The 'perverse' effects of wage and price controls in search markets*

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This paper examines the effects of price ceilings and minimum wages on the performance of markets in which agents must invest in costly search to become informed about prices or wages. In this context it is found that the market equilibrium may respond to changes in policy instruments in strikingly counterintuitive ways. In particular, the imposition of price ceilings and minimum wages may respectively result in consumer price increases and wage decreases. Thus an important implication of our analysis is that when unions fight to increase wages by raising the minimum wage, they may, paradoxically, actually be reducing the average wage of its members.

1. Introduction

There are few issues on which there is as broad a consensus of opinion among economists as with regard to the effects of price and wage controls. According to the received wisdom, an increased minimum wage benefits the employed, but by raising wages, also increases the number of unemployed workers. Similarly, price ceilings lower the cost of purchase for consumers who are able to buy the good, but can lead to shortages, non-price rationing and the flourishing of black markets. This view takes for granted that controls, when effective, do actually affect the market price or wage in the intended direction, i.e., pushing wages up in the case of a minimum wage and reducing consumer prices in the case of a price ceiling. Our purpose in this

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1This is the view of Milton Friedman, for example, as quoted in an interview in Dialogue, No. 90, 4/90, pp. 21-22.
paper is to challenge the conventional wisdom and argue that the direction in which wages and prices are affected by controls may well be opposite to that intended.

To be sure, the accepted approach is irrefutable within the abstraction of a perfectly competitive market governed by the law of one price. In that context, controls exert a uniform effect on all market prices and wages. Beginning with the seminal work of Stigler (1961), however, a large body of both theoretical and empirical research has made us aware that in the absence of a Walrasian auctioneer, the law of one price need not apply: when information about the prices and wages of different firms is scarce and costly to acquire, different firms may charge different prices for the same good or offer different wages for the same job. In markets characterized by price and wage dispersion, only the highest market prices (i.e. those initially above the ceiling) are affected directly by a price ceiling and only the lowest market wages are directly affected by a minimum wage. These initial changes at the extremes of the wage and price spectrum, by altering the shape of the wage and price distribution, affect the behavior of consumers (workers) and competing firms in complex ways. A complete analysis must therefore account for the overall impact of price and wage controls on the equilibrium price and wage distributions. More specifically, consider a market for a homogeneous product distinguished by price dispersion in which consumers search for low prices. Intuitively, the extent to which prices may vary in equilibrium is restricted by the amount of search activity in which consumers engage; the more consumers search, the more competitively the market should behave. The optimal amount of search is, in turn, determined by the shape of the price distribution; the expected benefit from search is greater the more prices vary and, in equilibrium is balanced against the cost of search. Against this background, the effect of a price ceiling might be to lower the expected benefit from additional search, reduce the equilibrium amount of search activity and thus endow firms with increased market power. Firms whose prices are initially below the ceiling may exploit such increased market power to charge higher prices. Thus, while some prices are certainly reduced by the price ceiling, the net effect on the equilibrium price distribution is unclear and in particular may increase the average market price. Similarly, a minimum wage restricts the variability of wage offers, reduces the incentive for job search and may lower the average wage.

Technically, the paper is based on a comparative static of the Burdett and Judd equilibrium search model [Burdett and Judd (1983)]. The features of this model which make it particularly suitable for our purpose are that consumers (workers) search actively in equilibrium and that, moreover, the

2For other search models which accounts for price dispersion as an equilibrium phenomenon, see for example, Albrecht and Axell (1984), Carlson and McAfee (1983), Reinganum (1979) and Rob (1985) and a recent survey by Burdett (1990).
equilibrium intensity of search, i.e., the number of prices canvassed per search is endogenously determined in response to the potential benefit from search. In the context of this model, our above intuition about the effects of price and wage controls on the average price and wage is richly substantiated: When the market equilibrium is characterized by price dispersion, imposing an effective legal price ceiling unambiguously increases the average market price. Similarly, a minimum wage unambiguously decreases the average market wage. Thus an important policy implication of our analysis is that when unions fight to increase wages by raising the minimum wage, they may, paradoxically, actually be reducing the average wage of its members.

Our analysis has some equally unconventional implications with respect to the effects of sales taxes. In particular we show that an increase in the sales tax may increase producer prices and profits. Thus in markets where prices are determined in part by the extent of consumers' search, the evaluation of tax policy cannot be narrowly restricted to its direct effects on prices but must also account for secondary effects on search intensity and the market power of firms.

The counterintuitive implications of our analysis illustrate what appears to be a more general feature of equilibrium search models: Second round policy effects on search behavior may be important and lead to 'perverse' behavior. For example Albrecht and Axell (1984) present a search model in which an increase in unemployment insurance may, in some cases increase employment. A related point is also made by Stiglitz (1987) who shows that for some search technologies, an increase in the number of firms in the market may be anticompetitive.

The paper proceeds as follows: In section 2 we present the basic market setting in the context of price search. In section 3 we analyze the effects of price ceiling on the equilibrium price distribution within this setting. Section 4 extends the model to a labor market and explores the effect of minimum wages on the equilibrium wage distribution. Section 5 looks at the implication of our analysis for the effect of sales tax on the equilibrium prices.

2. A model of price dispersion

We use the equilibrium search model of Burdett and Judd (1983) (henceforth B–J), a brief review of which follows. A market for a homogeneous good consists of a continuum of firms and consumers. The measure of consumers per firm is \( \gamma > 0 \). Each firm is able to supply an unlimited quantity at a constant marginal cost, assumed, for simplicity, to be zero.

Each consumer has inelastic demand for exactly one unit of the good for

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3This implies that individual sellers and buyers behave as if their behavior has no effect on the distribution of prices in the market.
which she is willing to pay $p^* > 0$ at the most. Consumers are unaware of the price charged by each firm and, prior to buying, must first solicit price quotations from one or more firms at a cost of $c > 0$ per price. Firms may in principle charge different prices and we denote the distribution function of prices as $F(p)$. Thus any price quotation demanded by a consumer constitutes a random draw from $F(p)$.

Consumers act to minimize the overall cost of buying the good which includes the price paid for the product plus sampling costs. Firms choose prices to maximize their profits taking as given the prices of other firms and the consumers' search behavior.

The search technology is as follows. A consumer first solicits and pays for a sample of $n$ prices, where $n$ is any positive integer. After observing her price sample, the consumer purchases the good at the lowest available price as long as this price does not exceed her reservation price $p^*$. While this procedure is non-sequential, recent work [e.g., Benhabib and Bull (1983), Manning and Morgan (1982)] indicates that it may be appropriate when price offers are subject to delay and consumers are impatient to buy. It is possible, however, to extend the model to include a search technology which combines elements of both fixed sample size and sequential search [see Fershtman and Fishman (1992b)].

Let $q_n$ denote the probability that a randomly selected consumer demands exactly $n$ price quotations, $\sum_{n=1}^{\infty} q_n = 1$. Alternatively, one may interpret the consumers' search rule as a mixed strategy such that $q_n$ is the probability of sampling $n$ prices. It is useful to think of $\langle q_n \rangle_{n=1}^{\infty}$ as a description of the consumers' search intensity. The consumers' search behavior is fully described by $(\langle q_n \rangle_{n=1}^{\infty}, p^*)$.

A market equilibrium is defined by $\{F(p), \langle q_n \rangle_{n=1}^{\infty}, p^*\}$ such that:

(a) given $\langle q_n \rangle_{n=1}^{\infty}$ and $p^*$, all firms charging a price in the support of $F(p)$ earn equal profits and cannot earn more by charging a price outside the support.

(b) Given the price distribution $F(p)$, the consumers' search intensity $\langle q_n \rangle_{n=1}^{\infty}$ describes the optimal search response. In particular, no consumer can benefit by changing her search strategy.

Analyzing the above model, B–J show that corresponding to every positive search cost there exists a single price, Diamond (1971) equilibrium, in which each firm's price is the monopoly price, $p^*$. This equilibrium clashes with basic economic intuition which suggests that the firms' market power should be proportional to the cost of search. There is, however, a more intuitive type of equilibrium in which prices are dispersed if search costs are small, while the monopoly price obtains only if search costs are relatively large.
Specifically, corresponding to each \( p^* \), there exists \( c^* > 0 \) such that if \( c > c^* \) all firms charge the monopoly price. If \( c \leq c^* \), however, prices are distributed continuously between the lowest price in the market, \( p \) (derived below), \( 0 < p < p^* \), and the monopoly price. In the latter case, a proportion \( q \) of consumers, \( 0 < q < 1 \), samples only one price while the proportion \( 1 - q \) samples two prices (no consumers sample more than twice). Consumers who search twice incur greater search costs, but pay lower prices on average. At the same time, high priced firms earn more per unit sold but make fewer sales to consumers who search twice. The equilibrium price distribution is constructed to balance these factors so that

(i) all firms earn equal profits
(ii) the expected total expenditure of consumers who search twice (including the additional search cost) equals that of those who search only once.

In particular, firms that charge \( p^* \) sell only to consumers who search once because those who search twice are sure to observe at least one price below \( p^* \). Therefore those firms' expected profit is \( q p^* \). A firm whose price is \( p < p^* \) sells to all of its consumers who search once and to those of its twice-searching consumers whose second price is greater than \( p \). If \( F(p) \) denotes the cumulative price distribution, the probability that \( p \) is the lowest price sampled by a consumer who searches twice is \( 1 - F(p) \). Therefore this firm's expected profit is

\[
\gamma [q + 2(1 - q)(1 - F(p))] p.
\]

The equal profit condition requires that the profit from \( p^* \) equals the profit from any price \( p < p^* \) in the support of the distribution. Thus

\[
\gamma q p^* = \gamma [q + 2(1 - q)(1 - F(p))] p.
\]  
\( \gamma q p^* = \gamma [q + 2(1 - q)(1 - F(p))] p. \)  \( \text{(1)} \)

Indicating by \( F^{p^*} (\cdot) \) the dependence of \( F(\cdot) \) on the relevant parameters, we obtain from (1) that

\[
F^{p^*} (p) = \begin{cases} 
0 & \text{if } p \leq p^* , \\
1 - \left( \frac{p^* - p}{p} \right) \left( \frac{q}{2(1 - q)} \right) & \text{if } p \leq p \leq p^* , \\
1 & \text{if } p > p^* .
\end{cases}
\]  
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0 & \text{if } p \leq p^* , \\
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1 & \text{if } p > p^* .
\end{cases} \)  \( \text{(2)} \)

The lowest price, \( p \), is derived by noting that \( 1 - F(p) = 1 \) and substituting in (1), yielding

\[
p = p^* q / (2 - q).
\]  
\( p = p^* q / (2 - q). \)  \( \text{(3)} \)

\( q \) is in turn determined by the optimal search behavior of consumers in response to \( F^{p^*} (\cdot) \). Let \( V(p^*, q) \) be the expected difference between the price paid by a consumer who searches twice and a consumer who searches once.
The expected price paid by a consumer who searches only once is just the mean of the price distribution: $E_1 = \int_2^\infty p dF^q(p)$. The expected price paid by a consumer who searches twice is: $E_2 = \int_2^\infty p (1 - F^q(p)) dF^q(p)$.

Thus, $V(p^*, q) = E_2 - E_1$. In equilibrium, the savings from searching twice must equal the additional search cost, i.e., $V(p^*, q) = c$. Substituting from (2), integrating by parts and carrying out the indicated integration gives the condition

$$V(p^*, q) = p^* \left[ \frac{q}{2(1-q)^2} \ln \left( \frac{2-q}{q} \right) - \frac{q}{1-q} \right] = c. \quad (4)$$

B–J show that $V(p^*, q)$ is single peaked, attaining a unique maximum at some $q^*, 0 < q^* < 1$, is strictly increasing (decreasing) if $q^* > q > 0$ (if $q^* < q < 1$) and $V(p^*, q) \to 0$ as $q \to 0$ or $q \to 1$.

The function $V(\cdot, \cdot)$ is illustrated in fig. 1. It is apparent that if $c < c^*$ there exist two different price dispersion equilibria corresponding to $q^0 < q < q^*$ and $q^1 > q^*$ in fig. 1 respectively.

Note, however, that although two price dispersed equilibria exist, only one of these equilibria is stable. Consider the equilibrium at $q^1$. If $q > q^1$ it becomes unprofitable to search twice as $V(p^*, p) < c$ and thus $q$ will increase to 1. An analogous argument obtains for $q < q^1$. On the other hand, $q^0$ is stable; for every $q^0 < q < q^1$, $V(p^*, q) > c$ and the number of consumers who wish to search twice increases, moving $q$ towards $q^0$. Similarly if $q < q^0$, $V(p^*, q) < c$, the number of consumers who search once increases, moving $q$ towards $q^0$. In our analysis we therefore restrict attention to the stable equilibrium. This completes our review of the B–J model of price dispersion.

*We are grateful to Dale Mortensen for pointing the stability property to us. Also note that the unstable equilibrium has the unappealing feature that as the search cost becomes arbitrarily small, $q \to 1$ and the average price approaches $p^*$. In the stable equilibrium, on the other hand, the average price approaches the competitive one as the search cost goes to zero.
3. Price ceilings

Let us assume that the government’s objective, for whatever reason, is to control prices by imposing a legal price ceiling. It is obvious that the price ceiling can affect actual prices only if it is strictly below the consumers’ reservation price, \( p^* \). Note that by (2), prior to the imposition of the price ceiling, a positive measure of firms charges prices in the neighborhood of \( p^* \) even in a dispersed price equilibrium. Since these prices are now illegal, it follows that the equilibrium price distribution and the concomitant equilibrium search behavior are affected.

Let \( \tilde{p} < p^* \) be the price ceiling. The new market equilibrium can now be calculated, replacing \( p^* \) by \( \tilde{p} \) as the highest price. Let

\[
\tilde{p}(c) = \inf\{p \in R_+ \mid \text{there is a } 0 \leq q \leq 1 \text{ such that } V(p, q) = c\}. \tag{5}
\]

That is, \( \tilde{p}(c) \) is a critical value such that for every price ceiling \( \tilde{p} \geq \tilde{p}(c) \), prices are dispersed in equilibrium while for \( \tilde{p} < \tilde{p}(c) \) the equilibrium is characterized by a single price. Let \( A(\tilde{p}) \) be the average market price as a function of the price ceiling. If \( \tilde{p} < \tilde{p}(c) \) all firms charge the same price and thus \( A(\tilde{p}) = \min \{\tilde{p}, p^*\} \). For \( \tilde{p} \geq \tilde{p}(c) \), prices are dispersed according to \( F_{\tilde{p}, p^*}(p) \) as described by (2). In that case

\[
A(\tilde{p}) = \tilde{p} \int \frac{q}{2(1-q)} \ln(\frac{2-q}{q}) \, dp. \tag{6}
\]

Substituting from (2), integrating by parts, letting \( F(p) = 0, F(\tilde{p}) = 1 \) and \( \tilde{p} = \tilde{p}/(2-q) \) yields

\[
A(\tilde{p}) = \tilde{p} - \int \left[ 1 - \left( \frac{\tilde{p} - p}{p} \right) \frac{q}{2(1-q)} \right] dp. \tag{7}
\]

Solving for the integral in (7) yields

\[
A(\tilde{p}) = \tilde{p} - \frac{q}{2(1-q)} (\tilde{p} - p) + \frac{q \tilde{p}}{2(1-q)} (\ln \tilde{p} - \ln p). \tag{8}
\]

Substituting for \( p \) and simplifying we obtain

\[
A(\tilde{p}) = \tilde{p} - \frac{q}{2(1-q)} \ln \left( \frac{\tilde{p} - q}{q} \right). \tag{9}
\]

**Proposition 1.** Let \( \tilde{p} > \tilde{p}(c) \). An increase in the price ceiling, \( \tilde{p} \), lowers the average equilibrium price, i.e. \( dA(\tilde{p})/d\tilde{p} < 0 \).

**Proof.** Differentiating (9) yields
\[
\frac{dA(\bar{p})}{d\bar{p}} = \frac{\partial A(\bar{p})}{\partial \bar{p}} + \frac{\partial A(\bar{p})}{\partial q} \frac{dq}{d\bar{p}}, \tag{10}
\]

where

\[
\frac{\partial A(\bar{p})}{\partial q} = \bar{p} \left[ \ln \left( \frac{2-q}{q} \right) - \frac{1}{2(1-q)^2} - \left( (1-q)(2-q) \right)^{-1} \right]. \tag{11}
\]

\(\partial A(\bar{p})/\partial q\) is strictly positive for \(0 < q < 1\). \(dq/d\bar{p}\) is calculated by implicitly differentiating \(V(\bar{p}, q) = c\). Differentiating (4) yields

\[
\frac{\partial V(\bar{p}, q)}{\partial \bar{p}} = \frac{q}{2(1-q)^2} \ln \left( \frac{2-q}{q} \right) - \frac{q}{1-q} \tag{12a}
\]

\[
\frac{\partial V(\bar{p}, q)}{\partial q} = \frac{\bar{p}(3-q)}{(1-q)^2(q-2)} - \frac{\bar{p}(q+1) \ln \left( (2-q)/q \right)}{2(q-1)^3}. \tag{12b}
\]

Using (12a) and (12b) to calculate \(dq/d\bar{p}\), differentiating (9) to calculate \(\partial A(\bar{p})/\partial q\), and substituting the result into (10) yields

\[
\frac{dA(\bar{p})}{d\bar{p}} = \frac{q}{2(1-q)} \ln \left( \frac{2-q}{q} \right) - q \left[ \frac{\ln((2-q)/q)}{2(1-q)} - (2-q)^{-1} \right] \left[ \frac{1}{2(1-q)} \ln \left( \frac{2-q}{q} \right) - 1 \right] \tag{13}
\]

\[
- \frac{(q-3)}{(2-q)} + \frac{(1+q) \ln \left( \frac{2-q}{q} \right)}{2(1-q)} \left( \frac{2-q}{q} \right)
\]

It is shown in the appendix that the sign of the RHS of (13) is negative for \(0 < q < q^*\). \(\square\)

The intuition behind Proposition 1 is brought out by (10). \(\partial A(\bar{p})/d\bar{p}\) is the \textit{direct} impact which has been shown to be positive. The indirect effect operates through the effect on the equilibrium search intensity. This is captured by the second term on the RHS of (10). \(\partial A(\bar{p})/\partial q\) represents the effect of a change in search intensity on the average price. As \(q\) increases, the percentage of consumers who sample only once increases, reducing competition between firms and driving the average price up. \(dq/d\bar{p}\) represents the effect of a higher price ceiling on the search intensity. As shown in the proof of Proposition 1, as \(\bar{p}\) is increased, the equilibrium search intensity is also increased (i.e. \(q\) decreases). The overall indirect effect, given by the second term on the RHS of (10), is therefore negative, and moreover, as shown in the proof, dominates the direct effect. Note that although an increase in the
price ceiling reduces the average price, this does not imply that all sellers’ prices are reduced. On the contrary, since a positive measure of firms charge prices in the neighborhood of the price ceiling in any equilibrium, some firms’ prices must increase in response to the change.

It is also possible for a small reduction of the price ceiling to lower the average price by a disproportionately large amount. This occurs if the price ceiling is initially above the critical level, \( \hat{p}(c) \), and is reduced below it. As long as the price ceiling is above \( \hat{p}(c) \), a price dispersion equilibrium obtains. In that case, consumer search serves to maintain the average price below the price ceiling. Once the price ceiling falls below \( \hat{p}(c) \), however, there is a shift to a single price equilibrium. Absent price dispersion, consumers cease to search and the average market price coincides with the new price ceiling. Consequently, the average price may rise discontinuously by an amount which is disproportionate to the change in the price ceiling. We elaborate on this effect more fully below in the context of a specific numerical simulation.

**Simulation**

In the following simulation we illustrate the effects of price ceilings on the average price. Consider a market in which the consumers’ reservation price is \( p^* = 16 \) and the sampling cost is \( c = 1 \). In table 1 we show the average price as a function of the price ceiling.

One can calculate that in this example \( \hat{p}(1) = 9.63 \). If the price ceiling \( \hat{p} \geq 9.63 \), prices are dispersed. In this case the average price is reduced by an
increase in the price ceiling, in accordance with Proposition 1. This decrease in the average price results from the decreased amount of search which accompanies an increase in the price ceiling. For example, when $\tilde{p} = 10$, $q = 0.26$ so that only 74 percent of consumers sample two prices. When the price ceiling is increased to $\tilde{p} = 15$, more than 91 percent of consumers sample twice. If the price ceiling is initially less than 9.63, there is a single price equilibrium in which each consumer samples only one price. In that case, an increase in the price ceiling which maintains it below 9.63 simply increases the market price by the full amount of the increase.

Table 1 also illustrates how a small change in the price ceiling can have a dramatically large impact on the average price. Thus, suppose the price ceiling is initially $\tilde{p} = 10$. Since 10 is above the critical value 9.63, prices are dispersed and consumer search maintains the average price at only 3.35. Now, suppose the price ceiling is decreased below the critical level to, say, 9. As a result of this change, the range of prices in the market becomes too small to support consumer search ($q = 1$). In the absence of consumer search, the firms exploit their market power to charge the new maximum price, shifting the outcome from a dispersed price equilibrium to a single price equilibrium. Indeed, since there is no price dispersion if the price ceiling is below the critical value, the average price and the price ceiling coincide. It is only when the price ceiling is above the critical value and prices are dispersed that there is a disparity between the maximum price and the market average. Therefore, any change in the price ceiling from above the critical value to below it is accompanied by a dramatic and discontinuous increase in the average price.$^5$

4. Minimum wages

One may adapt the model of price dispersion developed in the previous sections to a labor market including wage setting firms and workers who search for highly paid jobs. Each worker has an identical reservation wage, $w^*$ and an identical constant marginal productivity of $\lambda$. Search is costly: workers pay $c$ dollars for every wage offer and may sample as many wage offers as desired. Employers sell the workers' product in a competitive market at a constant price of $p$. Thus a firm's profit from hiring a worker at the wage $w$ is $\lambda p - w$.

The derivation of the equilibrium wage distribution is completely analogous to that of the price distribution in the previous section. There exists a cutoff level $\bar{w}(c)$ such that wages are distributed continuously if the reservation wage is below this level and such that the average wage is a decreasing

$^5$A formal proof of this statement is contained in our working paper [Fershtman and Fishman (1992a)].
function of the reservation wage. Thus we have the following corollary of Proposition 1:

Corollary 1. Suppose the workers' reservation wage is below the cutoff level \( \tilde{w}(c) \). Then the imposition of a minimum wage \( \tilde{w}^* < \tilde{w} \leq \tilde{w}(c) \), lowers the average wage.

The intuition behind this result corresponds to our earlier reasoning. An increase in the minimum wage increases the lowest possible wage a worker can expect to encounter. This has the effect of reducing the value and hence the intensity of the workers' search. As a consequence of reduced search activity the employers' market power is enhanced, causing the wages of employers whose wages were initially above the new minimum wage to decrease. While the wages of the lowest paid workers rise, the net effect on the equilibrium wage distribution is to shift the average wage down, to the detriment of workers.

5. Sales tax

The effects of sales taxes on market performance is well documented in the economic literature, e.g. Atkinson and Stiglitz (1980). According to conventional wisdom, the burden of the tax is borne by both consumers and sellers,
reducing the producers’ price and increasing the consumer price by less than the amount of the tax.\textsuperscript{6}

We reexamine this conventional wisdom in the context of our search model. Let $t$ denote the amount of the (per unit) sales tax and assume, for simplicity, that the tax is imposed on consumers. In this case the consumer, whose purchase cost now includes the sales tax, is willing to pay only $p^* - t$ at the most. Thus an increase in the sales tax is equivalent to a decrease of the price ceiling by the same amount. This equivalence permits the direct application of our earlier analysis. In particular, we have as a direct application of Proposition 1:

\textbf{Corollary 2.} Suppose that $p^* \geq p(c)$. The imposition of a sales tax in the amount of $t$ increases the average consumer price by more than $t$ and increases the profit of each seller.

As the increase in the sales tax increases the average consumer price by more than $t$, the average producer’s price is increased as well. Since the total quantity sold in the market is constant, the equal profit condition implies that the profit of each seller is increased. Consider, for example, those firms which always charge the highest possible price. The imposition of the tax reduces these firms’ prices from $p^*$ to $p^* - t$. This is only the direct effect on their profits, however. The indirect effect is to sufficiently reduce the equilibrium search intensity so that the increased sales of these firms more than compensates them for the reduction in their per unit price.

\textbf{6. Concluding remarks}

In a market in which information about prices is costly, it has been shown that the effects of interventionist policies may run contrary to established thinking; price controls and sales tax reductions may increase average consumer prices, while the legislation of minimum wages may decrease average wages.

In a competitive market, an increase in the minimum wage affects all wages uniformly. As a result there exists a tradeoff between a higher wage for the employed, on the one hand, and higher unemployment, on the other. Labor leadership must bear this tradeoff in mind when pressing for a higher minimum wage. Our analysis makes it clear that in a decentralized market there is a second type of tradeoff to consider, one which applies to the wages of the employed. While an increased minimum wage raises the wages of lower paid workers, it reduces those of higher paid workers, and, as is the

\textsuperscript{6}A perverse situation may, of course, occur when the supply function is downward bending, but this possibility is more of a curiosium than a plausible hypothesis.
case in our search model, the net effect may well be to reduce the average wage.

Appendix

The purpose of this appendix is to show that the RHS of eq. (13) \( <0 \) for \( q < q^* \). By (12b), the denominator of the second term on the RHS of (13) is equal to \( [(1-q)^2/p] \cdot [\partial V(\bar{p}, q)/\partial q] \). By the analysis of B–J the last expression is positive (see fig. 1). Thus, since the denominator of the first term is obviously positive, the common denominator of the RHS is positive. Therefore, simplifying the RHS, its sign is identical to the sign of the numerator, which after some calculations reduces to \( [q\{\ln((2-q)/q)\}^2-1]/2(1-q) \). So \( \frac{dA(\bar{p})}{d\bar{p}} <0 \) for \( q < q^* \) if the preceding expression is negative for \( q < q^* \), i.e., if

\[
\ln\left(\frac{2-q}{q}\right)^2 < \frac{2(1-q)}{q}.
\]

Examination of (12b) reveals that \( \partial V(\cdot, q)/\partial q <0 \) for \( q \geq \frac{2}{3} \). Therefore \( q^* < \frac{2}{3} \). So to show that (A.1) is true for \( 0 < q < q^* \), it is enough to show that it holds for \( 0 < q < \frac{2}{3} \). It is immediately verifiable that (A.1) holds for \( q = \frac{2}{3} \). Therefore it also holds for any \( 0 < q < \frac{2}{3} \) if

\[
\frac{d\{\ln((2-q)/q)^2\}}{dq} > \frac{d\{2(1-q)/q\}}{dq} \quad \text{for} \quad 0 < q < \frac{2}{3}.
\]

Carrying out the differentiation and simplifying shows that (A.2) is equivalent to

\[
\ln\left(\frac{2-q}{q}\right) < \frac{2-q}{q} \quad \text{for} \quad 0 < q < \frac{2}{3}.
\]

(A.3) clearly holds for \( q = \frac{2}{3} \). To show that it holds for any \( 0 < q < \frac{2}{3} \), we repeat the above procedure. Differentiating both sides of (A.3) and simplifying shows that (A.3) is equivalent to

\[
3q < 2,
\]

which is true for \( q < \frac{2}{3} \). This completes the proof.

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