged 35 to 55.[9] All variables are state–level with the exception of the GDP deflator and the real GDP.

If the predictions of the two-sector model hold, the minimum wage will reduce covered employment more than it reduces total employment.

Table 6 on page 15 in the appendix presents the results for regressions using both the log of the ratio of total teenage employment to the teenage population and the log of the ratio of covered teenage employment to the teenage population as the dependant variable. Results are presented for both level and first-difference regressions. The first-difference analysis is employed to remove state-level fixed differences in employment. The addition of state dummies further removes fixed differences in employment growth among states. In the top half of the table the dependent variable is the log of the ratio of total teenage employment to teenage population. In the bottom half of the table the dependent variable is the log of the ratio of covered teenage employment to teenage population. In both, columns 1 through 3 show the results from level regressions, while columns 4 through 7 show the results from first-difference regressions. The results are corrected for autocorrelation using lags of the independent variable.[10] An increase in the minimum wage significantly decreases covered employment and decreases it more than it decreases total employment.

The decrease in the log of covered employment is roughly four times as great as the decrease in the log of total employment. For the level regression, the minimum wage elasticity for total teenage employment ranges from -0.228 to -0.168, and for covered teenage employment, from -1.111 to -0.854. For the first-difference regression, the elasticity ranges from -0.187 to -0.169 for total employment and from -1.048 to -1.01 for covered employment.

Of interest is the similarity between the level and first-difference results. The similar negative effect between the two suggests that the negative effect is not influenced by confounding factors specific to either method of estimation. Given this and that in principle both estimators are consistent in a correctly specified model, the choice between level and first-difference estimation is not of great consequence.

Tests of the Model

Some labor economists would criticize the approach used here to classify covered workers as being paid the minimum wage or more.[11] It is believed that because of various biases, the estimated decrease in employment will be too high. If this belief is true, then correcting for these biases should result in a smaller estimated impact of the minimum wage. Instead, an examination in Appendix B shows that the corrections for such biases resulted in higher estimated impacts; to put it bluntly, the results show that this belief is wrong.

We tested the validity of our results in several other ways. First, the minimum wage should have increased uncovered employment. It did, with a coefficient of 4.0 (with a standard error of 0.25). These results are for first-difference regressions of the form used above with only the dependent variable changed. Second, covered employment should be reduced more for those less skilled. For teenagers aged 16 and 17, a 10 percent increase in the minimum wage reduced covered employment by 13 percent and total employment by 3 percent. On the other hand, for teenagers 18 and 19, a 10 percent increase in the minimum wage decreased covered employment by 3.7 percent and total employment by 1.5 percent. All of these results are significant. For the less skilled, relatively more covered jobs are lost.

Some states extend the coverage of the minimum wage law to employers not covered by the federal law. This reduces the relative size of the uncovered sector. An important implication of the results of this paper is that in those states with smaller uncovered sectors, an increase in the minimum wage could decrease employment more.

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[10] Two criteria for selecting lags were employed: the first based on the Akaike Information Criterion (AIC), the second based on the significance of lags. As each additional lag is added, it must be significant.

[11] These criticisms are known by many labor economists and were once held by the senior author of this paper.

Conclusion

Current literature on the effects of the minimum wage examines the change in total employment. This, however, is not an accurate measure of the loss of jobs caused by the minimum wage since some workers in the covered sector who lost their jobs may move into the uncovered sector. In this case, the job loss in the covered sector should be greater than the net loss in jobs. Some may argue that the net loss of jobs is what matters. Yet, all those losing jobs in the covered sector, whether they leave the workforce or not, are not as well-off as those retaining their covered job at a higher wage.

This study extends the conventional models to examine the loss of covered jobs in response to changes in the minimum wage. It shows that the effect of the minimum wage on covered employment is, at a minimum, three times as large as the effect on total employment, with or without correcting for errors in reporting wages. Ignoring the shift in employment from the covered to the uncovered sector seriously underestimates the effect of the minimum wage on the demand for labor. The results are validated through tests and corrections for errors in reporting wages. Our results suggest that either there is little misreporting or that there is an over-reporting of covered workers immediately after a hike. If the latter is the case, it is speculated that it is due to the publicity that accompanies an increase in the minimum wage combined with the fact that it is someone other than the worker reporting the wage. Without utilizing the two-sector model, false conclusions will be drawn about the effects of minimum wages.

Some states, by extending the coverage of the minimum wage law beyond that of the federal law, effectively reduce the opportunity for minimum wage workers who have lost their job to find alternative employment in the uncovered sector. The results in this paper suggest that this will make the minimum wage's negative effect on employment even larger.

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Appendix A: Who Are the Minimum Wage Workers?

Over the sample period (1987-2001) used in this paper, a sizable number of workers were not covered by the minimum wage law. According to Schiller (1994), "The U.S. Department of Labor estimates that only thirty percent of all employers and approximately seventy percent of the workforce is directly covered by Fair Labor Standards Act (FSLA) statutes." This low percentage of coverage results from minimum wage exemptions for specific worker and employer characteristics. The most notable employer-based hole in FLSA coverage is the exemption for small businesses. The "enterprise test" for coverage is based on a firm's annual revenue; the level used was revenue of $500,000 or less. How important is this exemption? Assuming employment is roughly related to revenues, this exemption is large. In 1997, 47.6 percent of the 5,541,918 firms in the U.S. employed 4 or fewer workers; 65.8 percent employed 9 or fewer workers (Axtell, 2001).

Schiller goes on to note that there are exemptions for full-time students, agricultural workers, outside sales workers, and casual domestic workers. Some workers not covered by the federal minimum wage law are covered by state law. However, Schiller, writing on state minimum wage laws, notes that "although the specific boundaries of the state-covered sectors are indiscernible, they commonly exclude teenagers."

This paper assumes that workers earning less than the minimum wage are in the uncovered sector. Haugen and Mellor (1990) report that 6.2 percent of teenagers aged 16-19 paid hourly wages earned less than the minimum wage, while 16.9 percent earned exactly the minimum wage. The Bureau of Labor Statistics (BLS) began to regularly report data on teenagers earning less than minimum wage in 2002. Haugen (2003) found that 6.5 percent of teenagers paid hourly earned less than the federal minimum wage and 3.9 percent earned exactly the minimum wage. These two numbers span the dates of our data (1987-2001).

Tipped workers, while covered by the minimum wage, were not affected by increases in the federal minimum wage, as the federal minimum wage for tipped workers was essentially unchanged over this period (rising from $2.01 to $2.12). Thus, tipped workers are part of the "uncovered" sector in the sense that many restaurants were in a position to hire the workers who lost jobs in the covered sector. Tipped workers likely represent 20 percent of low-wage workers (Wessels, 1996).

Low-Wage Workers

Demand and supply are basic concepts of economics. In the labor market for low-wage workers, the demand side consists of low-wage jobs, while the supply side is made up of low-wage workers. The market for low–wage workers exists because low-wage employers want the kind of individuals who are low–wage workers and because low-wage workers want the types of jobs offered by low-wage employers. First, we will analyze who the low-wage workers are.

Various studies have examined low-wage workers. Using data from the 1988 Current Population Survey (CPS), Haugen and Mellor (1990) find that workers earning at or below the minimum wage were more likely to be young, women, and working part-time. They found that 36 percent of all workers earning such wages were teenagers and that 22 percent were 20 to 24 years of age. Beginning in 2002, the BLS began publishing an annual report on the characteristics of workers who earn the minimum wage or less. In the 2002, 2003, 2006 and 2009 reports, the general findings were the same. Workers who earn less than or equal to the minimum wage are typically young; approximately 20 to 25 percent, dependent on the year, of all workers earning at or below the minimum wage are teenagers. They are more likely to be women, work part-time and have completed lower levels of education.

Using 1981 data from the National Longitudinal Survey of Youths, Schiller (1994) examines workers who earn below the minimum wage. He found that the percentage of "below the minimum wage" workers decreases as age increases. More than 50 percent of 16-and-17-year olds earned below the minimum wage compared to 42 percent of 18-year olds and 34 percent of 19-year olds. Using logit regression techniques, age, being male, higher levels of education, and prior work experience are all shown to decrease the probability of earning below the minimum wage, while current school enrollment increases the probability. Approximately 33 percent of the "below minimum wage" workers in Schiller's sample had no prior work experience compared to 14 percent of those who earned wages equal to or greater than the minimum wage. More than 60 percent of "below the minimum wage" workers worked part-time.

Schochet and Rangarajan (2009) used data from the Survey of Income and Program Participation to analyze low-wage workers (defined, in their study, as earning $7.50 or less in March, 1996).

In the study, they found that low-wage workers tend to frequently enter and exit the labor force: "our duration analysis that low-wage jobs spells tend to be short." In addition, low-wage workers tend to work part-time; low-wage males worked an average of 33 hours a week, while females worked an average of 26 hours a week. It appears that low-wage workers prefer "short-short" jobs – working short hours for a short time. Various reasons proffered for this include not wanting to lose welfare benefits and wanting to spend more time in the home. Such persons may not want to work full-time and instead choose the low-wage jobs that don't require full-time workers. Similarly, many teenagers, given that they are in school, may prefer part-time jobs.

Low-Wage Jobs

On the other side of the supply and demand graph scissors are the characteristics of jobs paying low wages.

We will begin by examining the BLS's analysis of wages by major occupation groups in 1999 (Bureau of Labor Statistics, 2001). Table 2 shows the five lowest wage occupations, measured by the tenth percentile wage level. In 1999, the minimum wage was $5.15. The largest low-wage group was sales: ten percent of its workers earned $5.83 or less. The next largest occupation group was food preparation and service where 10 percent of workers earned $5.50 or less. This occupation also had the narrowest distribution of wages. For the whole economy, 10 percent of workers earned $6.33 or less, and a sizeable number of workers earned wages near the minimum wage.

"Sales and related" was the largest occupation group paying low wages. The industries in which sales had the lowest mean wage were eating and drinking places ($7.24), motion pictures ($7.94), general merchandise stores ($8.10), apparel and accessory stores ($8.39), and food stores ($8.57). The next largest low-wage occupation group was food preparation and serving related. The industries having the lowest mean wage for this occupation was motion pictures ($6.37), wholesale trade-durable goods ($7.10), eating and drinking establishments ($7.23), personal services ($6.37), and miscellaneous retail ($7.43).

In the BLS 2001 study cited above, 10 percent of workers employed in a service occupation earned less than or equal to the minimum wage, and 3 percent of workers in farming/forestry/fishing occupations earned such wages. These numbers were quite similar in the 2003, 2006, and 2009 reports. In 2002, roughly three-fifths of all workers earning the minimum wage or less were in the retail industry (this included food service workers in 2002), and 8 percent of retail workers earned the minimum wage or less. In 2003, the CPS classification of industries changed. In the 2003 to 2009 reports many of the food services and drinking places industry codes were moved from retail to leisure and hospitality. Accordingly, in 2003, roughly three-fifths of all workers earning the minimum wage or less were in the leisure and hospitality industry, and approximately 15 percent of leisure and hospitality workers earned the minimum wage or less. By 2009, approximately 50 percent of all workers earning the minimum wage or less were in the leisure and hospitality industry, and 21 percent of leisure and hospitality workers earned the minimum wage or less.

Schiller (1994) found that "below the minimum wage" workers are more likely to be employed in small firms (median size of 18 employees) and in the retail industry (including food service).

Table 2. Employment and Wages of The Lowest-Paying Occupation, 1999

Major Occupational	Group Employment	10th percentile	50th percentile	Mean Wage
Food Preparation and Serving Related	9,687,970	$5.50	$6.64	$7.50
Building and Grounds Cleaning and Maintenance	4,274,200	$5.79	$8.08	$9.09
Personal Care and Services	2,556,920	$5.69	$7.82	$9.76
Farming, Fishing, and Forestry	463,360	$5.83	$6.96	$8.65
Sales and Related	12,938,130	$5.83	$9.02	$13.01
Total, All Occupations	127,274,000	$6.33	$12.10	$15.18

Table 3: Distribution of Low-Wage Workers and All Workers by Industry, March 1996		
Industry	Percent of Low-Wage Workers	Percent of All Workers
Agriculture/Forestry/Fishing/Hunting	9%	6%
Mining/Manufacturing/Construction	16%	23%
Transportation/Utilities	3%	7%
Wholesale/Retail	29%	17%
Personal Services	12%	7%
Health Services	7%	8%
Other Services	17%	26%
Other	6%	16%

Wages below the minimum wage were also more likely to be found in the agricultural, personal services, and entertainment and recreation industries.

As noted, a characteristic of many low-wage employers is that they are small firms. Examining single-firm establishments in a study by Iowa, Orazem and Mattila (2002) found that about one-quarter of retail employees and about one-third of service sector workers were in the uncovered sector (which, in Iowa, included firms with less than $300,000 in annual sales). The largest fraction of workers earning below the minimum wage, 17 percent, was in uncovered firms in rural areas. In urban areas, uncovered firms and covered firms had similar percentages of being paid less than the minimum wage: 6.7 percent for uncovered urban firms versus 5.8 percent for covered urban firms. The percentage of workers being paid less than the minimum wage for covered rural firms was 4.6 percent. The legal status only affected the fraction being paid below the minimum wage in rural areas.

Low-wage workers represented 28 percent of all workers in their survey, earning an average of $5.58. More than 25 percent earned less than $5.00 when the minimum wage was $4.75. Table 3 from the Schochet and Rangarajan (2004) study cited above shows the distribution of workers by industry, contrasting low-wage workers with all workers. Low-wage workers are relatively greater in number in agriculture, wholesale and retail trade and personal services.

As noted above, many low-wage jobs are less than full-time and have frequent turn-over. Such jobs likely require little training and little investment by the firm in getting the worker prepared for the job. Also, many of these jobs have fluctuating demand. For example, few restaurants need workers on a given shift for more than six hours a day. Similarly, agriculture's demand for workers is seasonal and not steady.

Beginning in 2002, one year after our data set ends, the BLS began reporting characteristics of workers being paid at the minimum wage separately from those who are paid less than the minimum wage. The fraction of workers being paid at or below the minimum wage declined dramatically in the 1980s (from 15.1 percent in 1980 to 5.1 percent in 1990). After that, it declined at a slower rate, equaling 4.6 percent in 1999. We will examine the data for 2002 (BLS, 2003). Table 4 shows the major occupational and industry groups paying a greater percentage of workers the federal minimum wage or less when compared to the national average (shown in the last column).

We used a logit regression to analyze which factors significantly affected the probability that a worker earns less than the minimum wage. Data from years when the minimum wage had not been recently increased were used so as to not introduce any confounding effects due to an increase in the minimum wage. The dependent variable equaled one if the worker earned less than the minimum wage and zero otherwise. The independent variables are age, education, experience, average hours, seven industry dummies, eight occupation dummies, and indicators for race, sex, reference person, marital status, full-time employment, union membership, urban residence, and state. The logit results are presented in Table 5, which shows the marginal effects.

Table 4: Characteristics of Workers Paid Hourly, 2002		
	Percent Paid $5.15	Percent Paid Below $5.15
Lowest Paying Occupations		
Food Service Workers	2.80%	16.70%
Health Services	2.80%	16.70%
Service, Private Household	1.30%	15.60%
Personal Service Workers	2.80%	4.40%
Handlers, Equipment Cleaners, Helpers, and Laborers	1.10%	1.40%
Farming, Forestry, and Fishing	1.00%	1.50%
Lowest Paying Industries		
Private Households	1.40%	14.50%
Retail Trade	1.90%	6.60%
Entertainment and Recreation	2.30%	3.90%
Professional Services	1.20%	3.70%
Total: 16 and over	0.80%	2.20%

The results from the logit regression presented in this study are consistent with those in the literature. In general terms, characteristics of teenagers less likely to earn below the minimum wage include older age, white, union member, male, full-time work, higher education, urban residence and specific industry and occupational employment.

The results in Table 5 describe several characteristics of uncovered workers in terms of the probability of being an uncovered teenage worker. Teenagers aged 16 are 6.3 percent more likely to earn less than the minimum wage compared to those aged 19. Likewise, those aged 17 are 3.6 percent more likely to earn less than the minimum wage and those aged 18 nearly 1 percent more likely. Female teenagers are 2.6 percent more likely to earn less than the minimum wage than males. Blacks are 3 percent more likely to do so than whites. Both working full-time and attending school decrease the probability of being an uncovered worker by 1 to 2 percent. Employees that are union members are 5.4 percent less likely to earn below the minimum wage than non-union members. Compared to those with a high school diploma, teenage employees with less education are 1.5 percent more likely to earn less than the minimum wage and those with more education are 2 percent less likely. Teenagers that reside in urban areas are 3.7 percent less likely to earn less than the minimum wage. Working more hours only has a small effect on the probability of being an uncovered worker. Among teenagers, marital status does not affect the probability of being an uncovered worker.

Occupation and industry are significant factors in the probability that an individual earns less than the minimum wage. Occupations were summarized into nine broad categories based on occupation codes in the MORG and industries were organized into eight categories based on industry codes in the MORG.[13] The excluded occupation category is farming/forestry/fishing and the excluded industry is other. Relative to the excluded occupation and industry groups, teenagers working in nearly all of the remaining occupations and industries were less likely to be uncovered workers. The notable exceptions are teenagers in tipped restaurant occupations who are 26 percent more likely to be uncovered and those in other service occupations who are 4.7 percent more likely. Further, teenagers working in the retail industry (including food services) are 2 percent more likely to be uncovered workers and, those in the education services industry are 7.3 percent more likely.

These results suggest that the teenagers most affected by the minimum wage are female, young, and black.

Appendix B: Testing for Errors Resulting from Using Reported Wages

Workers being paid the minimum wage or more are defined in this paper as being covered workers. This definition better captures the dynamics of the two-sector model than would a legal definition of covered workers. For example, using the "wage" definition, "covered" jobs logically include legally uncovered jobs, which always pay the minimum wage or more (perhaps to avoid social condemnation or to attract workers). Conversely, "uncovered" jobs, by this definition, include legally covered jobs that pay less than the minimum wage because employers choose to not comply with the law (Ashenfelter and Smith, 1979).

Some economists would expect that using wages to classify workers will overestimate the true loss in covered jobs. We will show in this section that this assumption, when tested, proves to be invalid. If anything, our estimates understate the true loss in covered jobs.

When the minimum wage is increased, a likely bias is that there is a lag in the reported wages.[14] This lag could be due to a lag in reporting the new wage or due to a lag by employers in raising wages. If so, during periods when the minimum wage is increased, the fraction of workers covered by the minimum wage will be understated. This is not the only bias that may exist. When the minimum wage is increased, there appears to be wide coverage in the news of the new minimum wage level. Parents, being unfamiliar with their teenager's wage, may report the minimum wage as the wage their teenager is earning – even when the teenager is earning less. In this case, the fraction of covered workers will be overstated when the minimum wage is increased. The evidence below suggests that the second effect dominates or, at best, the two effects cancel each other out.

Table 5: Logit Results-Probability of Being An Uncovered Worker

Demographics	Marginal Effect	Standard Effect
Age 16	0.063***	(0.006)
Age 17	0.036***	(0.005)
Age 18	0.009*	(0.004)
Female	0.026***	(0.003)
Black	0.030***	(0.005)
Other Race	-0.005	(0.007)
Married	-0.002	(0.008)
Divorced	0.008	(0.020)
Head of Household	-0.005	(0.006)
Live in MSA	-0.034***	(0.003)
Education		
Less than HS Diploma	0.015***	(0.004)
More than HS Diploma	-0.02***	(0.004)
Education		
In School	-0.012***	(0.003)
Full-Time	-0.016***	(0.004)
Usual Hours	-0.003***	0.000
Union Employee	-0.054***	(0.005)

[13] Classification of occupations and industries is available from the authors upon request.

[14] The occurrence of measurement error in the CPS is documented in the literature with a large emphasis on income reporting. In general, measurement error leads to false results and makes the underlying economic relationships difficult to discern. The estimates may be biased or inconsistent if the dependent variable is limited in some way (Hausman 2001). The interested reader is referred to the following: Bound and Krueger, 1991; Bollinger, 1998; Roemer, 2000; Cavanagh and Sherman, 1998, and Abrevaya and Hausman, 1999.

Table 5 (Continued)

Occupation		
Tipped Restaurant	0.261***	(0.019)
Non-Tipped Restaurant	-0.002	(0.007)
Sales	-0.087***	(0.005)
Admin/Management	-0.055***	(0.005)
Health	-0.049***	(0.008)
Professional/Specialty	-0.049***	(0.006)
Other Service	0.047***	(0.009)
Trade	-0.033***	(0.006)
Industry		
Retail	0.021***	(0.004)
Construction	-0.047***	(0.006)
Business Services	-0.030***	(0.006)
Entertain/Recreation	-0.017**	(0.005)
Personal Services	0.002	(0.008)
Health Services	-0.027***	(0.008)
Education Services	0.073***	(0.073)
N	90466	
Psuedo-R-Squared	0.1408	
Wald chi2(80)	7309.14	
Log pseudolikelihood	-32736.876	

Other variables included in the model are state dummies and a constant.
Standard errors in parentheses; Sampling weights used in estimation
* Indicates significance at the 5% level.
** Indicates significance at the 1% level.
*** Indicates significance at the 0.1% level.

To test how misreporting affects the results, a logit regression was used to classify workers instead of their wage. This procedure assumes that individuals reporting wages near the minimum wage are more likely to be misclassified. For example, a person reporting a wage $5 above the minimum wage is almost certain to be a covered worker, while a person reporting a wage 5 cents above the minimum wage is less likely to be a covered worker. Using this insight, information from the non-adjustment period was utilized to determine the probability of an individual being a covered worker when they earned a wage within a certain range of the minimum wage.

First, two time periods were defined: an adjustment period and a non-adjustment period. The adjustment period includes time where there may be a lag in reporting wages following an increase in the minimum wage. The observations from 1990Q2 to 1992Q2 inclusive and from 1996Q4 to 1998Q3 inclusive are defined as the adjustment period and all other time periods defined as the non-adjustment period.[15]

Second, a logit model was estimated using individuals from the non-adjustment period with wages that lie in a preset range of the minimum wage. A logit does not fit well when the event has a small probability of occurring. Thus the wage restriction (for example, sampling workers earning a wage that is no more than fifty cents different than the minimum wage) is employed to increase the proportion of uncovered workers. This increases the quality of the fit of the model. The dependent variable is a binary indicator for covered employment (equaling 1 if a worker earns at least the minimum wage or 0 if they earn below the minimum wage). The independent variables are age, education, experience, average hours, seven industry dummies, eight occupation dum-

[15] These time periods were selected by examining the average monthly reported wage to see when the wage leveled off after the minimum wage hike.

mies, and indicators for race, sex, reference person, marital status, full-time employment, union membership, urban residence, and state. The logit coefficients from the non-adjustment period are used to calculate the probability that each individual within the preset wage range is covered in the adjustment period. The coverage probabilities for individuals outside the wage range or in the non-adjustment period are taken directly from the data. The probabilities for each state and time period are summed, resulting in the proportion of employees that are covered, $P_{s,t}$:

$$P_{s,t} = \sum_{i} p_i \; \forall \in s, \; t=1987:1\text{-}2001:4$$

Teenage covered employment is calculated by multiplying total teenage employment by $P_{s,t}$. Equation (1) is estimated using the new measure of covered employment. This method was proved valid in out-of-sample testing.[16]

To better understand the procedure, take, for example, a ten-cent range around a minimum wage of $5.15. The logit is estimated in the non-adjustment period over individuals reporting a wage between $5.05 and $5.25. These coefficients are used to estimate the probability of being covered in the adjustment period for individuals reporting a wage between $5.05 and $5.25. In the adjustment period, in this example, individuals earning be-

Table 6: The Effect of an Increase in the Minimum Wage on Teenage Employment

	Dependent Variable: Log of Total Teenage Employment						
	Level Results			First-Difference Results			
Log Minimum Wage Coefficient	-0.228*	-0.176*	-0.168*	-0.187*	-0.169*	-0.180*	-0.184*
Standard Error	0.051	0.049	0.049	0.083	0.080	0.069	0.073
n	3000	2950	2850	2950	2900	2800	2600
R-Squared	0.81	0.82	0.82	0.53	0.57	0.68	0.68
AR	No	1~^	3	No	1	3~^	7
	Dependent Variable: Log of Covered Teenage Employment						
	Level Results			First-Difference Results			
Log Minimum Wage Coefficient	-1.111*	-0.910*	-0.854*	-1.031*	-1.042*	-1.010*	-1.048*
Standard Error	0.080	0.078	0.079	0.129	0.120	0.107	0.113
n	3000	2950	2850	2950	2900	2800	2600
R-Squared	0.70	0.71	0.71	0.35	0.45	0.55	0.56
AR	No	1~^	3	No	1	3^	7~

Other variables included in the regressions: the log of adult wages, the log of per capita income, the adult unemployment rate, the fraction of teenagers in the population, the log of the GDP deflator, the log of real GDP, quarterly dummy variables, and year dummy variables. The teenage employment population is calculated with CPS weights.

All variables are state-specific except for the GDP deflator and real GDP.
White standard errors are reported.
*Indicates significance at the 5% level or better.
^Indicates the number of lags selected using the Akaike Information Criterion (AIC).
~Indicates the number of lags selected by lag significance.

[16] The fit of the method is tested in two ways: first, in an out-of-sample test, the logit coefficients reported in Table A.4 are used to estimate the fraction of covered teenage workers for each bracket in the years 1986 and 2003. The actual and estimated fractions of covered teenage workers are compared; second, by running the logit over the 1995-2001 period for each bracket and then using the results to estimated the coverage probabilities for the 1987-1994 period for each bracket. The actual and estimated probabilities are compared. The results are available upon request.

low $5.05 are assumed to be uncovered and individuals earning above $5.25 are assumed to be covered.

The results are presented in Table 7 for five brackets around the minimum wage: 10 cents, 25 cents, 50 cents, 75 cents, and one dollar. The covered minimum wage elasticity ranges from -0.628 to -1.127 for the level results and from -0.702 to -1.368 for the first-difference results. These results are similar to the unadjusted estimates reported above. This estimator corrects for biases from regression to the mean, measurement error, and from the lag in wages after a minimum wage hike. It also addresses another bias.

Some legally uncovered jobs pay more than the minimum wage before the hike and less after: using wages would classify these workers as losing their "covered" job when in fact they did not. The logit procedure, by identifying jobs by according to their usual status, reduces this bias.

It is difficult to detect a bias from the lag in reporting wages or any other source of misreporting. The effect on covered employment is still significantly more negative than the effect on total employment.

Table 7: The Effect of the Minimum Wage—Logit Coverage Results

Coverage Probabilities Utilized to Classify Workers Within Each Preset Bracket

	10¢ Bracket								
	Level Results			First-Difference Results					
Log Minimum Wage Coefficient	-1.127*	-0.935*	-0.800*	-1.368*	-1.328	-1.234*	-1.271*	-1.272*	-1.279*
Standard Error	0.093	0.092	0.088	0.148	0.141	0.126	0.127	0.131	0.133
n	3000	2950	2800	2950	2900	2800	2750	2650	2600
R-Squared	0.68	0.69	0.70	0.38	0.48	0.57	0.58	0.58	0.58
AR	No	1^	4~	No	1	3^	4~	6	7
	25¢ Bracket								
	Level Results			First-Difference Results					
Log Minimum Wage Coefficient	-1.059*	-0.868*	-0.716*	-1.267*	-1.193*	-1.071*	-1.111*	-1.123*	-1.145*
Standard Error	0.099	0.096	0.094	0.163	0.153	0.142	0.144	0.146	0.147
n	3000	2950	2800	2950	2900	2800	2750	2650	2600
R-Squared	0.61	0.670	0.69	0.31	0.43	0.55	0.56	0.56	1.56
AR	No	1^~	3	No	1	3	4^~	6	7
	50¢ Bracket								
	Level Results			First-Difference Results					
Log Minimum Wage Coefficient	-0.920*	-0.755*	-0.628*	-0.811*	-0.748*	-0.702*	-0.732*	-0.730*	-0.747*
Standard Error	0.096	0.091	0.087	0.138	0.127	0.114	0.144	0.117	0.118
n	3000	2950	2800	2950	2900	2800	2750	2650	2600
R-Squared	0.61	0.670	0.69	0.31	0.43	0.55	0.56	0.56	0.56
AR	No	1^~	3	No	1	3	4^~	6	7

Table 7 (continued)

	75¢ Bracket								
	Level Results			First-Difference Results					
Log Minimum Wage Coefficient	-0.840*	-0.749*	-0.681*	-0.864*	-0.811*	-0.784*	-0.833*	-0.808*	-0.788*
Standard Error	0.098	0.094	0.096	0.163	0.155	0.141	0.143	0.146	0.149
n	3000	2950	2800	2950	2900	2800	2750	2650	2600
R-Squared	0.48	0.5	0.51	0.17	0.34	0.47	0.51	0.49	0.50
AR	No	1^~	3	No	1	3	4	6^~	7
	$1 Bracket								
	Level Results			First-Difference Results					
Log Minimum Wage Coefficient	-0.834*	-0.767*	-0.725*	-0.868*	-0.779*	-0.756*	-0.812*	-0.787*	-0.764*
Standard Error	0.099	0.094	0.097	0.183	0.168	0.159	0.160	0.163	0.166
n	3000	2950	2800	2950	2900	2800	2750	2650	2600
R-Squared	0.46	0.47	0.47	0.15	0.34	0.45	0.49	0.48	0.48
AR	No	1^~	3	No	1~	3	4	6^~	7^

Other variables included in the regressions: the log of adult wages, the log of per capita income, the adult unemployment rate, the fraction of teenagers in the population, the log of the GDP deflator, the log of real GDP, quarterly dummy variables and year dummy variables. The teenage employment population is calculated with CPS weights. White standard errors are reported.

*Indicates significance at the 5% level or better.

^Indicates the number of lags selected using the Akaike Information Criterion (AIC).

~Indicates the number of lags selected by lag significance.

An alternative to the above procedure is to simply eliminate observations immediately after an increase in the minimum wage. Rises in wages after an increase in the minimum wage are completed within a year. Thus, dropping a year of observations is appropriate. The observations from 1990Q2 to 1992Q2 and from 1996Q4 to 1998Q3, the adjustment period, were removed from the data. Equation (1) is estimated using the new sample. The results are presented in Table 8. The elasticity is more elastic (more negative) than for the entire sample.[17] If the covered sector is overstated, then it is overstated immediately following the minimum wage hikes. The effect here may occur because the size of the covered sector is understated after a minimum wage. Alternatively, the larger effect may reflect the longer-run equilibrium effects arising from firms having time to adjust employment levels. If there is a positive bias, then, once again, the results in Table 4 understate the effect the minimum wage has on covered employment.

Tracking Reported Wages

To examine if there is a bias in reported wages, we examined how wages of individual workers changed over time. The first observation in the CPS MORG is from the fourth interview of the household and the second observation is from the eighth interview. The observations are one year apart. Using a standard matching algorithm, CPS MORG data on individuals were matched across interviews, giving us two observations a year apart on each teenager. The resulting selection of teenagers is not random: many teens were dropped because their first observation did not match their second observation. In some cases, the teenager had left the household. In others, for example, the teen was reported as being two or more years older in the second observation. Cases like these were dropped. Thus, whatever factor caused a teenager not to be dropped may affect our results.

[17] See Table 6.

Table 8: The Effect of the Minimum Wage—Correction for Lag in Reported Wages

Potentially Problematic Observations Deleted, 1990Q2 to 1992Q2 & 1996Q4 to 1998Q3

	Dependent Variable: Log of Covered Teenage Employment				
	Level Results		First-Difference Results		
Log Minimum Wage Coefficient	-1.212*	-0.945*	-1.612*	-1.442	-0.416*
Standard Error	0.099	0.098	0.427	0.384	0.545
n	2150	2000	2000	1700	950
R-Squared	0.71	0.72	0.37	0.53	0.57
AR	No~	1^	No	2~	7^

Other variables included in the regressions: the log of adult wages, the log of per capita income, the adult unemployment rate, the fraction of teenagers in the population, the log of the GDP deflator, the log of real GDP, quarterly dummy variables and year dummy variables. The teenage employment population is calculated with CPS weights.

All variables are state-specific except for the GDP deflator and real GDP.
White standard errors are reported.
*Indicates significance at the 5% level or better.
^Indicates the number of lags selected using the Akaike Information Criterion (AIC).
~Indicates the number of lags selected by lag significance.

We first examined if there was evidence of a lag in reported wages. If reported wages do lag actual wages after an increase in the minimum wage, then the wages of many workers classified as uncovered will be understated in the period following an increase in the minimum wage and then raised later to the correct level. In this case, after a minimum wage increase, workers incorrectly reporting a wage below the minimum wage should have their reported wages grow faster (as the reported wage catches up with the workers' actual wages) as compared to periods when the minimum wage was not increased. We compared the growth of wages for uncovered workers after a minimum wage hike to the growth in other periods where there was no hike. Our results rejected the assumption that reported wages lagged actual wages. There was no faster growth after a hike due to reported wages catching up with actual wages.

Next, we examined if the number of minimum wage workers is overstated in periods after the minimum wage is increased. Our hypothesis is that reporting adults are more likely to be aware of the minimum wage when it is increased. As a result, they may report their teenager as earning a minimum wage when the teenager is earning less. If this happens, then a year later, they should be more likely to report their real (and lower) wage. To test for this, we used the same matched data set to examine workers who reported earning exactly the minimum wage in the first observation. We then calculated the fraction of these exact minimum wage workers who reported earning a wage below the initial minimum wage a year later in the second observation. The data set was limited to states where the federal minimum wage was binding. We compared years when the minimum wage was increased to years when the minimum wage was not increased. Note the difficulty of this test. In particular, the federal minimum wage has been increased in two steps, a year apart (1990 and 1991, then 1996 and 1997). Thus, the second observation, being a year later, often takes place when a still higher minimum wage exists. The independent effect of this likely reduces the below–minimum wage fraction since this is the fraction of persons being paid less than the original (and lower) minimum wage.

As shown in Table 9, we found that the below-minimum wage fraction was higher for the 1996-97 hikes; the fraction was 9.7 percent in 1997, while it was below 4% in the surrounding years before the hikes (the "year" refers to the year after the month the minimum wage was increased and for the similar months in years when it was not increased). The results for the 1990-1 hikes were higher when compared to earlier years, but the same as later years. The fraction was 9.2 percent in 1991 compared to 3.9 percent in 1989 (the year before the hikes), but was 6.5 percent in 1992 and 8.9 percent in 1993. Thus, the evidence lends some support to the over-reporting hypothesis.

Table 9: Percentage of Minimum Wage Workers Earning Less a Year Later

Year	Percent	N	Year	Percent	N
1989	3.9%	282	1995	3.6%	166
1990	7.4%	136	1996	4.0%	149
1991	9.3%	367	1997	9.7%	144
1992	6.5%	322	1998	3.8%	106
1993	8.9%	232			

*Sampling weights used in all calculations.

Employment Policies

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