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Abstract

This paper shows that a high-wage country might reduce its unemployment by trading with a low-wage economy, despite popular predictions to the contrary. We demonstrate this possibility in a Heckscher-Ohlin-Samuelson type of model with two countries, which differ only because one of them has a binding minimum-wage constraint and a technological improvement that (despite the heightened wage) creates a comparative advantage in the labor-intensive good. Under these circumstances, the minimum-wage economy will experience an unemployment reduction when it trades with a low-wage counterpart. This theoretical result is consistent with some recent empirical estimates.

JEL Classification Code: F16

Key Words: Trade, Unemployment, Minimum wage, Country-specific technology

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1. Introduction

As this paper shows, a high-wage country might reduce its unemployment by trading with a low-wage country, even though the opposite outcome is routinely predicted in public-policy debates on globalization. In our model, a reduction in unemployment occurs when the former country's exports are relatively intensive in labor (instead of capital). This factor-intensity scenario is reminiscent of what Leontief (1953) paradoxically found for the United States, contrary to the Heckscher-Ohlin Theorem on the pattern of trade for a labor-scarce (capital-abundant) economy.[1] As shown by Trefler (1993), however, the Leontief Paradox can be resolved when international differences in technology are taken into account.[2] A type of technological difference between countries also plays a key role in the present paper.

Our analysis begins with a standard Heckscher-Ohlin-Samuelson type of model, including a pair of (initially) identical countries that use capital and labor to produce two consumer goods. Next, adopting techniques of Findlay and Grubert (1959), we let the home country have a Hicks-neutral technological improvement in producing the labor-intensive good.[3] Then, this country is

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[1] Subsequently, there were similar paradoxical findings for additional countries, as discussed by Baldwin's (2008, chaps. 3 and 4) review of the literature.

[2] Such differences are also used by Kiyota (2021), to resolve a related paradox identified by Brecher and Choudhri (1982).

[3] Alternatively, we could have assumed instead a factor-augmenting improvement, which uniformly increases the number of efficiency units of labor per employee throughout the home economy. However, under this alternative assumption, our results would become ambiguous, because the country with the higher wage per worker might then fail to have the higher wage per efficiency unit of labor.

subjected also to a minimum wage that creates unemployment, as in the work of Brecher (1974). In our resulting minimum-wage model with country-specific technology, trade can (under specified conditions) reduce unemployment of the high-wage (home) economy.[4]

Intuitively, the technological improvement tends to give the home country a comparative advantage in the labor-intensive good, while the minimum wage has the opposite effect. If the latter effect is outweighed by the former, the home country exports (imports) its labor-intensive (capital-intensive) good when trade is allowed to occur. In this case, there is a net increase in demand for home labor, and hence a reduction in the aggregate level of unemployment.

This intuition, however, leaves out the following important challenge. On the one hand, the minimum wage must be set high enough to be a binding (unemployment-creating) constraint, and to exceed the wage of the foreign (low-wage) country. On the other hand, this minimum must not be so high as to leave the home (technologically advanced) country without an overall comparative advantage in the labor-intensive good. Our analysis shows that there exists a relevant range for a minimum wage that simultaneously satisfies these conflicting requirements.

Although minimum wages are typically viewed as resulting from government legislation, they could arise instead from other institutional arrangements, such as social custom or labor unions. Alternatively, firms might not offer a wage below a constant level that minimizes the

[4] This possibility would not occur if there were no international differences in technology, as we know from the analysis of Davis (1998). However, in a shorter-run model with capital immobile between industries, a high-wage country might have an employment gain from trade with a technologically identical country, as shown by Brecher and Yu (2021).

cost of a unit of effort.[5] The present analysis simply assumes that the real wage is (for some reason) constrained by a fixed floor that exceeds the full-employment level.[6]

Our main result – namely, the possibility of a reduction in unemployment for a high-wage country via trade with a low-wage economy – is consistent with empirical estimates of Feenstra and Sasahara (2018). A key feature of their approach is to consider not only jobs lost through import competition but also jobs gained through export expansion. This general-equilibrium approach is also a central aspect of the present paper.

In section 2, we set up the basic model. Section 3 uses this model to show that trade with a low-wage country can reduce the national level of unemployment in a high-wage economy. Concluding comments are provided by section 4.

2. Model

Assuming two initially identical countries, we begin by describing the home one. It has fixed endowments of capital and labor, which are homogeneous and perfectly mobile domestically, but completely immobile internationally. Every firm in an industry has the same production function, with first-degree homogeneity and strict quasi-concavity. All consumers have the same utility function, which is homothetic and strictly quasi-concave. Producers and consumers

[5] This possibility is analyzed by Solow (1979), who makes an early contribution to the efficiency-wage literature. Akerlof and Yellen (1986) provide a collection and discussion of various contributions to this literature, including ones in which the efficiency wage is a decreasing function of the unemployment rate.

[6] For other ways to introduce unemployment into the theory of international trade, see Davidson and Matusz (2004, chap. 3).

maximize profits and utility, respectively, under perfect competition. Capital stays fully utilized, because its rental rate remains perfectly flexible. However, unemployment of labor arises when a minimum wage is introduced later in the analysis.

Home technology is described by

$$X_i = \lambda_i F^i(K_i, L_i) = \lambda_i L_i F^i(K_i / L_i, 1) \equiv \lambda_i L_i f_i(k_i), \quad i = 1, 2, \tag{1}$$

where X_i is output of good i; K_i and L_i denote capital and labor, respectively, in sector i; and an increase in the parameter λ_i represents a Hicks-neutral technological improvement in this sector. Each production function F_i has constant returns to scale and strictly positive but diminishing marginal products. The economy continues to produce both goods, 1 and 2.

The usual marginal-productivity conditions are

$$w_i = \lambda_i \partial F^i(K_i, L_i) / \partial L_i = \lambda_i [f_i(k_i) - k_i f_i'(k_i)], \quad i = 1, 2, \tag{2}$$

$$r_i = \lambda_i \partial F^i(K_i, L_i) / \partial K_i = \lambda_i f_i'(k_i), \tag{3}$$

where w_i and r_i respectively denote the wage rate of labor and rental rate of capital, both denominated in units of good i; while $f_i'(k_i) \equiv df_i(k_i) / dk_i$. Given factor mobility between sectors,

$$pw_1 = w_2, \tag{4}$$

$$pr_1 = r_2, \tag{5}$$

where p stands for the relative price of the first good in terms of the second. Let the first industry be more labor intensive than the second, so that $k_2 > k_1$ for any economy-wide set of factor prices.

Assuming that technology remains unchanged in sector 2, set $\lambda_2 \equiv 1$ and suppress the subscript of λ_1, which then becomes simply λ. Thus, from (2) and (4),

$$\lambda p = [f_2(k_2) - k_2 f_2'(k_2)] / [f_1(k_1) - k_1 f_1'(k_1)]. \tag{6}$$

Since the capital/labor ratio in each sector is a function of w_2 by well-known reasoning,[7] (6) can be rewritten as

$$\lambda p = s(w_2), \tag{7}$$

where s is a monotonic increasing function of w_2, in light of the Stolper-Samuelson (1941) Theorem.

In Figure 1, curve OS illustrates the relationship between p and w_2 in (7), for the initial value of λ. This curve starts at the origin if we assume the Inada (1963) Conditions (under which the marginal product of a factor approaches infinity or zero as the use of this factor approaches zero or infinity, respectively). The ratio w_2 / p continuously increases as we move up curve OS, in accordance with what Jones (1965) calls the "magnification effect" (according to which a rise in the relative price of a good leads to a proportionally greater increase in the real wage in terms of the other good). Initially, the home country is in autarkic equilibrium (with all markets cleared) at point A, where $p = \tilde{p}$ and $w_2 = \tilde{w}_2$.

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[7] Pick any value of w_2, which fixes k_2 [by (2)], which determines w_2 / r_2 [by (2) and (3)], which equals w_1 / r_1 [by (4) and (5)], which fixes k_1 [by (2) and (3)].

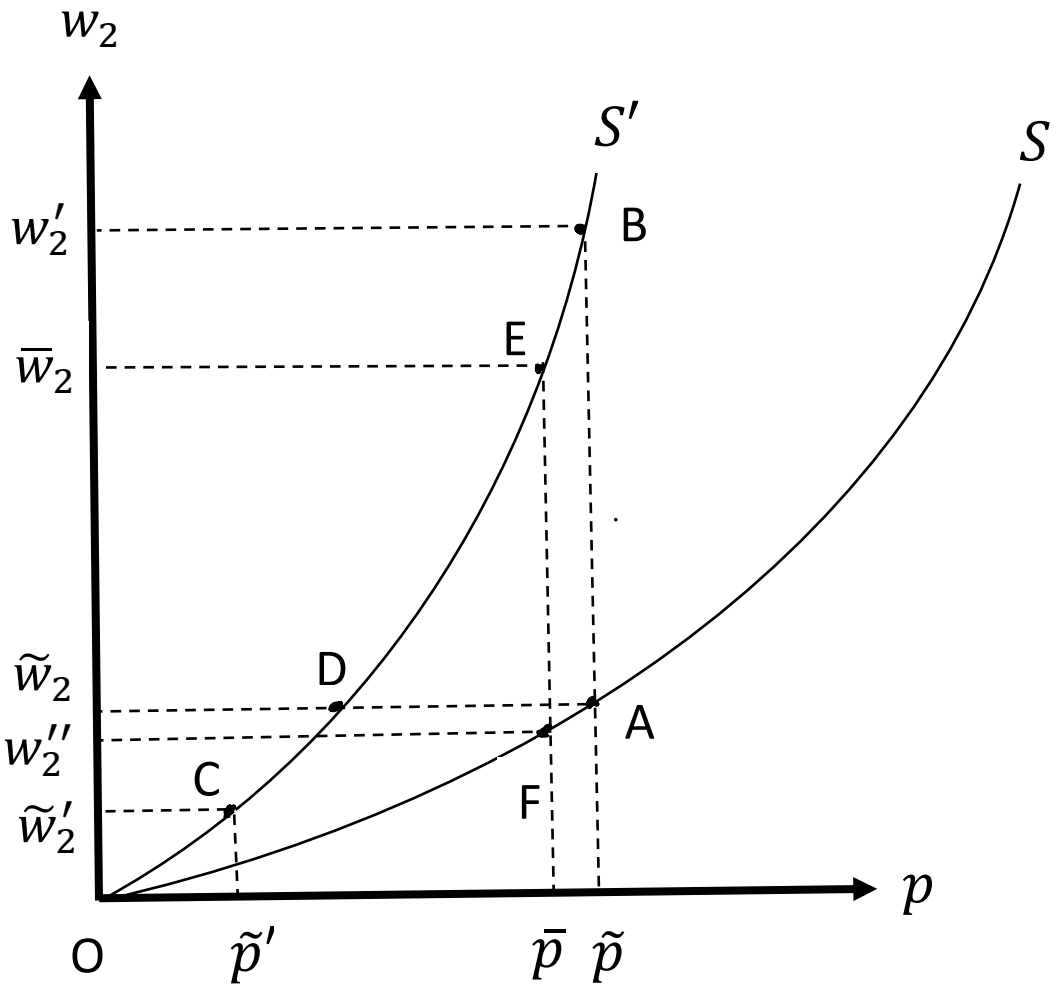

Figure 1

3. Analysis

Now increase λ to (say) twice its initial level. Then, for each value of w_2, the corresponding value of p in (7) is halved, thereby shifting curve OS leftward by 50% to OS' in Figure 1.

If p were held constant at $\tilde{p}$ in this diagram, w_2 would rise to w_2' at point B. However, by the reasoning of Findlay and Grubert (1959), the autarkic equilibrium value of p actually falls, because the increase in λ would otherwise create an excess supply of good 1.[8] Suppose that the new equilibrium is at point C, where $p = \tilde{p}'$ so that $w_2 = \tilde{w}_2'$. Our following analysis would be essentially unchanged if point C were at or above D (but still below B) on curve OS'. (The appendix shows that point C is below, at or above D as the elasticity of substitution in consumption is respectively less than, equal to or greater than 1.) What matters here is simply that point C is below B, implying that $\tilde{p}' < \tilde{p}$ and $\tilde{w}_2' < w_2'$.

Starting at the new autarkic equilibrium (point C), suppose that the home country imposes a binding minimum wage equal to $\overline{w}_2 (> \tilde{w}_2')$ units of the second good, such that $\tilde{w}_2 < \overline{w}_2 < w_2'$. This minimum-wage constraint leads to an autarkic equilibrium at point E where $p = \overline{p}$, and unemployment arises to clear product markets, in accordance with the analysis of Brecher (1974).

Now consider the (initially identical) foreign country, whose autarkic equilibrium is at point A, with neither a technical improvement nor a minimum wage. The foreign economy at this point has a higher p and a lower w_2 than the home economy (at E).[9] Thus, the latter economy (because of its lower p before trade) has a comparative advantage in the first good.

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[8] Although their article discusses the free-trade equilibrium, essentially the same reasoning applies to our autarkic one.

[9] In light of (4), the foreign country also has a lower w_1.

Therefore, when free trade is introduced, the home (high-wage) country exports this (labor-intensive) good.

Consequently, by Brecher's (1974) reasoning, home unemployment decreases as the world moves to free-trade equilibrium, at which the world-price ratio equals $\bar{p}$. In Figure 1, the foreign country is now at point F, where $w_2 (= w_2'')$ and $w_1 (= w_2'' / \bar{p})$ are both lower than in the home country (at E), which thus retains its status as the high-wage economy.

In summary, we have the following result.

Proposition 1: *International trade with the low-wage foreign country will reduce unemployment in the high-wage home economy, if this economy has not only a Hicks-neutral technological improvement in the labor-intensive good, but also a minimum wage in the relevant range defined by* $\max(\tilde{w}_2, \tilde{w}_2') < \bar{w}_2 < w_2'$.

To understand the condition at the end of this proposition, recall that depending on the elasticity of substitution in consumption, $\tilde{w}_2'$ may be less than, equal to or greater than $\tilde{w}_2$. The minimum wage must exceed both of these values if the home country has not only unemployment but also a higher autarkic wage than its trading partner.

Proposition 1 would still hold if the minimum wage were re-specified in terms of the first (instead of the second) good. However, the analysis would then be somewhat more complicated, because the right-hand side of (7) would be re-written as $s(w_1 / \lambda)$.

If not for the international difference in technology, both countries would be on the same curve OS in Figure 1, even if they differed in factor endowments and/or consumer preferences. Thus, without country-specific technology, the economy with the higher w_2 in autarky would

also have the higher autarkic p, indicating a comparative advantage in the capital-intensive (instead of labor-intensive) good. Then, this high-wage country would suffer an employment loss from trade.

4. Conclusion

As our analysis shows, a high-wage home economy might unexpectedly reduce its unemployment by entering into trade with a low-wage foreign counterpart. To demonstrate this possibility, we start with a standard Heckscher-Ohlin-Samuelson model of two countries, initially assumed to be identical in every respect. This model is then extended to include a minimum-wage constraint that creates unemployment at home, and a technical improvement that (despite the minimum wage) gives the home economy a comparative advantage in the labor-intensive good. In the extended model, international trade has the effect of reducing unemployment in the high-wage (home) country, even though the opposite effect is routinely predicted in public-policy discussions on globalization. Our result is consistent with some recent empirical estimates.

Appendix

To see how the elasticity of substitution in consumption affects the analysis before the minimum wage is imposed, start by holding w_2 temporarily constant at its initial level $\tilde{w}_2$. Since w_2 determines the capital/labor ratios in the two industries (as explained in section 2 above), these ratios are also temporarily constant, at levels denoted by $\tilde{k}_1$ and $\tilde{k}_2$.

From the usual full-employment identity and the fact that $L_1 / \bar{L} + L_2 / \bar{L} \equiv 1$, we then have $\bar{K} / \bar{L} \equiv \tilde{k}_1 L_1 / \bar{L} + \tilde{k}_2 L_2 / \bar{L} \equiv (\tilde{k}_2 - \tilde{k}_1) L_2 / \bar{L} + \tilde{k}_1$; where $\bar{K}$ and $\bar{L}$ are the fixed endowments of capital and labor, respectively. Solving this identity allows us to determine $\tilde{L}_2$ and hence $\tilde{L}_1 (= \bar{L} - \tilde{L}_2)$, which denote the temporarily constant values of employment in the two industries. Then, from (1), the corresponding values of output are $\tilde{X}_1 = \lambda \tilde{L}_1 f_1(\tilde{k}_1)$ and $\tilde{X}_2 = \tilde{L}_2 f_2(\tilde{k}_2)$, since we replaced λ_1 by λ and set $\lambda_2 \equiv 1$.

Letting C_i denote national consumption of good i (= 1, 2), we have $X_1 = C_1$ and $X_2 = C_2$ in autarkic equilibrium. Therefore, this equilibrium requires that $X_1 / X_2 = C_1 / C_2$. When λ doubles, $\tilde{X}_1 / \tilde{X}_2$ [$= \lambda \tilde{L}_1 f_1(\tilde{k}_1) / \tilde{L}_2 f_2(\tilde{k}_2)$] also doubles. If the elasticity of substitution in consumption equals 1, then C_1 / C_2 will double as well, given that p will be halved because w_2 remains temporarily equal to $\tilde{w}_2$ in (7). Thus, in this particular case, there is no need for a further change in p to maintain product-market equilibrium, and hence w_2 will actually remain constant at $\tilde{w}_2$. By similar reasoning, if the elasticity of substitution in consumption is less

(greater) than 1, the further change in p must be negative (positive), in which case the autarkic equilibrium value of w_2 must move below (above) $\tilde{w}_2$ by the Stolper-Samuelson Theorem.

In summary, when λ increases, there will be a negative, zero or positive change in the autarkic equilibrium value of w_2 as the elasticity of substitution in consumption is respectively less than, equal to or greater than 1.

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