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Minimum Wages and Job Search: What Do Employment Effects Really Measure?

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Executive Summary

In this study, Drs. Peter Arcidiacono and Thomas Ahn investigate claims of positive employment effects resulting from a minimum wage. The study first highlights the multitude of reasons why, under the classical economic model—the widely accepted model of economic behavior—an increase in the minimum wage cannot lead to an increase in employment. Then, by relaxing certain assumptions critical to the classical model, a search model is constructed. This model—which runs contrary to commonly accepted economic theory—is created to study a hypothetical situation of positive employment effects from a minimum wage increase? *Even in this case,* the authors show that those individuals who most value minimum wage jobs—current employees—end up with *a higher probability of being unemployed* after a minimum wage increase. In fact, all increases in the minimum wage under this model result in decreased employment prospects for individuals.

The authors conclude that the overall employment level does not fully describe the negative effects resulting from a minimum wage increase? **Instead, this antipoverty policy should be judged by its effect on the group it is attempting to help—current minimum wage employees.** Examining the distributional employment results reveals that minimum wage increases decrease employment opportunities for current employees—the very individuals these policies are attempting to help. This decreased probability of employment is a result of increased labor force participation by teenagers from wealthy families.

> "Those individuals who most value minimum wage jobs—current employees—end up with *a higher probability of being unemployed* after a minimum wage increase."

Competitive Labor Market

Recent studies suggesting a lack of employment loss—or even more unbelievably, an increase in employment—after a minimum wage increase generated significant criticism from the academic community. A vast amount of this criticism stems from the failure of studies' authors—most prominently Drs. David Card and Alan Krueger—to advance any rigorous theory explaining their results.

Arcidiacono and Ahn establish that in the competitive economic model, raising the mandated wage level cannot result in an increase in employment. Decades of economic research and theory show that these increases result in fewer employment opportunities for affected individuals. Increasing the minimum wage will only result in those employees with the lowest reservation wages—the least skilled—facing increased difficulties securing and retaining employment.

Search Model

Economists claiming positive employment results from a minimum wage hike suggest the labor market may be best described as a monopsony—a market with one buyer and many sellers. Most economists, however, dismiss these claims because the requirement of a captive labor market is difficult to achieve in an era with a high degree of firm and labor mobility.

Arcidiacono and Ahn avoid monopsony arguments and construct a search model in which employment is determined by the number of successful matches between employers and applicants. While this does not require a captive labor market, it does require violating many critical assumptions of the classical model. **The authors do not state that they believe the labor market is best represented by this search model but, rather, construct the model as a means to examine the distributional results of a hypothetical situation of no employment loss after a minimum wage increase.**

The key difference between the search model and the classical model is that in the search model, employment level is not determined solely by labor demand (the number of searching firms) but also by labor supply (the number of applicants). Under the competitive model, the number of employees seeking employment does not affect the number hired if the wage floor is above the equilibrium price. Instead, labor demand is expected to be less than labor supply, and the resulting surplus represents unemployment from the wage floor. If labor demand is not the sole determinant of the employment level (i.e., labor supply influences total employment), it is possible to imagine a situation in which a minimum wage hike does not result in decreased employment. As the number of employees searching for jobs increases in response to a minimum wage increase, it could overcome the number of firms no longer interested in employment at the higher wage, resulting in an increased number of successful matches. It is important to note, however, that in all the situations described by this model—even those in which overall employment increases—**an increase in the minimum wage must result in a decreased probability of an individual finding a job.**

Employment Level or Distribution—Which Is The Best Measure?

What happens to current minimum wage employees under this hypothetical scenario? These often low-skilled employees are left with decreased employment opportunities. The authors found that "the effect of an increase in the minimum wage may appear to have little effect on the employment prospects of low-income workers if one only looks at employment levels. However, as our search model shows, the employment levels may be masking much larger changes in the probability of finding a job." If this is the case, the overall employment level is an incomplete gauge of the damage caused by a minimum wage hike.

Why might these underlying unemployment rates change while overall employment does not? Previous economic research suggests that as the mandated wage level rises, current low-skilled minimum wage recipients face increased competition from more experienced and skilled applicants attracted to the new wage. As a result, the very individuals minimum wage hikes are intended to help—those with the lowest wages and skill levels—are the individuals most hurt by these policies.

The employment level becomes an ineffective indicator because even "if the number of searching workers increases as a result of an increase in the minimum wage, the expected loss in employment understates the loss of any one individual obtaining a job." A higher minimum wage will mean little to current employees unable to secure continued employment. To fully understand the impact of an increase minimum wage, it is clear that one must examine both the overall employment level and the distributional impact.

What Are the Distributional Effects?

The study found that a 10 percent increase in the minimum wage causes a 2.9 percent decrease in the probability of employment for job searchers. Put into perspective, the recently proposed federal minimum wage increase to $7.00 would result in a 10 percent decrease in the probability of finding a job. As a result, those individuals who most want minimum wage jobs—current minimum wage employees—are less likely to retain employment after the wage increase.

If the point of raising the minimum wage is to improve the living conditions of current low-wage employees, changes in the employment level are an inappropriate measure. The authors show that increased unemployment is focused on low-skilled and low-income employees who must compete with wealthier and more skilled entrants to the labor force. When searching for jobs, individuals from "high-income, highly educated, two parent families are more likely to actually find a job" than the average searcher, who is more likely to come from a low-income family with low parental education. Policymakers must examine these differing unemployment rates before casting judgment on a wage increase.

Who Benefits from a Minimum Wage Hike

Current low-wage workers—the intended beneficiaries of a minimum wage increase—are those who are most hurt by raising the mandated wage. This alone should caution policymakers. Even more troubling, the authors found that these low-skilled workers are displaced by wealthy teens who did not even participate in the labor force at the lower minimum wage. While there is nothing wrong with wealthy teens entering the labor market, one must question the efficacy and equity of a policy that takes jobs from current low-skilled employees and gives them to wealthy teens with marginal labor force attachment.

The authors utilize 12 years of Current Population Survey (CPS) data to examine who actually benefits from an increased minimum wage. The authors find that raising the minimum wage causes teenagers, particularly teenagers from wealthy families, to increase labor force participation. These individuals have higher reservation wages—due to both supplemental income and greater returns from education—causing them to enter the labor force at the new wage while they were content not to work at the previous wage. As a result, current employees "are hurt by a minimum wage increase as they are now competing with teenagers from wealthier families." These wealthy teenagers are more likely to secure a job, decreasing employment opportunities for current minimum wage employees.

Conclusion

While much has been said recently about a small number of largely discredited studies showing no decrease in employment from a minimum wage increase, this paper clearly

shows that these increases are not without cost. Even if the improbable circumstance described in these studies were to occur, significant and harmful changes in the employment rates of different subgroups make an increased minimum wage destructive to incumbent workers. Examining the distributional employment effects reveals that increases in the minimum wage harm the employment prospects of entry-level employees. **In many cases, low-skilled employees pay for the increase with their jobs.** Who really benefits from these increases? CPS data reveal that the beneficiaries are wealthy teens who were not even working at the previous minimum wage. These distributional effects show that the minimum wage is an inefficient anti poverty effort, that harms the very individuals it is designed to assist.

— Craig Garthwaite
Director of Research

Minimum Wages and Job Search: What Do Employment Effects Really Measure?

Peter Arcidiacono and Tom Ahn, Duke University

How does increasing the minimum wage affect the labor market outcomes of its intended beneficiaries? Economists have generally believed that increasing the minimum wage hurt low-income workers by raising the cost of labor. A higher cost of labor means firms substitute away from workers to capital and therefore leads to job losses among the most disadvantaged. Until recently, there was consensus on the direction of the employment effect of an increase in the minimum wage, with the only debate being on the magnitude of the effect. Although the negative employment effect of an increase in the minimum wage was never particularly strong, the sign of the effect matched the classical theory.

"The empirical estimates suggest that the distributional effects of a minimum wage increase favor those who come from wealthier families, … [Current employees] are hurt by a minimum wage increase as they are now competing with teenagers from wealthier families."

From the perspective of economists, the one case in which increasing the minimum wage could lead to a positive effect on both employment and earnings of low-income workers would be if firms operated as monopsonies. In the simplest case, a firm operates as a single buyer of labor–the reverse of the standard monopoly model where there is one seller. Since the firm is the only buyer and must pay one wage rate to its workforce, increasing the wage to hire one more worker leads to increases in wages for all workers. This leads to an inefficiently low wage and number of workers. Monoposony stories have held little weight in the eyes of economists, however, because these stories require a captive labor market—firm and worker mobility should render a monopsony powerless (Boal and Ransom 1997).

However, recent work by Card and Krueger (1994, 1995) calls into question the classical analysis. In their 1994 article in the *American Economic Review*, they show that increases in the New Jersey minimum wage actually increased employment at fast food restaurants relative to Pennsylvania, which did not have a similar minimum wage increase. In their 1995 book, *Myth and Measurement: The New Economics of the Minimum Wage*, they argue that the evidence of the classical model is not particularly convincing. The effect of increases in either federal or state minimum wages typically leads to insignificant effects on employment.

There has been considerable debate regarding these findings, with Welch et. al. (1995) and Neumark and Wascher (1994) calling into question the robustness of the results from Card and Krueger's 1994 paper. Indeed, the reaction by economists has been quite hostile to Card and

Krueger's evidence—in part because of the lack of a credible model that which can generate the positive employment effects they find. This view is best summarized by a quote in the *Wall Street Journal* from James M. Buchanan, a 1986 Nobel laureate, who said:

> Just as no physicist would claim that "water runs uphill," no self-respecting economist would claim that increases in the minimum wage increase employment. Such a claim, if seriously advanced, becomes equivalent to a denial that there is even minimal scientific content in economics, and that, in consequence, economists can do nothing but write as advocates for ideological interests. Fortunately, only a handful of economists are willing to throw over the teaching of two centuries; we have not yet become a bevy of camp-following whores." Wall Street Journal April 25, 1996)

We believe that many of Buchanan's objections arise because there are no credible economic models that includefree entry by firms and firms competing for workers, and in which an increase in the minimum wage increases employment. In this paper we present a general equilibrium search model. This model exhibits all three of these features and is a specialized version of Ahn and Arcidiacono (2004).

In a search model, the number of matches (the employment level) depends on both the number of searching workers and the number of searching firms. Firms and workers each pay a fixed cost to search, with the endogenous entry of the former leading to zero expected profits in equilibrium. The key difference between search models and the classical model is that the employment level depends on both the number of searching workers and the number of searching firms. In the classical model, this is not the case. Rather, in the presence of a minimum wage, the employment level is determined solely by labor demand (the number of searching firms) because the minimum wage operates as a price floor. However, in a model with search frictions, the employment level can increase even if the number of searching firms falls. This can occur because increasing the minimum wage leads to more workers searching for jobs. More workers also search for jobs in the classical analysis, but in that model the entry of workers has no effect on the employment level.

An increase in the minimum wage may appear to have little effect on the employment prospects of low-income workers if one looks only at employment levels. However, as our search model shows, the employment levels may be masking much larger changes in the probability of actually finding a job. Individuals who decide to search because of the increase in the minimum wage may cause higher employment levels. However, the higher minimum wage reduces the probability of any one individual finding a job, including those who wanted the low-wage job prior to the minimum wage increase. Hence, there may be large negative welfare effects from a minimum wage increase, even if the employment level increases. As in Luttmer (1998) and Glaeser (1996), in expectation, those with the lowest reservation wages are hurt most by an increase in the minimum wage, when workers are randomly allocated to jobs.

Another paper also has firms earning zero expected profits and yet can still generate employment increases from a minimum

wage hike. Lang and Kahn (1998) use a model with segmented labor markets and firms with preferences for workers of a particular type to obtain their result. Without a minimum wage, an equilibrium exists in which second-class workers have high employment rates and low wages, while preferred workers have just the opposite and are better off in expectation. For a minimum wage slightly above the equilibrium wage in the low-wage market, Lang and Kahn show that an equilibrium exists in which some preferred workers now search for minimum wage jobs, trading off higher wages for higher employment probabilities, and that this effect can more than compensate for the loss of jobs for the second-class workers.[1]

Flinn (2003) also estimates a search model with minimum wages. His paper arises out of the traditional search literature, in which an individual's reservation wage is determined by the expected wages from continued search. In our model, reservation wages are determined by the value of leisure. The advantage to Flinn's work is that his paper estimates a continuous-time infinite-horizon model, while ours is static. However, a significant benefit from using our model is that we have endogenous labor supply and demand, whereas in Flinn's model the number of searching workers and firms is fixed. Our model is then able to have firms earn zero expected profits in equilibrium and is also able to generate positive employment effects from an increase in the minimum wage.

For the search model to explain why estimated employment responses to minimum wages are so small and still have large movements in labor demand, the labor supply response of teenagers to an increase in expected wages must be large. We test this using 12 years of data from the Current Population Survey. We find that, indeed, teen labor supply is responsive to increases in the expected wage. Further, we show that teenagers from high-income families have higher reservation values than those from low-income families. Hence, as the minimum wage increases, the composition of searching workers changes as the searching workers are now more likely to come from wealthier families.

This still begs the question as to why the low-wage market should behave differently from the rest of the labor market. The answer lies in the types of workers who are looking for work in the low-wage labor market. For example, teenagers are much more prevalent in this labor market. While the labor force participation rates for adult males are very high, teenagers are less apt to participate. Recall that the key point in our analysis is that the number of employees is determined both by the number of searching firms and the number of searching workers. As wages increase, participation rates for the adult male labor force will remain virtually unchanged. However, for teenagers, a group that is relatively unattached to the labor force, the increase in the wage may lead to a large increase in labor force participation rates.

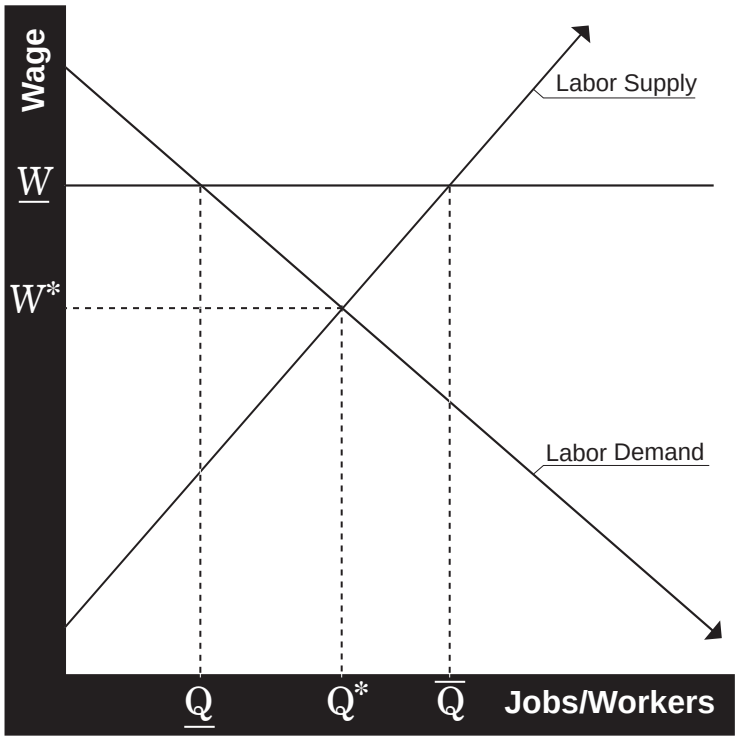
The next section shows the classical analysis and how microeconomics textbooks typically misrepresent the welfare effects of a minimum wage increase. Section 2 presents a specialized version of the model in Ahn and Arcidiacono (2004). Section 3 shows how positive employment effects from an increase in the minimum wage can arise even if firms earn zero expected profits. Section 4 examines the welfare effects for

workers, showing that those who most want the minimum wage jobs are hurt most by the increase. Section 5 presents data used in the econometric analysis. Section 6 presents some empirical evidence in support of the model. Section 7 concludes.

1. The Classical Model

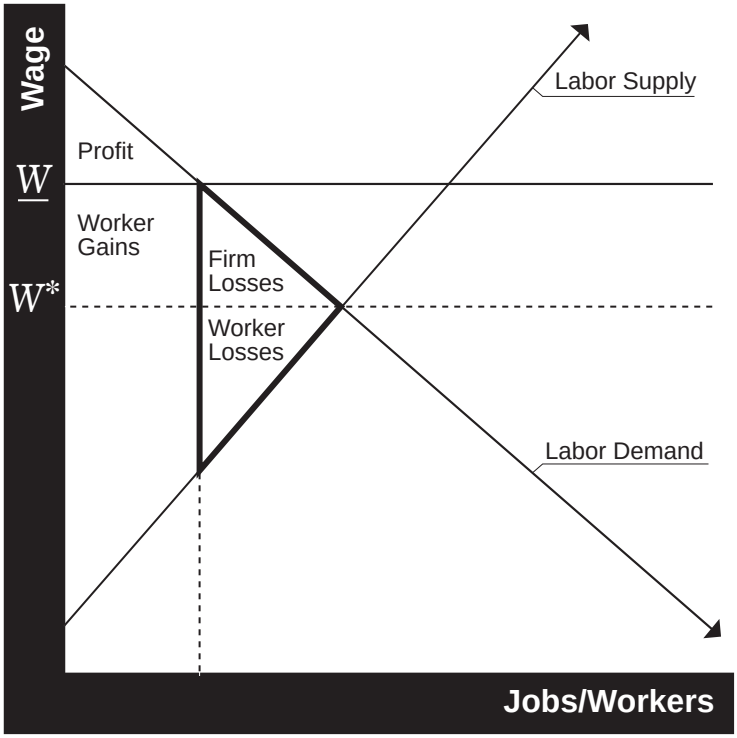
The classical analysis of the effects of a minimum wage can be found in most introductory economics textbooks. Generally, however, the welfare analysis in these textbooks is either not done or relies on assumptions about the labor market that lead to the lowest possible deadweight loss from an increase in the minimum wage.[2] To see this, first consider the employment levels in the classical analysis once a minimum wage is implemented. Figure 1 shows this situation. Note that, at the minimum wage, the elasticity of the labor supply curve does not affect the employment level as long as at the minimum wage the number of interested workers is above $\underline{Q}$. This is because of the implicit assumption that firms and workers can effortlessly and instantaneously find each other. Therefore, the employment level is determined solely by the minimum of the number of vacancies and the number of interested workers. Since the number of vacancies is smaller than the number of interested workers in the case of a price floor, the employment level is unaffected by the elasticity of labor supply. Note also that

Figure 1 Classical Employment Losses From Minimum Wage Increase



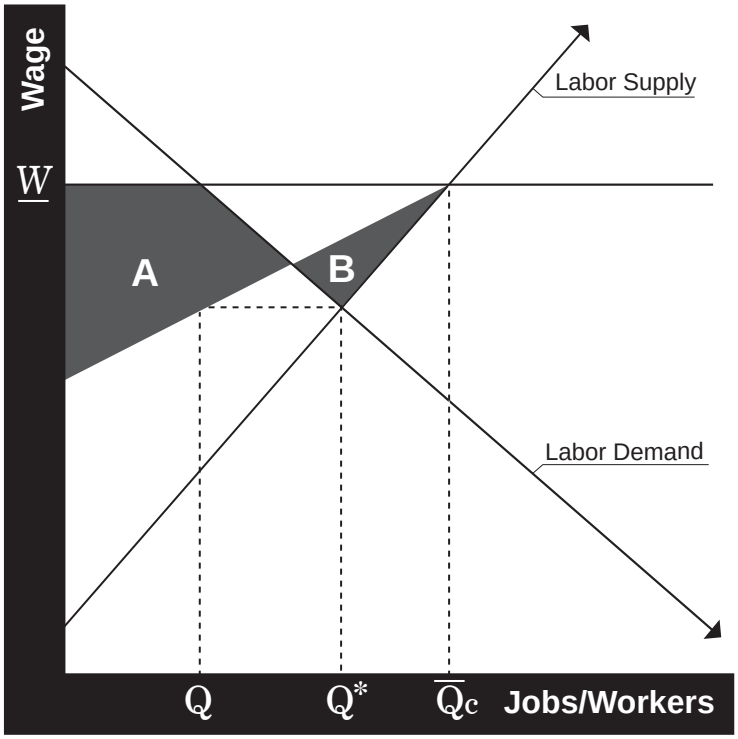
In the classical model, a binding minimum wage means that the employment level is determined only by labor demand. Here, the imposition of a minimum wage causes employment to fall from Q^* to $\underline{Q}$. The number of workers interested in working at the minimum wage, $\overline{Q}$, only affects the unemployment rate, not the employment level.

Figure 2 Smallest Deadweight Loss in the Classical Model



If the workers who obtain the minimum wage jobs are those who wanted the minimum wage jobs the most, deadweight loss is minimized. Some of the firm's surplus is now given to the workers, the worker gains region, while the deadweight loss is given by the sum of firm losses and worker.

Figure 3 Deadweight Loss When All Have the Same Probability of Employment



When all searching workers have the same probability of finding a match, the workers who wanted the minimum wage most lose. In particular, the kinked line repr sents the expected worker surplus given the minimum wage–the worker surplus at the minimum wage times the probability of being employed. Those who now have expected surpluses that are lower than the surplus under the market clearing wage, workers to the left of Q_c, lose because of the minimum wage increase. Since the workers who want the job the most now have the same probability as all other searching workers of fin ing a job, deadweight loss increases. The new deadweight loss is Area A minus Area B.

the number of those interested in working has increased from Q^* to $\underline{Q}$ with the increase in the minimum wage.

The question, then, is who gets these minimum wage jobs? The standard textbook analysis assumes that the people who most want the minimum wage jobs, those to the left of $\underline{Q}$, will be the ones to obtain the jobs. One way of calculating the extra gains a worker receives from having a minimum wage job over being unemployed is taking the difference between the minimum wage and the wage that would make the individual indifferent between working and not working (their "point" on the labor supply curve). This welfare analysis is displayed in Figure 2, showing profit, worker gains and losses, and the deadweight loss from the minimum wage. Note that, in addition to firms losing profits, some workers interested in the minimum wage job also lose. Namely, those individuals who fall between $\underline{Q}$ and Q^* would have been employed when there was no minimum wage but are not employed at the minimum wage $\underline{w}$.

However, the "winners" may not be the ones who want the minimum wage jobs the most. In fact, those who most want the minimum wage jobs are unlikely to have the job networks necessary to obtain a job when jobs are rationed. Let us instead operate under the assumption that everyone interested in a minimum wage job has an equal probability of finding one. That is, we confer an additional advantage to those workers who want the minimum wage job the most.

If it can be shown that even under this case, these workers are not "winners" after a minimum wage increase, it becomes clear that we need to consider the welfare implications of a minimum wage increase with much more care. This probability of finding a minimum wage job would be given by $\underline{Q}/\overline{Q}$. To calculate the expected gains from the minimum wage for a particular individual, we take the probability of finding a job times the difference between the minimum wage and the wage that would make the worker indifferent between working and not working.

Figure 3 shows the welfare analysis for this case. The workers who prefer the minimum wage increase are not the ones who most want the minimum wage jobs. In fact, those who most want minimum wage jobs would be most vehemently against an increase. This is because it is no longer the case that workers who desire the minimum wage jobs the most get them. In particular, the winners are those individuals who are interested in working at the minimum wage but who were either uninterested in working before the minimum wage (those between Q^* and $\overline{Q}$) or who were marginally interested before the minimum wage change (those between Q_c and Q^*).[3] However, those who wanted the minimum wage jobs the most (i.e had the lowest reservation wages) lose. These individuals are willing to trade off a higher probability of finding a job for a lower wage. On the other hand, the winners are those whose employment is of sufficiently low priority that they are willing to accept a lower probability of finding a job for a higher wage. Note that the deadweight loss is higher here than when the minimum wage jobs are given to those who want them the most—-the allocation of jobs to workers is inefficient in this latter case.

The allocation of jobs to workers, however,

does not affect the basic result from the classical analysis: increasing the minimum wage cannot lead to an increase in the level of employment. This occurs because, at the minimum wage, the level of employment is solely determined by labor demand. In the next section, we relax this restriction and instead use a matching model with two-sided search. The employment level will then depend on both the number of searching firms **and** the number of searching workers. With an increase in the number of searching workers, even if the number of searching firms falls, it is possible to increase the employment level with an increase in the minimum wage. However, the welfare analysis turns out to be very much the same as the classical case when workers are randomly matched to jobs. In particular, those searching workers who are most interested in employment are hurt by the minimum wage increase, with marginally interested workers benefiting.

2. The Search Model

In this section we present a two-sided search model designed to highlight the effects of a minimum wage increase in the low-wage market. In the two-sided search model, firms search for workers and workers search for firms. The model is a special case of Ahn and Arcidiacono (2004). We focus in particular on the market for teenage workers. Teenage workers are differentiated in their reservation values for being unemployed, which can be interpreted as the value of schooling. Students who expect to acquire much human capital in school will consider a minimum wage job to be relatively unattractive.

Let there be $\overline{N}$ teenagers, N of which work where N is endogenous. All teenagers interested in searching pay a search cost K. Let p indicate the probability of finding a match and is common across individuals. All matches pay $\underline{W}$, the minimum wage. Individuals are assumed to be risk neutral. The expected value of searching, V_i, is then given by

$$V_i = p[\underline{W} - R_i] - K, \qquad (1)$$

where R_i is the reservation value for individual i. Individuals search if $V_i > 0$.[4]

Each worker can match with at most one firm. Similarly, each firm can match with at most one worker.[5] The number of searching firms, J, is determined by the expectation of earning zero profits in equilibrium. All firms face an identical probability of finding a match, q, and pay a cost, C, to search. In equilibrium, expected profits are then given by

$$q(S - \underline{W}) - C = 0 \qquad (2)$$

where S is the value of the match.[6]

To close the model, we need to specify the matching process. The matching process most common in the search literature (see Petrongolo and Pissarides, 2001, for details) takes the Cobb-Douglas form

$$Q = \min\{J, N, AJ^{\alpha}N^{1-\alpha}\} \qquad (3)$$

where Q is the employment level, A is a constant, and $0 \leq \alpha \leq 1$. The "min" on the outside of the matching function restricts the level of unemployment to be no greater than either the number of searching firms or the number of searching workers. Searching workers and searching firms then have match probabilities $p = \frac{Q}{N}$ and $q = \frac{Q}{J}$,respectively. Ahn and Arcidiacono (2004) show that an equilibrium exists for this model.

3. Positive Employment Effects

With the basic model in hand, we now show that the model is able to generate positive employment effects from an increase in the minimum wage using reasonable parameter values. To begin, note that an increase in the employment does *not* imply an increase in the probability of finding employment. In fact, the probability of finding a match must fall in this model given an increase in the minimum wage. In particular, Proposition 3 in Ahn and Arcidiacono (2004) shows that in equilibrium an increase in the minimum wage always lowers the probability of matching:

Proposition 3 of Ahn and Arcidiacono (2004):

$\frac{dp}{d\underline{W}} < 0$, *regardless of the sign of* $\frac{dN}{d\underline{W}}$, $\frac{dJ}{d\underline{W}}$, *and* $\frac{dQ}{d\underline{W}}$.

With the probability of finding a match guaranteed to fall, we are back to the classical prediction on the effect of a minimum wage: there exists a trade-off between employment and earnings at the individual level. Therefore, even if the employment level does rise, this does not necessarily translate into low-income searchers benefiting from an increase in the minimum wage.

Much of the intuition for the result can be found from examining the expected profit condition given in equation (2). Substituting in the firm's share of the surplus under a (binding) minimum wage into equation (2) and noting that the minimum wage is only effective if it binds:

$$q(S - \underline{W}) - C = 0 \qquad (4)$$

As $\underline{W}$ increases, q must also increase for the expected zero profit condition to bind. However, for q to increase, p must decrease. This is because the probability of a firm finding a match depends positively on the ratio of workers to firms, while the probability of a worker finding a match depends negatively on the same ratio. In particular, we can write q and p as

$$(5) \quad q = \left(\frac{N}{J}\right)^{1-\alpha}$$

$$(6) \quad p = \left(\frac{J}{N}\right)^{\alpha}.$$

Hence, if q is increasing, p must be decreasing. Since q must increase for the expected zero profit condition to hold, the probability of a worker finding a match, p, must fall. Note that the total number of searching firms, J, may increase, but it must be accompanied by an even larger increase in the number of searching workers.

While the probability of finding employment must fall, the effect on the employment level is ambiguous. The reason for the ambiguity is that an increase in the minimum wage may lead to an increase in the number of searching workers. If the increase in searching workers is large enough, an increase in the employment level is possible. Differentiating the employment level in equation (3) with respect to the minimum wage yields

$$\frac{dQ}{d\underline{W}} = \alpha\frac{Q}{J}\frac{dJ}{d\underline{W}} + (1-\alpha)\frac{Q}{N}\frac{dN}{d\underline{W}}. \qquad (7)$$

Multiplying through by $\frac{\underline{W}}{\underline{W}}$ and rearranging terms yields

$$\frac{dQ}{d\underline{W}} = \frac{Q}{\underline{W}}\left(\alpha\frac{\frac{dJ}{J}}{\frac{d\underline{W}}{\underline{W}}} + (1-\alpha)\frac{\frac{dN}{N}}{\frac{d\underline{W}}{\underline{W}}}\right). \qquad (8)$$

Note, however, that the expression inside the parentheses contains both the elasticity of labor supply and the elasticity of labor demand. Also, placing the fraction $\frac{Q}{\underline{W}}$ on the

left-hand side yields the elasticity of the equilibrium employment level with respect to the minimum wage, ε_Q. We can then write the elasticity of the equilibrium employment level with respect to the minimum wage as

$$\varepsilon_Q = \alpha\varepsilon_{LD} + (1-\alpha)\varepsilon_{LS}. \qquad (9)$$

This last equation shows that the more elastic the response by either labor supply or labor demand is to an increase in the minimum wage, the larger the impact on the employment level in equilibrium. Note that we expect these effects to move in opposite directions, with labor demand falling as the minimum wage increases and labor supply increasing with the minimum wage. Note also that in the classical model it is only the first effect that is relevant; labor supply does not affect the employment level in the presence of a binding minimum wage.

The α parameter shows how much weight the number of searching firms receives in determining the employment level. The more sensitive the employment level is to the number of searching firms (higher α's), the more difficult it will be to obtain positive employment effect given an increase in the minimum wage. That is, in the search model, positive employment effects must be driven by increases in the number of searching workers.

Given the formula for ε_Q, we would like to know whether reasonable values for α and the elasticities of labor demand and labor supply generate positive employment effects from an increase in the minimum wage. Most labor economists estimate the labor demand elasticity to be between -1.00 and -0.30 (see Fuchs, Krueger, and Poterba 1998). Most estimates of the α parameter in the matching function are between 0.40 and 0.60 (see Petrongolo and Pissarides 2001). The only question, then is, what values to use for the elasticity of labor supply for teenagers. Unfortunately, there are virtually no estimates of this parameter in the economics literature. Instead, we use estimates of the Marshallian labor supply elasticity for women as a proxy for the corresponding teenage labor supply elasticity. We believe this to be much more reasonable than using the male labor supply estimates because we expect teenagers to be less attached to the workforce than their adult male counterparts. Most labor economists place the Marshallian labor supply elasticity for women in the 0.10 to 0.70 range (see Fuchs, Krueger, and Poterba 1998).

Substituting these parameter ranges into equation (9) yields estimates of employment elasticity between -0.56 and 0.30, with a positive employment elasticity implying that an increase in the minimum wage would increase the equilibrium employment level. Hence, positive employment effects are a very real possibility in a simple search model.

4. Welfare

Even with positive employment effects, the decreased probability of finding a match means that the welfare effects of an increase in the minimum wage are ambiguous. What we *can* say is that if anyone is hurt by the minimum wage increase, it will be those who most want the minimum wage jobs. The intuition for this result is the same as in the classical analysis: those who most want the minimum wage jobs are willing to trade off a lower wage for a higher probability of employment.

In order to calculate the winners and losers from a minimum wage increase, we differentiate the expected value of searching with respect

to the minimum wage. If this derivative is positive for a particular individual, that individual benefits from the change in the minimum wage. Substituting in $\underline{W}$ for the expected wage and differentiating V_i with respect to $\underline{W}$ yields

$$\frac{dV_i}{d\underline{W}} = p_i + \frac{dp_i}{d\underline{W}}[\underline{W} - R_i]. \qquad (10)$$

Note that we know the derivative of the probability of matching with respect to the minimum wage must be negative from Proposition 3. Note also that the equation is not relevant for teenagers who have reservation values above the minimum wage: these teenagers will never find it optimal to search. Hence, the term in brackets must be positive and is multiplied by a negative number $\left(\frac{dp_i}{d\underline{W}}\right)$.

This equation then distinguishes winners and losers from an increase in the minimum wage, with a worker being indifferent regarding a minimum wage increase if the expression in equation (10) exactly equals zero at reservation value. As R_i approaches $\underline{W}$ the term in parentheses goes to zero and the effect of an increase in the minimum wage for workers with reservation values close to R_i must be (weakly) positive. These are the workers who would not find it worthwhile to work for a low wage; a minimum wage that moves a worker from not searching to searching must be welfare enhancing for that worker. If we move in the other direction, however, the lower the value of R_i, the more impact the negative second term has on the expression. Hence, lower values of R_i make it more likely that the person is hurt by the minimum wage change. A trade-off then exists: an increase in the minimum wage may help the marginal entrant in the labor market at the expense of the welfare of someone who very much wanted a minimum wage job.

What this analysis implies is that if the number of searching workers increases as a result of an increase in the minimum wage, the expected loss in employment understates the loss of any one individual obtaining a job. As more workers enter the labor market, more firms will enter as well, all else being equal. Labor then creates its own demand (Pissarides, 1990).

5. Data

In this section we present the data used in the econometric analysis. We use a 12 year band of the basic monthly outgoing rotation survey files of the Current Population Survey (CPS) from 1989 to 2000. These 12 years are suitable for analysis because there were four federal minimum wage changes during this period. More important, 15 states[7] changed their state minimum wage to outpace the federal wage, at various points in time. The range of observed minimum wages in the 12 years runs from $3.35 to $6.50.[8] We select white teenage workers (16 years to 19 years) during non-summer month six to look at the employment and wage effects from an increase in the minimum wage. The CPS is especially useful for this analysis because the survey explicitly asks for hourly wage. From the CPS, we collect hourly wage, whether the individual is searching for work or not, whether the searching worker is employed or not, parent weekly income, years of parental education, and other demographic characteristics, such as whether the teenager is from a single-parent household.

Parent weekly income is a proxy for the level of monetary support teenagers have from their parents. A higher level of monetary support

from parents should lower the teenager's willingness to search for a minimum wage job. We restrict the analysis to teenagers who are identified as having parental income. If a parent was surveyed to be employed, but did not enter an income amount, the household was treated as having a missing income.

The level of parental education is indicative of the extent to which a family regards education for the teenager as important. That is, a teenager with parents with a high level of education is probably receiving encouragement to focus on studying. Therefore, the reservation value of a teenager with well-educated parents should be higher a that of a teenager with parents with a lower level of education, all else being equal. Using these two measures of reservation, we hope to capture many of the concrete sources of reservation (outside support) as well as preference for education over minimum wage work.

Table 1 contains general descriptive statistics from the CPS portion of the data. Individuals between 16 and 19 years old inclusive were included in the sample and were identified as employed, unemployed but looking for work, or not searching for work. Observations with employed individuals earning less than the minimum state or federal minimum wage were dropped, as well were individuals who reported earning more than $10 per hour, about 0.79% of the sample.[10]

Table 1 Description of Data

Variable	Mean	Standard Deviation
Entire Sample (N: 120,686)		
Age	17.36	1.102
Female	0.4757	0.4994
Pr (Search)	0.4808	0.0970
Single Parent	0.1824	0.3862
Parent Education (Years)	13.74	2.869
Weekly Parent Income	692.64	433.71
Missing Income	0.2668	0.4423
Searching Workers (N: 58,025)		
Age	17.62	1.077
Female	0.4745	0.4994
Pr (Employed/Search)	0.8387	0.0895
Single Parent	0.1951	0.3963
Parent Education (Years)	13.58	2.649
Weekly Parent Income	674.97	402.97
Missing Income	0.2346	0.4238
Employed Workers (N: 48,668)		
Hourly Wage	4.30	1.02
Age	17.66	1.068
Female	0.4835	0.4997
Single Parent	0.1829	0.3866
Family Size	3.790	1.153
Parent Education (Years)	13.66	2.601
Weekly Parent Income	693.53	400.43
Missing Income	0.2377	0.4257

Searchers are more likely to come from low-income families with low parental education and are more likely to be in a single-parent household. However high-income, highly educated, two-parent families are more likely to actually find a job. This latter trend will be picked up in our model by these individuals being in states with better economies.

We also use the Monthly Labor Review to collect minimum wage rates at the state and month level. That is, from 1989 to 2000, we observe the minimum wage in each state for each month. Table 2 presents minimum wages by state and year as well as giving the month in which any minimum wage changes took place. In the analysis, all dollar values are adjusted to 1988 dollars.

Table 2 State Minimum Wage from 1989 to 2000

State	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
California	4.25	4.25	4.25	4.25	4.25	4.25	4.25	4.75	5.00$^{\diamond}$	5.75$^{\diamond}$	5.75	5.75
Connecticut	4.25	4.25	4.27†	4.27	4.27	4.27	4.27	4.77°	5.18*	5.18	5.65‡	6.15‡
Iowa	3.35	3.85‡	4.25‡	4.65‡	4.65	4.65	4.65	4.75	5.15	5.15	5.15	5.15
Massachusetts	3.75	3.75	3.75	4.25	4.25	4.25	4.25	4.75‡	5.25‡	5.25	5.25	6.00‡
Maine	3.75‡	3.85‡	4.25†	4.25	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
Minnesota	3.85‡	3.95‡	4.25‡	4.25	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
New Hampshire	3.65‡	3.75‡	3.85‡	4.25†	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
New Jersey	3.35	3.80†	3.80	5.05†	5.05	5.05	5.05	5.05	5.15	5.15	5.15	5.15
New York	3.35	3.80†	3.80	4.25†	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
Oregon	3.85*	4.25‡	4.75‡	4.75	4.75	4.75	4.75	4.75	5.50‡	6.00‡	6.50‡	6.50
Pennsylvania	3.70‡	3.80†	4.25†	4.25	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
Rhode Island	4.25$^{\triangledown}$	4.25	4.45†	4.45	4.45	4.45	4.45	4.75	5.15	5.15	5.65$^{\triangle}$	6.15*
Vermont	3.75$^{\triangle}$	3.85$^{\triangle}$	4.25†	4.25	4.25	4.50‡	4.50	4.75	5.15	5.15	5.75°	5.75
Washington	3.85‡	4.25‡	4.25	4.25	4.25	4.90‡	4.90	4.90	5.15	5.15	5.70‡	6.50‡
Wisconsin	3.65$^{\triangle}$	3.80†	3.80	4.25	4.25	4.25	4.25	4.75	5.15	5.15	5.15	5.15
Other States	3.35	3.80†	4.25†	4.25	4.25	4.25	4.25	4.75°	5.15*	5.15	5.15	5.15

‡ Minimum wage change on 1/1 or 1/2. $^{\diamond}$ Minimum wage change on 3/1. † Minimum wage change on 4/1.

$^{\triangle}$ Minimum wage change on 7/1 or 7/2. $^{\triangledown}$ Minimum wage change on 8/1. * Minimum wage change on 9/1.

$^{\circ}$ Minimum wage change on 10/1.

6. Empirical Implementation

We focus the empirical analysis on the teenager's decision as to whether to search for a job with the estimation strategy for the full model given in Ahn and Arcidiacono (2004). Recall that an individual searches if

$$V_i = p(\underline{W} - R_i) - K > 0. \qquad (11)$$

Note that some teenagers (in fact, many) will actually make much more than the minimum wage. In order to accommodate the range of wages actually seen in the labor market, we replace $\underline{W}$ with the expected wage conditional on matching. That is, a matched worker receives a draw from the wage distribution subject to the wage being higher than the minimum wage.[11] Unlike the classical analysis, a draw from the wage distribution that is below the minimum wage does *not* result in unemployment for the worker: the firm simply receives a smaller share of the surplus than it otherwise would.

To obtain expected wages, we assume that the wage distribution is log normal with censoring points at the minimum wage. Note that these censoring points differ across states and years. We then regress log wages on age, state, month, and year indicator variables to take into account the ebbs and flows of the business cycles and allow productivity and bargaining power to be different across age and state. The estimated parameters are then used to calculate expected wages at the age, state, month, and year levels.

We also need to obtain values for the probability of finding a match conditional on searching. Ahn and Arcidiacono (2004) show how the firm's zero profit condition can be rewritten in terms of the probability of a searching worker finding a match. Rewriting the zero profit condition in this way also provides a link between minimum wages, expected wages, and the probability of finding a match. Hence, they are able to calculate the relevant demand elasticities. We use their estimates of the probability of finding a match at the age, state, month, and year level in our model of the individual's decision to search.

Finally, we need to specify the reservation values. We assume that the reservation values are a function of family income (FI), parental education (PE), whether an individual is living with both parents (TP), and sex (S). Further, the reservation value has an unobserved component, ε. We assume that no individual would be willing to work for free. Hence, all reservation values are bounded below by zero. A natural specification for the reservation values is then

$$R_i = \alpha_0 + \alpha_1 FI_i + \alpha_2 PE_i + \alpha_3 TP_i + \alpha_4 S_i + \exp(\epsilon_i). \qquad (12)$$

Substituting for R_i in equation (11) and solving the search condition for the $\boldsymbol{\varepsilon}_i$ yields:

$$\ln\left(E(W_i) - \frac{K}{p_i} - \alpha_0 - \alpha_1 FI_i - \alpha_2 PE_i - \alpha_3 TP_i - \alpha_4 S_i\right) > \epsilon_i, \qquad (13)$$

where an individual searches if the condition above holds.

To estimate the model, we need to specify the distribution for the ε's. We assume that the ε's are distributed standard normal, which yields probit probabilities. The estimated coefficient on the probability of finding a match conditional on searching then gives the search cost K.

7. Results

Estimates of the model are reported in Table 3. Consistent with the theory, the expected wage is positive and significant, while searching is costly. The parameters characterizing the reservation values consistently have the expected sign and, with the exception of female, all are statistically significant. In particular, higher parental education and parental income are both associated with lower probabilities of search while coming from a single-parent family makes it more likely that an individual will enter the labor market. With higher reservation values for wealthier and more highly educated families, individuals from these families will be more willing to trade off lower probabilities of finding a job for a higher expected wage conditional on employment. Reservation values are also higher for younger individuals.

Table 3 Estimates of the Search Parameters

Variable	Coefficient	Standard Error
Expected Wage	0.3463	0.0054
Search Cost / Pr (Match)	-0.0839	0.0071
Reservation Values (exp ()):		
Constant	0.3067	0.0062
Parental Education	-0.0188	0.0011
Parental Income	-0.0747	0.0065
Missing Income	-0.2428	0.0068
Two Parents	-0.0360	0.0062
Female	-0.0051	0.0056
Age = 16	-0.6098	0.0086
Age = 17	-0.2610	0.0087
Age = 18	-0.1161	0.0095

Because the probit is nonlinear, it is difficult to interpret the magnitude of the coefficients. To characterize what the parameters mean, we simulate how a 10 percent change in the minimum wage affects the decision to search, the probability of matching conditional on searching, and the employment level. The simulation utilizes both the search parameters estimated above and the parameters of the zero profit condition estimated by Ahn and Arcidiacono (2004). The average effects are presented in Table 4.

The table shows that with a minimum wage increase, the probability of searching increases as well. However, this is counteracted by a decrease in the probability of finding a job conditional on searching. The overall effect on the probability of employment is a modest -0.88% decrease. Note that this is the relevant number when speaking of the employment level, as it is not conditional on whether the individual searched. Hence, the employment level would be the probability of employment times the number of 16- to 19-year-olds. However, this small decrease in employment is masking large changes in labor supply and demand that are effectively canceling out. Namely, a 10 percent increase in the minimum wage causes a 2.1 percent increase in the probability of searching and 2.9 percent decrease in the probability of employment conditional on searching.

Table 4 Changes in Labor Market Outcomes from a 10 percent Minimum Wage Increase

Variable	Mean	Standard Deviation
Pr (Search) Before	0.4811	0.1239
Pr (Search) After	0.4910	0.1206
Pr (Match) Before	0.8269	0.0502
Pr (Match) After	0.8031	0.0601
Pct. Change in Employment	-0.88%	–
Pct. Change in Pr (Search)	2.1%	–
Pct. Change in Pr (Match)	-2.9%	–

8. Conclusion

Empirical estimates of the employment effects of an increase in the minimum wage are consistently small. Recent work by Card and Krueger (1994, 1995) suggest that the employment effects may even be positive. Does this then imply that workers in the low-wage labor market would benefit from a minimum wage increase? In order to answer this question, we need to have a credible model that is able to generate the employment effects found in the data.

This paper has proposed a search model as an alternative to the classical model. The key feature of the model is that the employment level in the presence of a minimum wage is not solely determined by labor demand, but is also a function of labor supply, the number of searching workers. While higher wages make hiring workers less attractive from the firm's perspective, increased wages lead to more workers interested in participating in the labor force. Hence, the effect on the employment level may be masking large changes in labor demand and labor supply.

We estimated the model on teenagers in the Current Population Survey. Consistent with previous work, a 10 percent increase in the minimum wage leads to only a -0.88 percent decrease in employment. However, this is masking a 2.1 percent increase in the probability of searching and a 2.9 percent decrease in the probability of employment conditional on searching. Hence, while employment levels remain unaffected, much larger effects can be found for unemployment rates.

Finally, the empirical estimates suggest that the distributional effects of a minimum wage increase favor those who come from wealthier families. Individuals from wealthier families are more likely to have higher reservation wages and hence are willing to trade off a lower probability of being employed for a higher expected wage conditional on employment. Individuals from low-income families, however, are more likely to take low-paying jobs, preferring a high probability of finding a job and a low wage to a low probability of finding a job and a high wage. These are the individuals who are hurt by a minimum wage increase because they are now competing with teenagers from wealthier families.

Endnotes

1. Burdett and Mortensen (1998) develop a search model that incorporates monopsonistic competition and can generate positive employment effects from a minimum wage hike. Firms earn positive profits in their model.
2. This holds true for the intermediate microeconomics and labor economics textbooks as well.
3. Marginally interested workers in this context are those who would work at the old minimum wage if and only if they were assured success in the job search. Q_C is the worker who is exactly indifferent about working at the old wage when match probability is not one.
4. Note that **K** is not indexed by workers. The model can be generalized to allow this value to change, as long as there is no correlation between the individual reservation value and the worker search cost.
5. While in reality firms generally have more than one employee, we can instead think about each vacancy as a firm. The assumption of one firm per vacancy has no effect on the results.
6. Allowing **C** to be indexed by firms will not change the qualitative results of the model.
7. There are actually 17 states that paced ahead of the federal minimum wage, but we exclude Alaska and Hawaii from analysis.
8. We look at state minimum wages because some of the larger and more populous states, such as California, New York, and Pennsylvania, have state minimum wages above the federally mandated minimum wage and are raised on different schedules.
9. We exclude June, July, and August.
10. All dollar figures are adjusted to 1988 dollars. The empirical estimates of the wage distributions were not significantly altered when the ceiling for hourly earnings was dropped or raised.
11. All of the analyses in the previous sections hold when workers receive draws from a wage distribution rather than all receiving the minimum wage. See Ahn and Arcidiacono (2004) for details.

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