Its Bark is Worse than Its Bite:  
The Wage and Employment Effects of the Minimum Wage in the United States

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Abstract

This study examines the effect of changes in the U.S. minimum wage on wages and employment in 32 industries selected for their presumed sensitivity to the minimum wage. Applying time series techniques commonly used in macroeconomics and finance to changes in the minimum wage occurring from 1967 and 1991, we initially test for a wage response; only where one is found do we test for an employment response. 25% of the industry/minimum-wage-increase pairs show evidence of an appropriate wage response. 8 of these 54 show a statistically significant negative employment response, while 6 show significant, positive employment responses. Positive effects may be due to either a high variance distribution centered on zero, or markets with ‘lemons’ problems concerning worker quality. Limiting analysis to industries in which the minimum wage binds provides no evidence of a consistent negative relationship between the historical minimum wage and employment.

An issue confronting researchers is to identify situations that satisfy the first condition, a minimum wage which is binding, prior to determining the effect on employment. The common practice has been to identify markets believed a priori to be directly affected by the minimum wage and go straight to examination of the employment effect: thus the numerous studies of teenagers and of racial minorities. A shortcoming of this approach is that it is not possible to know if the lack of an empirical relationship between

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2This takes compliance and enforcement largely for granted: see Ashenfelter and Smith (1979).

3Presumably, employers determine levels of wages, fringe benefits and other expenses that minimize overall labor costs. When minimum wage legislation raises wages, partial offsets may well be possible by reductions in other costs but the possibility of complete offsets would be a surprise. That would suggest behavior that is not cost-minimizing, a more serious contradiction of the neo-classical model than the minimum wage literature usually contemplates: but see Reynolds (1965).
the minimum wage and employment accurately reflects the effect of the minimum wage or occurs because the minimum was not binding (at that time) on the particular market being analyzed. This allows negative findings to be dismissed, perhaps too readily.

A more satisfactory approach, pioneered by David Card (Card, 1992a & 1992b), is to test for both wage and employment effects. A positive and significant wage effect assures that the minimum wage to be binding and that the necessary condition for meaningful employment tests is attained. We take advantage of monthly data on wages and employment by two and three digit SIC industries for the United States from Employment, Hours and Earnings (United States Department of Labor) to extend this methodology. We examine the effect of the 11 minimum wage increases between 1967 and 1991 on average wages and employment in 32 low wage and youth industries. A Box-Jenkins forecasting equation is applied to each of the 212 industry/minimum wage increase pairs -- hereafter industry/wage pairs -- and these are tested for a positive and significant relationship between increases in the minimum wage and the average wage. The effect of the minimum wage on employment is then tested on the subset of pairs which pass this wage filter, pairs for which there was positive wage effect. This procedure may be too strict in excluding industries (type I error), because the average wage is a relatively weak measure of the wage consequences of the minimum wage. However, it ensures that the employment tests are limited to a set of industries in which the effect of a minimum wage increase is robust.

The estimated effects of minimum wage increases on the average wage are relatively weak. Only one quarter of our industry/wage pairs, 54 in all, display a positive relationship between the minimum wage and the average wage. Furthermore, despite limiting the employment estimates to the set of industries in which we are assured the minimum wage is binding, there is

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4All of the industries have sufficiently long time series for examination of the minimum wage increases of 1981, 1990 and 1991. Only fifteen are long enough to study increases back through 1974, and only thirteen extend far enough back for analysis of the 1967 and 1968 increases.
little evidence of a strong negative employment effect. Only eight of the employment estimates are negative and significant while an additional six are positive and significant. The mean employment elasticity is negative, in the conventionally accepted range, but this result is an artifact of several large negative outliers. The median is positive, as is the modal interval. Trimming the largest positive and negative outliers results in a mean which is negative but too close to zero to be economically significant. The positive employment effect may be a product of problems in the association of wages and employee quality similar to that described by Akerlof in his Market for Lemons.

These results are in keeping with contemporary research which finds little evidence of consistently negative employment effects. We conclude that there are many markets in which minimum wage increases are not binding. Adjusting for this by limiting tests to those markets in which there is a measurable wage effect, however, does not reveal a strong relationship between increases in the minimum wage and employment loss.

1. **Data: Sources and Preliminary Analysis**

Our research focuses on employment and wages in two groups of industries that should be sensitive to the minimum wage: industries with average wages close to the minimum and industries which employ large numbers of teenager and young adults. The first group, which we refer to as 'Low Wage' industries, consists of 27 three digit SIC industries in which the average hourly wage of production and non-supervisory employees in January 1990 was less than 210% of the new U.S. minimum wage of $3.80 (less than $8). At that time, they had 13,915,000 employees, representing 15.5% of total private employment and included industries such as wooden containers (SIC 244: 43,100 employees in January 1990), hotels and motels (701:

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5Our data source do not provide industry wage distributions; instead we use average hourly wages to proxy the proportion of employees at or near the minimum. We consider this issue further in our discussion of Table I.
1,520,100), department stores (531: 2,221,200), and personal leather goods (317: 15,200). The second group, designated 'Youth' industries, consists of the 5 industries in which at least 30% of the labor force is under age 25 in 1989.6 These industries are leather tanning and finishing (SIC 311: 15,000 employees in January 1990), automotive rentals (751: 171,900), auto repair services (753: 522,200), grocery stores (541: 2,868,800), dairy product stores (545: 22,300), retail apparel stores (560: 1,222,200), and eating and drinking establishments (580: 8,395,000).7 8

Monthly observations on employment and average wages for our industries were taken from the Employment, Earnings and Hours (EEH) series of the United States Bureau of Labor Statistics (BLS) and this data is used throughout the time series analysis. Changes in the definition of industries and the introduction of new industries limited the length of some data series. Nevertheless we were able to examine the increases in the federal minimum wage of 1991, 1990 and 1981 for all of our industries, and were able to go back to the 1967 increase for nearly half of our industries. In all, there are 212 interventions in the Low Wage and Youth industries, where an intervention is an industry/wage pair. Data on the minimum wage are from Ehrenberg and Smith (1987) and Kaufman (1991).9

According to standard theory, the individuals who are at risk from an increase in the minimum wage are those earning less than the new, higher

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6The 1989 ORG files, a compilation of earnings records of the 1989 CPS, have 650,000 observations and include wage data for all employed participants.

7We based our selection of Youth industries on age distributions for 3 digit industries, constructed from the 1989 Out-Going- Rotation file from the BLS. Several industries that satisfy these criteria are not among those analyzed because of insufficiently long time series. For example, automotive rentals (SIC 751) and dairy product stores (SIC 545) both satisfy the youth criterion, but wage data are available only from the mid 1980s.

8The magnitude of employment in eating and drinking establishments relative to the other industries in our sample makes it particularly interesting and we examine the characteristics of this industry in detail at the end of this paper.

9The Consumer Price Index (CPI) and Unemployment Rate (UN) are from the BLS.
minimum when it is increased. If these individuals constitute a large fraction of an industry’s labor force, the employment consequences should be readily detected; if very small, detection may be difficult. The information needed to calculate this fraction is not available from the EEH and so we turn to an alternative data source, the Current Population Survey (CPS) for this estimate. Table 1 presents these for (most of) the industries that we examine in the year prior to the increase.¹⁰

Two patterns are apparent. First, a substantial fraction of employees in these industries earned less than the 'new' minimum wage in the year before the increase. In 1981, for example, this fraction ranged from 8.1% (SIC 239, miscellaneous fabricated textile products) to 78.4% (SIC 56, eating and drinking places); most fall between 9% and 27%. Only 7.3% of the labor force as a whole were bound by the minimum wage in that year. Other years’ data follows a similar pattern. Second, there is a decline in the fraction of employees below the new minimum over time. In the 1970s and early 1980s, eating and drinking establishments had between 68% and 78% of employees below the new minimum. This fraction had fallen to 35% by the 1990 increase and 25% by the 1991 increase. The decline in the fraction of employees below the new minimum is consistent with the declining real value of the minimum wage during the 1980s.¹¹ Despite this decline, most of our industries have a sufficient number of employees ‘bound’ by the minimum wage to produce a detectable effect even for the 1991 most recent increase in the minimum wage.

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¹⁰The May CPS is used for increases prior to 1980, the larger ORG files are used from 1980 on. CPS industry classifications are broader than the SIC system used in the EEH data and some CPS industries aggregate several SIC industries. Table I is limited to industries in which CPS and SIC industries are closely matched. Although the CPS includes all employees, the EEH is limited to production and non-supervisory employees, about 80% of total employment. The fraction of EEH 'employees' below the minimum wage will be larger than that found in the CPS.

¹¹Until 1981, Congress raised the minimum wage when it fell below 40% of the average manufacturing wage. By the time of the March 1990 increase, the minimum wage stood at 31.4% of the manufacturing average; in April 1991 it was 33.6% of that average. The long period in which the minimum wage remained unchanged, combined with market pressures on wages over the intervening nine years, greatly reduced the fraction of employees below the new minimum.
The CPS data can also be used to show that the wage filter methodology provides a conservative test of the conventional theory: if an employment response to the minimum wage exists, it is most likely where there is a response of the mean wage. The relationship between increases in the minimum wage and change in the mean wage is inherently weaker and more difficult to detect than the relationship between the minimum wage and change in total employment, the latter being a marginal effect. The wage filter limits the tests to industries with large wage effects and it is those very industries in which the largest employment effects are expected.

Consider the effect of the 1990 increase in the minimum wage on the average wage in hardware stores. The average wage for hardware store employees two months before the increase in the wage was $6.65 and Table I indicates that 11.7% of the employees in this industry were 'bound' by the increase. Suppose that the average wage for 'bound' employees was the mid-point between the old and new minimum, $3.58; this would imply an average wage for unbound employees of $7.06. If these employees are all 'sacked', the mean wage rises 6% to $7.06, half the magnitude of the reduction in employment. If instead, the only consequence of the increase is to raise the wages of the bound employees to the new minimum, the mean wage rises by three cents to $6.68 per hour, an increase of less than 0.5%.

Similar results are obtained for other industry/wage pairs under the same assumptions. When all employees are sacked a natural measure of the relative wage and employment effect is the ratio of the elasticity of the mean wage with respect to the minimum wage to the elasticity of employment with respect to the minimum wage. A ratio with an absolute value less than one means that the response of the mean wage is less than the marginal employment response. The top graph in figure 1 illustrates this using a box

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12If we instead assume that all 'bound' employees are making the old minimum wage before the increase, the average of all other employees beforehand is $7.09 instead of $7.06. If all 'bound' employees are not laid off but receive raises to the new minimum, the average wage rises not to $6.68 but to $6.70, which is what actually occurred.
The outside values, designated by asterisks, result from the treatment of eating and drinking establishments under the minimum wage laws. It is not a sufficient condition since the minimum wage may shift an industry's entire wage structure (see Grossman 1983), resulting in a large mean wage effect without any loss in employment. The mean wage can conceivably not rise when bound employees are laid off, if wages of other employees are cut, but there is no reason for thinking that this is anything other than a logical possibility only.

We cannot use this ratio to assess the case in which no employees are sacked, so we evaluate the change in the mean wage associated with all bound employees wages being increased to the new minimum wage. The bottom box and whiskers diagram indicates just how small this effect is. The median effect is less than 1%; there would be less than a 1.5% increase in the mean wage for 75% of the industry/wage pairs; even in the most extreme instance the increase in the mean is less than 5%.

This exercise illustrates two points. First, when all bound employees lose their jobs following a minimum wage increase, the employment elasticity is roughly twice as large as the mean wage elasticity. Second, a large mean wage effect is a necessary condition for an employment effect; when there is no employment effect, the mean wage effect is very small. That suggests that focusing our search for employment effects to situations in which there are mean wage effects is indeed a profitable strategy. As a statistical matter, however, will we be able to detect either effect with these data?

Let us consider hardware stores once again, looking now at the EEH data. From 1972-1991, the mean month-to-month change in the average wage is 0.43%, with a standard deviation of 0.9%. At 0.5%, the increase when no workers are laid off is likely to be statistically undetectable. For a 5% 1-

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13 The outside values, designated by asterisks, result from the treatment of eating and drinking establishments under the minimum wage laws.

14 It is not a sufficient condition since the minimum wage may shift an industry's entire wage structure (see Grossman 1983), resulting in a large mean wage effect without any loss in employment. The mean wage can conceivably not rise when bound employees are laid off, if wages of other employees are cut, but there is no reason for thinking that this is anything other than a logical possibility only.
sided test to be able to detect an increase due to the minimum wage, the average wage would have to rise by at least 1.9%, to $6.78. This in turn would require that at least 3.3% of employees (out of the 11.7% of bound employees) lose their jobs, while 8.4% would get a raise to $3.80. The mean month-to-month change in employment is 0.1%, with a standard deviation of 1.6%. A 5% 2-sided test would easily detect a change in employment of this magnitude following the minimum wage increase. If we can statistically detect a rise in the mean wage due to the minimum wage increase, and if it is due to laying off as little as one-third of the ‘bound’ employees, the decline in employment should be detectable.

2. Econometric Framework

Our analysis uses a forecasting approach to estimating the effect of minimum wage ‘interventions’. This has several advantages: the application of forecasting equations to estimate interventions is well established; use of relatively short time periods avoids the assumption of structural stability common to time series research on this topic; issues of structural modeling, which have proven controversial in this literature, are also sidestepped.15

The Box-Jenkins methodology presumes that both employment and the average wage are serially correlated within each industry, and exploits this in constructing a forecasting models. Hence the lagged wages are included in the wage equation, lagged employment in the employment equation. Many prior studies of employment suggest that macroeconomic conditions (the unemployment and inflation rates, and a dummy for whether the economy is in recession) contain additional information that improves the forecasts and these are included in the model (see Brown et al.) We use relatively short sample

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15While a structural model would use available information more efficiently, part of the current controversy revolves around the specification and measurement of the variables in structural equations (Card, Katz and Kreuger, 1994). Much as reduced form equations, a forecasting model avoids such disputes.
periods, nine years, but monthly data provide an ample number of observations, at least 100 per estimate.

When the wage is not integrated, the estimated equation has the following form:\textsuperscript{16}

\begin{equation}
W_t = \sum_{s=1}^{12} a_{ts} W_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + d_{t} \Delta MW_{t-s} + e_{t} \Delta MW_{t} + f_{t} BC + g_{t} t + C + \epsilon
\end{equation}

where \( W_t \) is the average wage in a SIC industry; \( CPI \) is the consumer price index; and \( UN \) is the unemployment rate; \( MW_y \) and \( MW_x \) are two minimum wage variables; all of these variables are in logs, and subscripts indicate lags in months.\textsuperscript{17} In addition, \( BC \) is a dummy variable equal to one during months that the NBER has identified as periods of recession; \( t \) is a linear time trend, \( C \) is a constant term, and \( \epsilon \) is an error term. The delta, \( \Delta \), indicates

\textsuperscript{16}In keeping with contemporary time series techniques, we conduct tests for trend stationarity, unit roots and cointegration in each of our 212 samples. The logarithms of the CPI, the unemployment rate and the minimum wage all display unit roots, so we test for cointegration between these variables and the dependent variable when it has a unit root.

A Granger causal relation runs from the Consumer Price Index (CPI) to the minimum wage, but not from the minimum wage to the CPI, for both the full sample period and for all but two of the nine year subsamples. There is no evidence of Granger causation in either direction between the Unemployment Rate (UN) and the minimum wage in the full sample or in any sub samples. The inclusion of inflation in the equation avoids confusing the impact of inflation with that of the minimum wage, without masking minimum wage effects.

\textsuperscript{17}For the average wage, the number of degrees of freedom varies from 66 to 73 degrees of freedom. Five of the average wage series are cointegrated with the RHS variables: SIC 554, Gasoline Service Stations; SIC 302, Rubber and Plastic Footwear; SIC 594, Miscellaneous Shopping Goods; SIC 805, Nursing Facilities, and SIC 553, Auto and Home Supply Stores.

For employment, the number of degrees of freedom for the unrestricted regression varies from 45 to 59, depending on the sample period, the industry, and the results of the AWS and cointegration tests. Three of the employment series are cointegrated with the CPI and nominal minimum wage: SIC 244, Wood Containers; SIC 316, Hotels and Motels; and SIC 239, Miscellaneous Fabric and Textile Manufactures. The restricted regressions have 9 to 13 more degrees of freedom.

1990 has a large number of degrees of freedom because no increases in the Federal minimum wage occurred during the preceding 8 years, so the \( d \) coefficients are set to zero. 1981 has a slightly smaller number of degrees of freedom for industries that have a unit root and/or begin in 1972. One more degree of freedom is lost whenever either a trend term is needed to stabilize any variable, or employment is cointegrated with any of the other variables.
first differences to remove unit roots. When the wage is integrated but not cointegrated with any of the other variables, the equation is:

$$\Delta W_t = \sum_{s=1}^{12} a_{ts} \Delta W_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + d_t \Delta MWx_t + e_t \Delta MWy_t + f_t BC + C + \epsilon_t$$

Finally, when it is cointegrated with other variables in the regression, it becomes:

$$\Delta W_t = \sum_{s=1}^{12} a_{ts} \Delta W_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + d_t \Delta MWx_t + e_t \Delta MWy_t + f_t BC + h_t ECM_{Wt-1} + \epsilon_t$$

where ECM_{Wt-1} is the lagged error correction mechanism, the residual from the cointegrating equation of the Wage on the RHS variables with which it is cointegrated. The corresponding equations for employment are:

$$N_t = \sum_{s=1}^{12} a_{ts} N_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + \sum_{s=0}^{11} d_{ts} \Delta MWx_{t-s} + \sum_{s=0}^{11} e_{ts} \Delta MWy_{t-s} + f_t BC + g_t + \epsilon_t$$

$$\Delta N_t = \sum_{s=1}^{12} a_{ts} \Delta N_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + \sum_{s=0}^{11} d_{ts} \Delta MWx_{t-s} + \sum_{s=0}^{11} e_{ts} \Delta MWy_{t-s} + f_t BC + \epsilon_t$$

and

$$\Delta N_t = \sum_{s=1}^{12} a_{ts} \Delta N_{t-s} + \sum_{s=1}^{12} b_{ts} \Delta CPI_{t-s} + \sum_{s=1}^{12} c_{ts} \Delta Un_{t-s} + \sum_{s=0}^{11} d_{ts} \Delta MWx_{t-s} + \sum_{s=0}^{11} e_{ts} \Delta MWy_{t-s} + f_t BC + h_t ECM_{Nt}$$

where N is employment in an industry. The sample period is 8 years prior and one year after “the current increase,” the specific increase in the minimum wage under study.

Following our testing sequence, we turn first to equation 1, the wage equation. We are interested in measuring the effect of the increase in minimum wage, the minimum wage intervention, which always occurs one year prior to the end of our sample period. Measurement is complicated because until the 1991 increase, more than one increase had occurred in each nine
year period, and there is no reason to expect their effects to be comparable. We resolve this problem by having rolling samples, each ending a year after a minimum wage increase, and including two minimum wage measures. MWy is the nominal minimum wage for the full sample period, while MWx is the nominal minimum for the first 8 years. MWx does not incorporate the last minimum wage increase in the sample, remaining at the last value of the minimum wage prior to the intervention being studied.\(^\text{18}\) Conditional on inclusion of MWx, the coefficient on MWy measures only the effect of the last increase in the minimum wage.\(^\text{19}\)

Most variables are entered with twelve month lags, but this is not the case for the minimum wage variables, MWx and MWy. Rather, these variables are contemporaneous with the industry average wage. This reflects the mandatory nature of increases in the minimum wage and the scheduling of the increase, which has occurred during the week prior to the collection of data for the EEH since 1957 as well as the nature of the industries and labor markets under study.\(^\text{20}\) As firms are required to pay the minimum wage, the industry average wage will immediately incorporate the increase in the minimum wage and the changes will be contemporaneous in monthly data. The casual nature of the employment relationship, the low level of capitalization and utilization of technology and the low training requirements in these industries also suggest that wage consequences of an increase in the minimum wage will be entirely contemporaneous. There is little point in raising the wage prior to the mandatory increase in labor markets with high turnover and low skill requirements. Similarly, the limited capitalization, the off-the-shelf nature of the technologies used in these industries, and the brief

\(^{18}\)MWx is not included in the equation that studies the 1990 increase since no change occurred in the previous eight years.

\(^{19}\)Splitting the minimum wage variable controls for increases in the minimum occurring prior to the increase under examination, and allows us to interpret the sum of the coefficients $e_i$ as the minimum wage elasticity of employment (in this industry at the time of the change in the minimum wage).

\(^{20}\)Minimum wage increases have taken place on the first or third of the month since March 1956: before then, the last week of the month was the practice.
training required to master the jobs also suggest that little or no time would be required to adjust to the new minimum wage.

Finally, the nominal minimum wage is used as a proxy for its real value for three reasons. One, the appropriate deflator would be an industry specific index of production prices, but these are seldom available before the 1980s. Two, the combination of the logarithms of the nominal wage and the CPI approximates the real minimum wage. Three, during the period under study, the real minimum wage rises only when the nominal minimum rises, and this specification captures such increases.21

Our measure of the response of average wages to increases in the minimum wage is $e$, the coefficient on MW$y$. The wage filter consists of a 1-sided t-test, at a 5% significance level, that $e$ is positive. We use industry/wage pairs that pass this test to identify instances where the minimum wage did indeed bite.

The next step is to estimate the employment equation, equation (2), on this subset of industries and periods. This equation differs from the wage equation in that lags on the minimum wage variables are also included to allow for convex adjustment costs of employment within firms. Again the timing of the increases and the reference period for the data suggest the use of lags zero through eleven rather than one through 12, as with the other variables.22

Our interest in the wage equation (equation 1) is limited to whether it is possible to detect a positive and significant effect of the minimum wage on the average wage. Equation (2) allows us to examine the employment effect of the minimum wage in two different ways. A pure time series approach with no explicit economic content is to test for Granger causality running from MW$y$ to employment. This involves an F-test of the $\{e_i\}$ coefficients and the

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21This may not be the case were industry specific prices used.

22The twelve month lag used in this research is consistent with the literature. Most studies find that employment adjustments are completed within four quarters (Hamermesh, 1993), Neumark and Wascher (1992) also use a one year adjustment period.
error correction term, where included, and is essentially a test of whether information about this minimum wage increase improves employment forecasts.

A significant Granger test can result from either a positive or negative employment response to the minimum wage. According to the neo-classical model, the employment effect is strictly negative. We calculate the elasticity of employment with respect to the minimum wage for each industry and minimum wage pair as the sum of the e coefficients, $\sum_{s=0}^{-1} e_s$, and use an asymptotic t-test to determine its sign and significance.

3. The Wage-Effect Filter

We turn first to the wage estimates. Results for the 212 wage tests are reported in Table II; Figures 2 & 3 summarize information about the p-values and distributions of elasticities from the wage test. We turn first to the figures. Figure 2 displays distributions of p-values for the test $H_0: e = 0$ vs. $H_1: e > 0$: where e is the coefficient on the contemporaneous minimum wage variable in equation 1. On the right of the upper figure is the Null Distribution, the large sample distribution of p-values when the null hypothesis is correct. The ‘boxes’ for both the Low Wage and Youth estimates are clearly shifted downward, in a direction consistent with rejecting the null of no effect. The median values for these industries both fall at or below a p-value of .25, when they should be at a p-value near 0.5 to be consistent with the null. For both, the first quartile is quite low, at or below 0.05. The third quartiles are less than the median of the null distribution for both sets of industries.

The distribution graph below plots this same information with the 45 degree line playing the role of the Null Distribution in the box plot. Again, the frequency of low p-values, those which allows us to reject the null, is substantially above that which would be expected if the null hypothesis held. Further, the results are not the outcome of a few outliers, which would produce spikes above the 45 degree line. Rather, it appears that
the population as a whole is shifted in a direction consistent with the alternative hypothesis.

Estimates of the elasticity of the mean wage with respect to the minimum wage are also of interest and these are provided in Figure 3. The two diagrams on the left of the page display the full distribution for Low Wage (top) and Youth (bottom) industries; the two on the right separate the estimates according to their statistical significance. The mean elasticity for Low Wage Industries is 0.113 (SE: 0.020) with a median elasticity of 0.0969. For Youth Industries the mean and median are 0.0666 (SE: 0.0182) and 0.0637 respectively.

As the graphs illustrate and the mean and median confirm, the weight of these distributions lies above zero. It is useful to separate the statistically significant and non-significant elasticities, provided in the right hand graphs in the figure. It is no surprise to find that in each set of industries, the statistically significant estimates tend to be larger than the insignificant ones. However, the considerable overlap between statistically significant and insignificant estimates in the box-plots make clear that it is not merely the largest point estimates, the upper tail, which are statistically significant. The overall distribution of the Youth industries is clearly bimodal; i.e., there are two distinct groups of events here. The distribution in the Low Wage industries is less obvious. Nevertheless, when the statistically significant and insignificant estimates are merged together, the distribution displays a prominent positive bulge, due primarily to the statistically significant estimates.

Turning to our wage filter, we assess the estimated wage elasticity against a null of a zero or negative effect using a 10% significance test. Although the analysis in Figures 2 & 3 suggests a considerable wage effect in most industries, only 54 out of 212 tests, one in four, meet the conventional criteria. As suggested at the start of this section, such criteria may be

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Outside values, points more than one and half times the inter-quartile range away from the first and third quartile, are not shown to allow larger scale.
too rigorous a standard for an average wage measure, but it has the advantage of limiting the employment estimates to markets in which there is no question about the wage effect. We now turn to tests of the employment effect when the minimum wage clearly bites.

4. The Employment Impact When the Minimum Wage Bites

Estimates of our 54 employment elasticities may be found in Table 3 and these are depicted in the bottom of Figure 4. The typical estimated elasticity is not significantly different from zero in either a one or two tailed test but estimates are widely dispersed, ranging from -14.3 to 6.75. Weighted averages for each year, with statistically insignificant estimates set to zero, are at the bottom of the table. They range from -2.37 to 2.14; 5 years have positive averages, and 6 have negative ones. There are a number of industry/wage pairs which are large and negative and several which are large and positive. The result, depicted in the lower right of Figure 4, is a distribution which is centered on zero with a large variance and a negative skew. This skewness is reflected in the measures of central tendency. The mean estimate is -0.29, within the range that Brown, Gilroy and Cohen proposed; this is the only support for the standard hypothesis. Measures of central tendency can be sensitive to large outliers. That this is the case here is clear from both the median, 0.05 and the 10% trimmed mean employment elasticity, -0.009, both well above the commonly accepted range. The modal effect falls between 0 and 0.7, also substantially above the range proposed by Brown, Gilroy and Cohen.24

The significance of the employment effect for these 54 events are judged by two tests: first, a Granger test of whether addition of the contemporaneous minimum wage variable improves the fit of the forecasting equation; and second, a one sided t-test of the sum of the minimum wage

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24Finally, there is little evidence of a pattern of effects by industry or year; there is some clustering of negative and significant outcomes in 1981 and in the family clothing (SIC 565) and drug stores (SIC 591), but such clustering is sparse and likely due to chance.
elasticities to determine if they are, as expected, negative. The Granger tests provide little evidence that the minimum wage affects employment. As shown in the box plot and p-value frequency distribution in the top of Figure 4, the Granger test is virtually identical to what would be expected if the null hypothesis of no effect were true. The Box plot for the Granger lies slightly above that for the Null Distribution, the p-value line for the Granger is somewhat above the 45 degree line in the lower corner of the distribution graph, but then follows that line very closely.

Results from the one sided Sum of Lags test are similar. Few of the tests are negative and statistically significant at a 5% level, eight out of 54. As indicated by the box plot, the distribution of p values is more dispersed than the null but otherwise similar. The distribution of one sided p-values has a heavy left hand tail, but then follows and falls below the 45 degree line. The dispersion of the estimates is more apparent in two tailed tests of the significance of the Sum of Lags. The number of negative and significant tests remains the same, eight, but there are six positive and significant tests (in a 10%, 2-sided test). The box plot of the p-values lies below that for a null distribution. Similarly, the plot of the distribution of p-values lies above the 45 degree line. Both are consistent with a distribution which is centered on zero but which is more widely dispersed than the null distribution.

The dispersion of the estimates is not entirely surprising. Disaggregated data are likely to show greater variance and these industry data are considerably more disaggregated than the data on teens and young workers typically used in time series analysis. The results suggest that there are instances in which increases in the minimum wage can have a large negative effect on employment, as well as instances in which it appears to have large positive effects. The relatively small number of significant results, and the apparent randomness and dispersion of significant results does not point toward any simple rule for when increases in the minimum might be expected to have a negative effect on employment.
To this point, all industries have been treated as equals. But the national consequences of increases in the minimum wage will be felt more profoundly if they occur in industries with high levels of employment than if they occur in smaller industries. Consider Eating and Drinking Establishments (SIC 58) the largest industry in our sample with 8.4 million employees in 1990. This industry is also important because it has the large percentage of employees bound by the new minimum wage for every year in the sample period (see Table I). Even in the 1990s, when the decline in the minimum wage reduced the fraction bound by the new minimum throughout the economy, 35.2% of employees were bound by the 1990 increase and 25.4% were bound by the 1991 increase.25 A higher fraction of the wage elasticities are positive and significant in industry 58 than for the sample as a whole. Six of nine tests are significant, 66% against 25.5% for the sample. Employment is no more sensitive to increases in the minimum in Eating and Drinking Establishments than it is in the full sample. Only one test -- 17% of the events -- is negative and significant; fifteen percent of the tests across all industries is significant. Although this industry does not display the significant positive effects found in other industries, the small evidence of employment effects in this important industry reinforces our overall results. A similar pattern can be found for other large industries. For example, our estimates show a significant positive wage elasticity in 45.5% of tests for Department Stores (employment of 2.2 million) but only one in five employment elasticities is significant. Retail apparel, with employment of 1.2 million, is similar to this with regard to overall outcomes but has a large positive employment elasticity in 1976.

To summarize, the estimated effect of the minimum wage on employment is notably weak. This sample is defined by the presence of a positive and

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25 The large proportion bound is due to the treatment of tipped employees under the minimum wage law. Employers are only required to pay half of the statutory minimum wage so long as employees tip income brings their earnings up to the minimum wage. The large proportion of tipped employees in this industry appears to hold average hourly earnings down to a level only slightly above the statutory minimum.
statistically significant minimum wage bite. Despite this filtering, fewer than three-tenths of the estimated employment effects are statistically significant, and barely one-seventh are negative and significant (at a 10% level). Given the nature of the sample, these results are not sufficiently strong to support the hypothesis that increases in the minimum wage will typically cause employment to decline.

5. Conclusions

A necessary condition for the minimum wage to influence employment is that it be binding on at least some employees in an industry. Most research on the minimum wage has selected groups subject to the minimum wage using a priori criteria.

This research uses an approach that allows us to test the theory more precisely. Looking at minimum wage interventions in 34 industries in the United States between 1967 and 1991, we first test to determine whether increases in the minimum wage have resulted in a detectable effect on the average wage of an industry. We then limit our study of employment effects to those industries in which there was a statistically significant and positive effect on the average wage. Although a test of the average wage may be too rigorous, and may exclude some instances in which minimum wage increases were binding on employees in the industry, it assures that there is a substantial wage effect in those industries which 'pass' the wage filter.

The wage filter equations indicate that minimum wage increases are often not binding. The industries selected for this study, industries at the bottom of the industry wage distribution or industries with large numbers of young employees, should have been quite sensitive to the effects of the minimum wage. Despite this, only 54 out of 212 industries demonstrated significant positive relationships between the minimum wage and the industry average wage. This suggests that the lack of a relationship between the minimum wage and employment found in many contemporary studies might be a result of a minimum wage which was not binding. Perhaps the lack of results
was because researchers were looking at the wrong markets, or mixing markets in which the minimum wage mattered with many others in which it did not.

Results from our employment equations do not support this view. A majority of our employment estimates are not statistically significant. Those which are, are fairly evenly distributed between positive and negative effects, a description that also fits the set of average elasticities for each increase, weighted by employment in the industries that pass the wage filter.\(^{26}\) Although the median employment elasticity fits the conventional view, and the mean, if anything, goes beyond that, the figure is an artifact of several unusually large and suspect estimates. Elimination of these extreme estimates resulted in a mean very close to zero. The dispersion of estimates, whether by year or by industry, does not support any simple reconciliation of the results with the standard view of the effect of the minimum wage on employment. Scatterplots of the wage and employment elasticities provided in figure 5, reveal no prominent patterns in the estimates.\(^{27}\) These results are not substantially altered if we move from

\(^{26}\)Statistically insignificant point estimates of the employment elasticity are set to zero for this calculation.

\(^{27}\)The scatterplots in figure 5 make this especially clear. For observations with a statistically significant and positive elasticity of the average wage with respect to the minimum wage, both graphs show this elasticity and the corresponding employment elasticity. The upper plot shows short run elasticities for both variables; observations with a statistically significant employment elasticity, with an “x” in the middle of the circle, appear darker. Except for eight observations, all form a shapeless nebula, with no discernable internal pattern. Of those eight, 3 have positive and statistically significant employment elasticities, and lie largely above the nebula. Two have statistically significant and unusually large, negative employment elasticities. These two, and one of the previously mentioned three observations have 3 of the six largest wage elasticities. But the three observations with far and away the largest wage elasticities do not have statistically significant employment elasticities.

The second scatterplot is the same graph, except using long run rather than short run elasticities. It should not be surprising that far fewer industry/wage pairs show evidence of statistically significant wage effects, only 14, nor that both types of elasticity are much smaller (compare the scales of the axes in the two graphs), nor that only one of the observations that passes this version of the wage filter has a corresponding employment elasticity that is statistically significant. During this period, inflation reduces the real minimum wage over time. The average wage elasticity for the observations with statistically insignificant employment elasticities exceeds that of the one observation with a statistically significant employment
treating all industries as equals and place more weight on results from industries with more employment. Results for industries accounting for the majority of employment in our sample are similar to those of the sample as a whole except in there being a greater likelihood of a positive wage elasticity.

The large and statistically significant positive employment effects are puzzling, especially for industries in which we have already found similar wage effects. In response to similar findings that Card and Krueger reported, Finis Welch skeptically suggested that they were trying to repeal the law of demand.28 An explanation of this finding would increase its credibility and perhaps lower the level of acrimony surrounding this issue.

The law of demand contains an important qualification, one that is quite common in economic analysis: to wit, ceteris paribus. What sorts of things might not be equal? And why? Begin with the second question. It is plausible that Akerlof’s (1970) model of the Market for Lemons aptly characterizes some labor markets, especially low wage and youth labor markets. When the average wage is low, potential suppliers of high quality labor choose not to work. Increases in the minimum wage raise the average wage, and by attracting higher quality labor into the market, make it profitable for firms to increase employment.

Why would firms wait for an increase in the minimum wage to hire high quality labor? Why not try to attract it through higher wages? That is the strategy that banks follow in models of credit rationing.29 Instead of raising interest rates to clear the market, banks are thought to keep them low to attract higher quality borrowers. Of course, they attract more borrowers of all quality, and have to screen them carefully; but at the lower elasticity, due to the three observations with the largest wage elasticities.

28Comments at the AEI symposium on the minimum wage, June 1, 1995.
interest rates, the average quality is higher, and the screening costs can be amortized over what is hoped to be a long term relationship.

Certainly in many labor markets, higher compensation is used to attract higher quality candidates, and screening (and the associated costs) are important, as are long term relationships. This is not the case in low wage and youth industries, where turnover is typically high. In a high turnover industry, raising wages is not an efficient way to improve average quality of potential employees because the screening costs would have to be repeated too frequently and could not be amortized over a long period.

Furthermore, information networks among workers already within an industry are likely to be more efficient than among those who are outside of it or entirely outside of the labor force. If a single firm were to raise its wage offer, most of those who would hear about it would be those already in the industry, presumably the suppliers of lower quality labor that the firm hopes to avoid. In contrast, increases in the minimum wage are well publicized, and if they draw higher quality workers into the labor force, would be much more effective toward this goal.

It is not our claim that increases in the minimum wage could not have an adverse impact on employment. We are limited to an analysis of the historical experience with the minimum wage in the United States and this experience has been one of moderate increases. Movement outside of this experience, a doubling of the minimum wage, might well have an employment effect. However, our research supports the view that the moderate increases in the minimum wage which have been acceptable to the political processes of the United States do not affect employment in a consistent and systematic fashion. Judging by the acrimony of recent debates about the minimum wage, it strikes us that the minimum wage’s bark has been worse than its bite.
References


Employment Elasticity of Average Wage
When all "at Risk" Workers are Sacked

Percentage Increase in Average Wage
When all "at Risk" Workers are Increased to new Minimum Wage
Distribution of p-values

H0: Minimum Wage Increase did not Affect Industry Average Wage
H1: Minimum Wage Increase Raised Industry Average Wage

Figure 2
The Wage-Effect Filter
Distribution of Estimated Minimum Wage Elasticities of Average Wage

Figure 3

Distribution of Minimum Wage Elasticity of Average Wage
Low Wage Industries

Distribution of Minimum Wage Elasticity of Average Wage
Youth Industries

Solid - Statistically Significant
Dashed - Statistically Insignificant
Figure 4

Employment Effects When Wage Effect is Detected

Distribution of p-values for Granger & Sum of Lags Tests
for Employment when Wage Effect is Detected

Trimmed Distribution of Minimum Wage Elasticity
for Employment when Wage Effect is Detected

Distribution of Minimum Wage Elasticity
for Employment when Wage Effect is Detected
Figure 5

Short Run Minimum Wage Elasticities

Long Run Minimum Wage Elasticities
## Table 1
### Percentage of Employees Earning Less Than the New Minimum Wage

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**YOUTH INDUSTRIES: by SIC**

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m - missing  
* - change in definition  
na - not a distinct category in earlier CPS system  
s - very small sample size
### TABLE 2

**Statistically Significant Wage Elasticities**

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Estimates of $e_1$ in equation 1 (1a, 1b or 1c), when significant at a 5% level:

- **$H_0$: Minimum Wage Increase had no effect on the Industry Average Wage**
- **$H_1$: Minimum Wage Increased the Industry Average Wage**

Legend: **bold** - significant at 1% level
. - not significant at 5% level

<table>
<thead>
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<th># events</th>
<th>a</th>
<th>b</th>
<th>Total</th>
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<td>Total</td>
<td>212</td>
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Table 3

**Employment Elasticity of the Minimum Wage When a Positive Wage Effect is Detected**

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<tr>
<th>Year</th>
<th>Low Wage Industries</th>
<th>Youth Industries</th>
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<tr>
<td></td>
<td>91 90 81 80 79 78 76 75 74 68 67</td>
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<tr>
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<td>533 2.48 2.81 -0.46 0.28 3.76&lt;sup&gt;a&lt;/sup&gt;</td>
<td>56 0.11 -0.09 -0.47 -0.91 -1.33&lt;sup&gt;c&lt;/sup&gt;</td>
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<tr>
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<td>562 0.55 0.31 4.73&lt;sup&gt;a&lt;/sup&gt;</td>
<td>58 0.11 -0.09 -0.47 -1.86&lt;sup&gt;a&lt;/sup&gt; -0.29</td>
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<td>225 1.47 0.33 0.44 0.61</td>
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<tr>
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<td>835 3.20&lt;sup&gt;a&lt;/sup&gt;</td>
<td>561 -0.75 1.49</td>
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<td>565</td>
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<td>-1.43&lt;sup&gt;c&lt;/sup&gt;</td>
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<td>1.47 0.33 0.44 0.61</td>
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<tr>
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<td>561</td>
<td>-0.75 1.49</td>
</tr>
</tbody>
</table>

**Average:**

| | 0.22 0.51 -2.37 -0.68 0.26 -0.19 2.14 -0.38 0.29 -0.79 -1.86 |

(weighted)

<sup>a</sup>: significant at 0.01 level (2 sided)
<sup>b</sup>: significant at 0.05 level (2 sided)
<sup>c</sup>: significant at 0.10 level (2 sided)

<table>
<thead>
<tr>
<th># events</th>
<th>total</th>
<th>a-</th>
<th>b-</th>
<th>c-</th>
<th>total +</th>
<th>a+</th>
<th>c+</th>
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<tr>
<td>Total</td>
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<td>8</td>
<td>6</td>
<td>1</td>
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</tr>
</tbody>
</table>

Youth Industries

Average: 0.22 0.51 -2.37 -0.68 0.26 -0.19 2.14 -0.38 0.29 -0.79 -1.86 (weighted)

a: significant at 0.01 level (2 sided)
b: significant at 0.05 level (2 sided)
c: significant at 0.10 level (2 sided)