

Minimum Wages for Ronald McDonald Monopsonies

A Theory of Monopsonistic Competition*

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Abstract

Recent empirical work on the effects of minimum wages has called into question the conventional wisdom that minimum wages invariably reduce employment. We develop a model of *monopsonistic competition* with *free entry* to analyse the effects of minimum wages, and our predictions fit the empirical results closely. Under monopsonistic competition, we find that a rise in the minimum wage a) raises employment per firm, b) causes firm exit, c) may increase or reduce industry employment. Minimum wages increase welfare if they raise industry employment, but welfare effects are ambiguous if employment falls.

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Recent empirical work on minimum wages has called into question the long accepted belief that minimum wages invariably reduce employment. Many of these studies suggest that moderate increases in the minimum wage need not reduce employment and may in fact raise employment (see Card (1992*a,b*), Card and Krueger (1994, 1998), Katz and Krueger (1992), and Machin and Manning (1994)).¹ These findings are anomalous in view of the conventional theory of competitive labour markets, where minimum wages necessarily reduce employment. Although minimum wages can raise employment under monopsony (e.g., Stigler (1946)), this is viewed as a theoretical curiosity, with limited practical relevance. Indeed, it is difficult to believe that the industries and labour markets in question, such as the fast food industry, can be characterised as monopsonies. Employers face competition from other employers, and entry and exit are important. None of the alternative theories which have been offered explicitly analyse the implications of free entry (see Boal and Ransom (1997) for a survey of this literature).

This paper provides a consistent theoretical framework with which to analyse such labour markets. We argue that the appropriate model is *monopsonistic competition*, where a large number of employers compete for workers, and are able to freely enter or exit. However, different jobs have different non-wage characteristics, giving each employer market power in choosing the wage, even though she employs only a small fraction of the work-force. This monopsony power is sufficient to ensure that a minimum wage raises employment in individual firms. However, competition between employers in the labour market gives rise to a wage-setting externality. This implies that the minimum wage has a first-order negative effect on profits, and hence firms exit the industry. The effect on aggregate industry employment is ambiguous—it increases with the minimum wage if the labour market is sufficiently distorted, but falls otherwise. Minimum wages raise welfare if aggregate employment increases, while welfare effects are ambiguous if employment falls. We also analyse the price effects of minimum wages. With a competitive product market, prices move inversely with employment. However, if firms have product market power, an increase in employment may be accompanied by an increase in price.

1 The Model

Competitive labour market theory requires firms to be wage takers so that labour supply to the individual firm is infinitely elastic. Empirical evidence suggests that this is not realistic. Card and Krueger (1995, c. 11) summarise this evidence and conclude that the wage elasticity of labour supply is about 5.0.² To

¹Neumark and Wascher (1992, 1996) reported negative employment effects, however, for several of their specifications they also found insignificant evidence that employment was reduced by the minimum wage increases.

ensure that labour supply is imperfectly elastic, we assume that different jobs have different non-wage characteristics. These include the job specification, hours of work, distance of the firm from the worker's home, the social environment in the workplace, etc. The importance of non-wage characteristics has been recognised in the theory of compensating differentials. This is a theory of vertical differentiation—some jobs are good while other jobs are bad, and wage differentials compensate workers who take bad jobs. We find it more convenient to assume *horizontal job differentiation*—jobs are not inherently good or bad, but different workers have different preferences over non-wage characteristics. For example, some workers are sociable and like meeting customers while others are more retiring. Some workers, like Adam Smith, find the chopping of meat a “brutal and odious business,” while others may have no strong feelings, and might instead be unable to carry heavy boxes. A teenager might prefer working at the local McDonalds rather than any other low paying job if some of her friends also work there.

To model horizontal differentiation in a simple and tractable way, we adapt the influential model of Salop (1979). We assume that the job characteristic space is a circle of unit circumference, along which workers are uniformly distributed. Let there be n firms in the market, who are uniformly spaced around the circle, so that the distance between adjacent firms is $1/n$. A worker who travels distance x to work in a firm incurs a “transportation cost” of tx . This cost should be interpreted as a subjective measure of the disutility the worker suffers, due to the mismatch between her preferred job characteristics and those offered by the firm.³ A worker takes into account the wages as well as the job characteristics offered by different firms.

Our desire is to construct a model with two features: a) total employment can either increase or decrease and b) employers must be competing with each other, in equilibrium. In order to do this we must allow for an additional dimension for worker heterogeneity, apart from “location.” We do this by assuming that there is a diversity of worker's reservation wages. Assume that there is a unit mass of low reservation wage workers, with reservation wage 0, who are uniformly distributed around the circle, and a mass μ of high reservation wage workers, with reservation wage $v > 0$, who are similarly distributed. Our results extend to the general case where we have any arbitrarily large finite set of types of workers at each location. We shall focus on parameter values where, in equilibrium, all low reservation wage workers work and only some high reservation wage workers work so that both a) and b) are satisfied.⁴

²The wage elasticity of the quit-rate is found to be greater than -1.0 , while the elasticity of the hiring rate is between 0.5 and 4.0 . Card and Krueger (1994) also report that the restaurant industry had difficulty in filling vacancies—over 200,000 vacancies (3 percent of jobs) were reported in 1988, and over 80 percent of fast-food stores had vacancies at any one point.

³Although we eschew a literal interpretation of “transport costs,” even these are significant for a low-wage worker. Simple calculations show that travel costs will be between 6% and 9% of a *full-time* minimum wage worker's *gross income* for public transportation costs of between \$1.00 and \$1.50 each way, and will be a greater percentage for part-time workers.

Consider first oligopsony where there is no free entry or exit so that n is fixed. We derive the supply of labour to firm i , given that firm i offers wage w_i and all other firms offer wage w_j . Every low reservation wage worker who is within distance $x^0 = (t/n + w_i - w_j)/2t$ of firm i will prefer to work for firm i . Hence firm i 's supply of 0-reservation wage workers is $2x^0$. For high reservation wage workers who are close to firm i , the choice is between working for firm i and not working at all, and only those who are located within distance $x^v = (w_i - v)/t$ will choose to work, where $w_i \geq v$. Therefore, provided $|w_i - w_j| \leq t/n$ and $w_i \geq v$, firm i 's total labour supply is:

$$L_i = 2(x^0 + \mu x^v) = \frac{t/n - 2v\mu + (1 + 2\mu)w_i - w_j}{t}. \quad (1)$$

Firm i 's supply of labour is increasing in w_i . Unlike perfect competition, firm level labour supply is *not* infinitely elastic. Labour supply is also decreasing in the wage paid by other firms, w_j . The own effect is larger than the cross effect, due to the increase in the participation rate of high reservation wage workers.

Our second assumption is that production requires fixed costs—in order to produce any output at all, the firm must install a minimum level of capital, C . Evidence suggests substantial fixed costs in the fast food industry—Krueger (1991) estimates that the total start up cost of a franchised restaurant in a major chain as between \$400,000 and \$600,000.⁵ Output is then given by a production function which is homogeneous of degree one in labour input L_i , and capital input, over and above C , K_i . Let $k_i = K_i/L_i$ be the ratio between additional capital and labour. Output, Y_i , is hence given by $Y_i = L_i f(k_i)$, where f , which is output per unit of labour employed, is assumed to be twice differentiable, increasing and strictly concave. Assume that capital can be freely hired at rate r , and that firms are price takers in the product market, facing a product price p , which is assumed to be fixed for the moment. Let $c = rC$. Using firm i 's first order condition with respect to capital, profits can be written as

$$\pi_i = \phi(r/p)L_i - w_i L_i - c \quad (2)$$

where $\phi(r/p) = p[f(k_i(r/p)) - f'(k_i(r/p))k_i(r/p)]$ is the *net revenue product of labour*—the value of an additional worker, given that firm i can adjust capital optimally (ϕ differs from the marginal revenue product of labour, since the firm can adjust capital). The firm's optimal wage is an increasing (linear) function of the wage set by other firms:

⁴The appendix provides precise details of these parameter restrictions.

⁵The franchisee typically pays a fixed fee and a sizeable royalty, typically 8 percent of gross sales. Franchisees are often required to post an explicit performance bond, implying that a part of these royalty payments are effectively fixed. Establishments also have to invest in order to build up clientele, and a large fraction of total fixed costs may well be sunk.

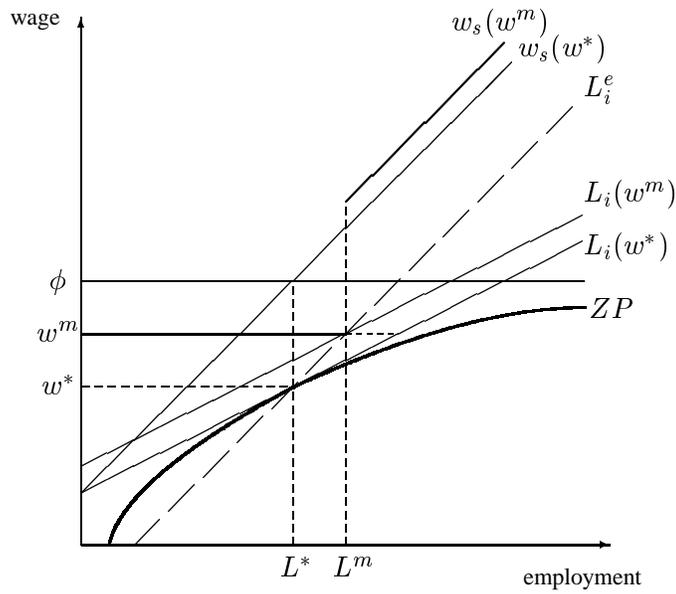


Fig. 1: Firm level employment and wages

$$w_i = \alpha + \beta w_j \quad (3)$$

where $\alpha = [(1 + 2\mu)\phi - t/n + 2\mu v]/2(1 + 2\mu)$ and $\beta = 1/2(1 + 2\mu)$. In a symmetric equilibrium all firms pay the same wage, $w^* = \alpha/(1 - \beta)$, and employ $L^* = 1/n + 2\mu[\alpha/(1 - \beta) - v]/t$ workers.

If a binding minimum wage is imposed which is less than ϕ , the firm's optimal employment is

$$L^m = \frac{1}{n} + \frac{2\mu}{t}(w^m - v). \quad (4)$$

Equation 4 shows that the firm's employment rises with the minimum wage, and hence if n is fixed, industry employment increases as well.

Our arguments can be illustrated using Fig. 1. An iso-profit curve for firm i consists of pairs (w_i, L_i) such that $[(\phi - w_i)L_i - c]$ is constant. ZP is one such iso-profit curve, with points above this curve yielding lower profits. The position of firm i 's labour supply curve depends upon the wages paid by other firms (recall equation (1)). The curve $L_i(w^*)$ shows the firm's labour supply given that other firms are paying the equilibrium wage, w^* . The firm optimally chooses a point on its labour supply curve which is on the highest iso-profit curve, i.e., the wage w^* and employment L^* at which its labour supply curve is tangent to the isoprofit curve ZP . This is also the point where the firm's shadow wage

curve corresponding to this labour supply, $w_s(w^*)$, equals the net revenue product of labour, ϕ . When a minimum wage w^m is imposed, this raises competitor wages and shifts the firm's labour supply curve inward to $L_i(w^m)$. The shadow wage is now discontinuous—it equals w^m as long as employment is less than L^m , and is given by $w_s(w^m)$ once employment exceeds L^m . To see that employment rises despite the inward shift in labour supply, consider L_i^e , which shows labour supply to the firm at any wage when *all* firms charge the same wage. This curve is upward sloping since higher wages raise the participation rate. Hence the minimum wage increases employment along this curve to the point L^m .

We now consider the effect of a minimum wage upon profits, focusing on the direct effects, on the assumption that the product price is fixed (in section 4 we discuss the indirect effects arising from price changes). Since a minimum wage raises both w_i and w_j , one for one, its effect can be broken down as follows:

$$\frac{d\pi_i}{dw^m} = \frac{\partial\pi_i}{\partial w_i} + \frac{\partial\pi_i}{\partial w_j} \quad (5)$$

Evaluate this expression at $w^m = w^*$, so that $w_i = w_j = w^*$. The envelope theorem implies that the first term is zero. However, the second term is negative, since a rise in competitor's wages reduces labour supply to firm i . Since the minimum wage raises competitor wages, it has a first order negative effect on profits. This negative effect under oligopsony differs from the situation under monopsony, where the firm faces no competitor in the labour market, and hence the second term does not exist. This argument can also be seen in Fig. 1. If the minimum wage only raised the firm's wage, without affecting competitor wages (as under monopsony), the firm would move along the $L_i(w^*)$ curve. Since this labour supply curve is tangent to the iso-profit curve ZP at w^* , profits are reduced, but by a negligible amount if the minimum wage is close to w^* . However, the rise in competitor wages implies that the firm moves along the L_i^e curve, which is *not* tangent to ZP , to the point L^m . Hence the negative effect on profits is first-order.

This negative externality in wage-setting is worth stressing since it does not seem to have been noticed before. Several authors (e.g., Card and Krueger (1995), Rebitzer and Taylor (1995)) have used the envelope theorem to argue that a minimum wage will have small direct effects upon profitability. As we have seen, this argument does not extend beyond the extreme case of monopsony. Wage-setting externalities arise in most models. For example, consider an efficiency wage model. If other employers offer higher wages, this reduces the cost of job-loss to the worker, resulting in lower effort, and lower profits for firm i .

We now consider the implications of free-entry, first upon the level of employment per firm, and then upon the number of firms. From Fig. 1 we can see that the effect on employment per firm continues to be positive under free entry, and is fact greater than under oligopsony. Suppose that the market equilibrium without a minimum wage had firms making zero profits, i.e., the ZP curve yields zero-profits. With a minimum wage w^m , employment rises to L^m , firms make losses, and some of them exit. This increases labour supply to the remaining firms—the low reservation wage workers of exiting firms are shared between them. Exit continues until firm level employment adjusts to maintain the equality between gross profits, $(\phi - w^m)L_i$, and the fixed production cost, c . Thus under free-entry, minimum-wage/employment combinations must move north-east along the zero-profit ZP curve, with remaining firms increasing their employment.

Under free entry a minimum wage obviously reduces the number of firms. Our analysis of profits implies that the impact on firm numbers must be first order. Since the impact on employment per firm is also first-order, we cannot derive unambiguous general conclusions about the net effect on industry employment without some convoluted and tedious calculations. While the details of these calculations are in the Appendix, we outline the general approach and its conclusions. Given a minimum wage, w^m and n firms, we can compute the associated equilibrium profits, $\pi^m(w^m, n)$. Solving this for n when $\pi^m = 0$ yields the equilibrium number of firms, $n^m(w^m)$, as a function of the minimum wage. Industry employment, E , given a minimum wage, is the product of employment per firm and the equilibrium number of firms. The derivative of industry employment with respect to the minimum wage is given by:

$$\frac{\partial E}{\partial w^m} = \frac{2\mu ct(\phi + v - 2w^m)}{[ct - 2\mu(\phi - w^m)(w^m - v)]^2} \quad (6)$$

The sign of this expression is the same as the sign of its numerator, and this yields two simple conclusions. First, if the minimum wage is less than the mean of the net revenue product of labour (ϕ) and the high reservation wage (v), aggregate employment is increasing in the minimum wage, and is decreasing otherwise. Second, if this derivative is negative at some minimum wage, it is also negative at any higher minimum wage. To gain further insight, we ask, what is the effect of a *small increase* in the minimum wage relative to the unconstrained equilibrium, w^* ? Evaluating the derivative (6) at the point $w^m = w^*$, we find that its sign depends on ct . If ct is sufficiently large, then total employment increases with a minimum wage; if ct is small, aggregate employment decreases. If either c or t is very small, the market is close to being competitive.⁶ The magnitude of the *product* of c and t captures the extent of

⁶If c is small, the number of firms will be large in equilibrium, and since workers do not have to ‘travel’ very far, firms will

distortion in the labour market.

To summarise, our predictions on the effects of a minimum wage are that i) firm level employment always increases ii) firms exit the industry, and iii) aggregate employment may increase or decrease, depending on whether the labour market is relatively distorted or not. This suggests that the positive employment effects found using firm-level data are not necessarily inconsistent with aggregate studies, which have tended in the main to find zero or weakly negative effects. Indeed, our model suggests that the two sorts of study are complementary.

In the light of these results we re-examine, Card and Krueger's analysis of fast food restaurants in New Jersey and Pennsylvania. They find that employment at the firm level increases in New Jersey, where the minimum wage was imposed, relative to Pennsylvania. This conclusion is robust to exit, since Card and Krueger are especially careful in re-sampling all New Jersey restaurants. They are unable to provide any direct evidence on entry in the two states. Instead, they relate information on the opening of McDonalds outlets between 1986 and 1991 across the US to minimum wage pressure, and find no evidence of any significant negative effect. This evidence seems less satisfactory in relation to the quality of the other evidence that they produce, and is understandable, given the difficulties in measuring entry. Nevertheless, entry seems particularly important—if fixed costs are partially sunk, then one would expect firm numbers to adjust by reduced entry rather than via increased exit.

2 Welfare Analysis

One advantage of our model is that we can examine the welfare effects of minimum wages, since we have fully specified micro-foundations for labour supply. We now consider separately the effects on low-reservation wage workers, the high-reservation wage workers and then producer and consumer surplus. The welfare effects of minimum wages are closely related to the employment effects. In particular, if employment increases with a small minimum wage, the average utility of each of the above groups rises. If employment falls, welfare effects are ambiguous since some groups are made better-off and others worse off.

Consider first the average utility of the low reservation wage workers. Since these workers always work, and minimum wages raise their earnings, one might expect that they would be better off; however, if firms exit, some of them have to accept less preferred jobs, and this reduces their utility. To see the net effect, observe that the derivative of the average utility of low reservation wage workers (U^0) with

have limited market power. Similarly if t is small, jobs are not very differentiated, and again the market is very competitive.

respect to the minimum wage is given by

$$\frac{\partial U^0}{\partial w^m} = \frac{(4 + 2\mu)(\phi - w^m)^2 - ct}{4(\phi - w^m)^2}. \quad (7)$$

The denominator is always positive and hence the sign of (7) depends only on the numerator. This will be negative if the minimum wage is set very high. However, if we evaluate the numerator at $w^m = w^*$, this is always positive (see Appendix). Thus the average utility of the 0-reservation wage workers is always increasing in a small but binding minimum wage, regardless of the effect of the minimum wage on aggregate employment.

Consider next the derivative of the average utility of the high reservation wage workers with respect to the minimum wage:

$$\frac{\partial U^v}{\partial w^m} = \frac{(w^m - v)^2}{t} \frac{\partial n^m}{\partial w^m} + 2n^m(w^m) \frac{w^m - v}{t} \quad (8)$$

The first term is negative and represents the effect of exit on high reservation wage worker utility. The second term is positive and represents the effect of increased wages. The sum is positive whenever employment increases as a result of the minimum wage and has an ambiguous sign when employment falls (see Appendix).

Since profits are zero with free entry/exit, a minimum wage has no effect on firm welfare. Finally, since the price effect has the opposite sign of the employment effect (see Section 3) when the product market is competitive, consumer welfare rises when employment rises, and falls when employment falls.

Let our welfare criterion W be *any* weighted sum of the average utilities of the above four types of agent, with strictly positive weights. Our results imply that W increases with a small, binding minimum wage if employment increases, since in this case, the utility of each type of agent increases. Furthermore, one can also show that a minimum wage which decreases employment may still increase welfare (see Appendix). This implies an interesting conclusion about the *welfare optimal minimum wage*—at such a welfare optimum, employment may be decreasing in the minimum wage.⁷

It may be useful at this point to discuss one comment and interpretation of our results. Our results

⁷One cannot obtain an unambiguous characterization of the behaviour of employment at the optimum minimum wage. In particular, it is not true that employment is decreasing in the minimum wage at such an optimum as one might guess. The high reservation wage workers are unambiguously better off with raises in the minimum wage which increase employment; however, this is not necessarily true for the low reservation wage workers. Initially, for these workers, a minimum wage unambiguously increases average utility (whether employment increases or decreases). However, further increases in the minimum, accelerate the rate at which firms exit and the increase in money income is outweighed by increased disutility from increasingly suboptimal job choices. Thus employment may be either increasing or decreasing in the minimum wage at the optimum minimum wage.

stems from the inefficiency of monopsonistic competition equilibrium, and it is often argued that such inefficiencies could be eliminated if we allowed firms to wage discriminate, by paying worker-specific wages. For such wage discrimination to be perfect, firms would require complete information on individual worker preferences (i.e., on each worker's location and reservation utility in our model). This intuition does not appear to be fully correct. In related work, Bhaskar and To (1998*b*) analyse a model of monopolistic competition with *perfect* price discrimination and find that this does not ensure efficiency. In the present paper we have assumed that the firm does not have information on worker preferences, making wage discrimination impossible. Wage discrimination may also cause morale problems. The empirical evidence shows that wage discrimination is limited and firms adopt indirect and less effective forms of discrimination. Card and Krueger's survey of New Jersey and Pennsylvania found that about one-third of the restaurants paid recruitment bonuses ranging from \$40 to \$75 to employees who brought in a friend to work in the restaurant. Such bonuses are a natural means of discrimination if the firm faces upward-sloping labour supply. The firm would be happy to pay the marginal employee more than the wage in order to induce her to join, provided that the firm can avoid paying this premium to all its existing employees, and recruitment bonuses avoid the morale problems associated with wage-discrimination.

3 Minimum Wages and Product Prices

We now relax our assumption that price is fixed. Consider first the case where firms are product market price-takers, but where the price is falling in total output. The qualitative effect of minimum wages upon employment is unaltered. More precisely, the *sign* of the effect of a minimum wage upon employment is unaffected but the *magnitude* of this effect is dampened. Suppose, for example, that a minimum wage raises employment. This can be thought of as an outward shift in the industry 'supply curve,' and will raise industry output and reduce industry price. The fall in price reduces the net revenue product of labour, ϕ , and leads firms to reduce capital intensity. It also reduces profits, prompting some more firms to exit, thereby reducing the magnitude of the increase in employment. Similarly, if parameter values are such that aggregate employment falls under fixed prices, the magnitude of the fall in aggregate employment will be less when prices vary. In general, the absolute magnitude of employment variations is larger if industry demand is the more elastic demand, since price varies less. The absolute magnitude of employment effects is also larger the greater the degree of substitutability in production.⁸

⁸Formally, if we define $\theta = -f'(k)^2/f(k)f''(k) > 0$ to be the *rent-elasticity* of output per worker and ϵ to be the price elasticity of demand, it can be shown that $dY/Y = \epsilon/(\epsilon + \theta)dL/L$ and $dp/p = -1/(\epsilon + \theta)dL/L$.

The prediction that price and employment co-variations are negative is contrary to Card and Krueger’s findings—both product price and employment rose in New Jersey (relative to Pennsylvania) with the increase in the minimum wage. This led critics to argue that the only explanation that is consistent with both employment and price effects is a positive demand shock in New Jersey, invalidating Card and Krueger’s ‘natural experiment.’ We now show that this conclusion is unwarranted—prices can rise even if aggregate employment rises once we allow for firms’ product market power. The basic reason is as follows: by inducing exit, minimum wages increase the product market power of firms (even as they reduce their labour market power), and this may cause a price rise, even as employment increases.

If both employment and prices are to rise with a minimum wage, one must have sufficient factor substitutability in production, so that additional employment can be used in order to substitute for capital rather than increase output. Since our purpose is to demonstrate this possibility, we consider the special case when capital and labour are perfect substitutes (i.e., $Y_i = \eta K_i + L_i$).

Assume that the n firms produce a homogeneous good and act as Cournot competitors. Since the number of firms is finite, this is sufficient to give firms some product market power. Summing over all firms’ first order conditions with respect to capital and dividing by n yields,⁹

$$\left(p' \frac{Y}{n} + p \right) \eta - r = 0 \quad (9)$$

This yields the market price as

$$p = \frac{r/\eta}{1 + \epsilon/n} \quad (10)$$

This is similar to an oligopoly pricing equation; market price is a fixed mark-up over marginal cost (r/η). Hence when n falls due to firm exit, the mark-up rises. More precisely, the effect of a decrease in n upon output is given by:

$$\frac{dY}{dn} = - \frac{(p - r/\eta)(2/(n + 1))}{p''(Y)(2Y/(n + 1)) + 2p'(Y)} > 0 \quad (11)$$

Since $p > r/\eta$ (price exceeds marginal cost) and the denominator is negative by our concavity assumption, this is positive. A minimum wage reduces industry output and increases price, because it induces exit by firms and increases the degree of monopoly power in the product market. This can well be

⁹We make the standard assumption that demand is not too convex so that the firm’s profit function is strictly concave (i.e., $p''(Y)Y_i + 2p'(Y) < 0$ for $Y_i \leq Y$).

associated with an increase in industry employment, under the same conditions as set out in Section 1.

We have focused on the case of a linear technology since it provides the clearest results. If we allow for more general production functions, minimum wages will always raise prices whenever employment falls. When employment rises, prices may rise or fall, depending upon whether the production function allows for more or less factor substitutability.

4 Concluding Comments

We developed a model of the labour market which differs significantly from perfect competition even though there is competition between employers and free entry. Our model hinges on two assumptions—fixed costs in production and imperfectly elastic labour supply to the firm, which in turn stems from our assumption that jobs are horizontally differentiated. The latter assumption maybe unfamiliar to labour economists, and merits more discussion. A similar assumption has a long standing in the industrial organization literature, where it is recognised that consumers may perceive products to be different *even if* these products are physically or functionally identical. There are stronger arguments for workers to differentiate between jobs, given that the choice of jobs is more significant than the choice between soft-drinks. Sociologically, work is an important part of an individual’s social life, and many workers’ social relations are built around the work-place.

Our assumptions are related to the well developed empirical literature on compensating wage differentials (see Rosen (1986) for a survey). The theory underlying this is one of vertical job differentiation, where all workers agree that one job is better than another. To generate monopsony power here, one must assume that there is heterogeneity of worker preferences, i.e., compensating differentials between jobs vary across individuals. Equilibrium wages will be always be lower in better jobs; however, labour supply to each firm will be a continuous increasing function of the wage. The extent of monopsony power that firms will have depends upon the extent of *dispersion* of compensating differentials across workers, rather than their average size. However, the empirical work in this area focuses on measuring the average compensating differential accurately, and there seems little information on the extent of dispersion, due to the difficulties in estimating *worker-specific* compensating differentials from market data.¹⁰

Data on heterogeneous worker preferences is more easily elicited via survey data. McCue and Reed (1996) analyse a survey where workers were asked about their willingness to accept different low-wage

¹⁰Indeed, the difficulties caused by heterogeneous worker preferences for the measurement even of ‘average’ compensating differentials has been well recognised in the literature—see, for example, Killingsworth (1986).

jobs at various wages and find “a significant heterogeneity in tastes” (p. 641). They calculate individual specific compensating differentials between each pair of jobs. The median of the *absolute* value of these differentials is relatively large, ranging from \$1.42 per hour to \$0.43 per hour. However, the median compensating differential is quite small, and is only 27 cents in the instance that the median of absolute values is \$1.42. Individual specific compensating differentials are also large in relation to the level of wages paid in these jobs. Similarly, in our model, the median compensating differential between a pair of jobs is zero, but the median of the absolute value of these differentials can be large if the transport cost parameter t is large. Our paper points to the need for additional empirical work on the extent of heterogeneity of worker preferences, given its implications for the extent of monopsony power.

There are a number of alternative theoretical explanations for positive minimum wage effects on employment, including efficiency wage models (Manning (1995), and Rebitzer and Taylor (1995)) and job search models (Burdett and Mortensen (1998)). Our main contribution as compared to the previous literature is that we are the only paper to focus on wage setting externalities and the resulting implications for firm entry and exit. We believe that our basic assumption of job heterogeneity is realistic. The resulting model is tractable, and we are able to completely analyse the effects of minimum wages, including welfare effects and the effects on product prices. Our predictions regarding the effects of minimum wages on employment and prices are consistent with the empirical evidence. The model can also be used to analyse other issues in labour economics—see Bhaskar and To (1998a) for an application of the current model to looking at the distribution of wages in the presence of heterogeneous firms.

Appendix

This appendix provides a derivation of the employment effects under free entry, our welfare results and the parameter restrictions required so that conditions a) and b) on page 3 are satisfied.

Free entry in an unrestricted labour market.

With n firms, equilibrium profits are given by

$$\pi^*(n) = \frac{(1 + 2\mu)(t + 2\mu n(\phi - v))^2}{(1 + 4\mu)^2 n^2 t} - c \quad (12)$$

Solving this for n when $\pi^* = 0$ yields:

$$n^* = \frac{t\sqrt{1 + 2\mu}}{(1 + 4\mu)\sqrt{ct} - 2\mu(\phi - v)\sqrt{1 + 2\mu}}. \quad (13)$$

In order for $n^* > 0$ we must have $ct > 4\mu^2(1 + 2\mu)(\phi - v)^2/(1 + 4\mu)^2$. Substituting n^* back into the equilibrium wage and labour supply yields $w^*(n^*) = \phi - \sqrt{ct}/\sqrt{1 + 2\mu}$ and $L^*(n^*) = \sqrt{ct(1 + 2\mu)}/t$.

We want equilibria where some high reservation wage workers work, $w^*(n^*) > v$. Subtracting and simplifying, $w^*(n^*) - v = \phi - v - \sqrt{ct}/\sqrt{1 + 2\mu}$. This is positive whenever $(1 + 2\mu)(\phi - v)^2 > ct$.

Parameter restrictions required under a minimum wage.

Equilibrium profits under a minimum wage is

$$\pi^m(w^m, n) = (\phi - w^m) \left(\frac{1}{n} + \frac{2\mu(w^m - v)}{t} \right) - c. \quad (14)$$

Solving for n when $\pi^m = 0$ yields

$$n^m(w^m) = \frac{t(\phi - w^m)}{ct - 2\mu(\phi - w^m)(w^m - v)}. \quad (15)$$

$n^m > 0$ is ensured by $ct > 2\mu(\phi - w^m)(w^m - v)$. The RSH is maximised when $w^m = (\phi + v)/2$ and hence reduces to $ct > \mu(\phi - v)^2/2$. It can be easily shown that the earlier constraint is satisfied whenever this holds. Together with the upper-bound, this implies $(1 + 2\mu)(\phi - v)^2 > ct > \mu(\phi - v)^2/2$.

Effect of a small binding minimum wage on aggregate employment

Simplifying $\phi + v - 2w^*(n^*)$ yields $\phi + v - 2w^*(n^*) = 2\sqrt{ct}/\sqrt{1 + 2\mu} - (\phi - v)$. This is positive if ct is sufficiently large and negative if ct is small. In particular, if we substitute the lower bound on ct , we see that this is negative; it is positive if we substitute the upper-bound on ct .

Welfare effect of a small binding minimum wage on 0-reservation wage workers.

Simplifying the numerator of (7) at $w^m = w^*$ yields $3ct/(1 + 2\mu)$. This is always positive.

Welfare effect of a small binding minimum wage on v -reservation wage workers.

Simplifying (8) yields

$$\frac{\partial U^v}{\partial w^m} = \frac{(w^m - v)[ct(\phi + v - 2w^m) + ct(\phi - w^m) - 2\mu(\phi - w^m)^2(w^m - v)]}{(ct - 2\mu(\phi - w^m)(w^m - v))^2}$$

The first term within the square brackets is positive when total employment is increasing in the minimum wage (see (6)). The sum of the remaining two terms is positive by the parameter restrictions.

Overall welfare effect of a minimum wage

Let welfare be measured as $W = \delta_0 U^0 + \delta_v U^v + \delta_P PS + \delta_C CS$ for arbitrary $\delta_i > 0, i = 0, v, P, C$. We will now show that even if ct is such that employment falls with w^m , it can be the case that $\delta_v \partial U^v / \partial w^m > \delta_C \partial CS / \partial w^m$. Since $PS = 0$ for any w^m , this implies that a minimum wage can still raise welfare, *even if it reduces employment*.

Take ct close to but greater than $\mu(\phi - v)^2/2$ (the lower-bound on ct), the first term in the numerator of $\partial U^v / \partial w^m$ is strictly negative and increases if ct is increased. Thus for some ct , the first term is negative but arbitrarily close to zero so that employment is falling. The sum of remaining the two terms of the numerator and the denominator are positive for ct close to but greater than $\mu(\phi - v)^2/2$ and is increasing as ct increases. Since the first term can be negative and made arbitrarily close to zero and the sum of the remaining terms are strictly positive and bounded away from zero, $\partial U^v / \partial w^m|_{w^m=w^*(n^*)}$ can be positive even when employment is falling. The employment effect can be made arbitrarily small, and as a result, the price effect can be made arbitrarily small and therefore the gains in high reservation wage worker welfare can outweigh the loss in consumer surplus.

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