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Trade and search generated unemployment

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Abstract

We argue that trade economists should begin to seriously consider environments in which unemployment is carefully modeled. We introduce such a model, derive several results, and compare them to results derived in full employment models. We argue that some traditional results are probably too narrow (the determinants of comparative advantage) and that some results do not generalize to models with unemployment (the link between trade and income distribution for *employed* factors). We also show that in some important cases results do generalize (there is an extended Stolper–Samuelson Theorem that links trade to the distribution of income for *searching* factors) and that our model allows us to address issues that traditional models cannot handle (the impact of trade on unemployment and the welfare of the unemployed). © 1999 Elsevier Science B.V. All rights reserved.

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1. Introduction

The vast majority of public debate concerning trade policy centers on the impact of trade on employment. Those opposed to free trade argue that lower production costs and fewer regulations in other countries allow foreign firms to out-compete domestic producers. This, they argue, results in less domestic output and fewer

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domestic jobs. On the other hand, proponents of free trade argue that free trade expands our export markets, resulting in a greater demand for our products, greater domestic production, and more jobs.

The vast majority of economists view both of these arguments as misguided and fundamentally incorrect. In fact, the debate about trade policy among economists almost always ignores the impact of trade on employment. There are at least two reasons for this dichotomy. First, most international trade economists view trade as a microeconomic issue that focuses on the distribution of resources within an economic environment while they view unemployment as a macroeconomic concern related to the overall level of economic activity and other aggregate measures of economic performance.¹ Second, the field of international trade has been, since inception, predominately a micro-based theoretical field relying on insights from mathematical models to draw conclusions about the impact of trade policies on real world economies. Since, until recently, economists have been unable to produce convincing microeconomic models of unemployment, trade economists have largely ignored the role of unemployment in the debate about trade policy.² In fact, the mainstream view among economists is that trade has little, if any, impact on unemployment. This is true in spite of the fact that there is little evidence to support or contradict this view. Almost all models of trade, and certainly those that have served as the area's workhorses, are full employment models. In addition, although there is some empirical work on the impact of trade on employment in particular sectors of an economy, there is very little empirical work on the aggregate employment effects of trade policies (see Baldwin, 1995, for a recent survey).

Recently, the obstacles to the development of trade models with unemployment have slowly been removed. Over the past 20 years economists have made great progress in developing micro-based models of unemployment. In these models, the frictions that obstruct labor market clearing are explicitly modeled and the rate of unemployment arises endogenously as an equilibrium outcome. These theories include, but are not restricted to, efficiency wages, search, implicit contracts, and insider–outsider models of the labor market (for a review, see Davidson, 1990).

¹See, for example, the articles of Krugman (1993) and Mussa (1993) in the *American Economic Review* in which they argue that “it should be possible to emphasize to students that the level of employment is a macroeconomic issue ... depending in the long run on the natural rate of unemployment, with microeconomic policies like tariffs having little net effect” (Krugman), and that “economists ... understand that the effect of protectionist policies is not on the overall employment of domestic resources, but rather on the allocation of resources across productive activities” (Mussa).

²Of course, there are some exceptions. In particular, in the 1970s there were several attempts to investigate the impact of trade policy in economies with imperfect labor markets. This literature, known primarily as the “labor-market distortions literature,” eventually fell out of favor due to the inability of the authors to draw general conclusions (see, for example, Magee, 1976). This failure was largely a result of inadequate micro-based models of unemployment.

Since the equilibrium unemployment rate generated in these models is generally intertwined with the equilibrium allocation of resources, anything that results in resource reallocation (e.g., trade policy) must affect the rate of unemployment and its composition across sectors of the economy. As a result, some economists have begun to emphasize the importance of generalizing the analysis of international trade to include considerations of unemployment (see, for example, the Ely Lecture of Blinder (1988) in the *American Economic Review*).

Extending standard trade models to allow for equilibrium unemployment is important for at least two reasons. First, there is the issue of whether trade creates net job opportunities. While we provide some preliminary answers to this question in this paper, we view this as largely an empirical question. Second, and we believe more important, there is the issue of whether or not results obtained in traditional, full employment trade models extend to settings in which unemployment is carefully modeled. This issue is particularly important for those results that have not held up well to empirical scrutiny.

The purpose of this paper is to use a simple general equilibrium model of international trade that includes an equilibrium rate of unemployment to address these two issues. That is, our goal is to try to determine the extent to which some of the classic results of trade theory must be modified when unemployment is a concern. In addition, we show that some questions that cannot be addressed in full employment models can be answered in our simple framework.

The plan of the paper is as follows. In the next section, we introduce a simple general equilibrium search model of trade between two countries. In this model, it takes time for unemployed factors to find each other and start a productive partnership. While searching for a partner both factors are unemployed. In Section 3 we determine the pattern of trade and show that the traditional list of the determinants of comparative advantage must be broadened to include features of the labor market (i.e., turnover rates) when unemployment is present. In Section 4 we investigate the link between trade and the distribution of income. We show that there is an extended Stolper–Samuelson Theorem that describes the impact of trade on *searching* factors. The impact on *employed* factors is more complicated, including Stolper–Samuelson forces as well as those at work in a traditional Specific Factors model.

While Sections 3 and 4 deal with issues that have been addressed previously in full employment models, Section 5 deals with an issue that full employment models cannot handle – the impact of trade on the unemployed. Our main finding is that when a relatively capital-abundant large country begins to trade with a small, relatively labor-abundant country, unemployed workers in the large country unambiguously suffer welfare losses. In addition, we find that such trade increases the aggregate unemployment rate in the large country. We close the paper in Section 6 where we discuss the generality of our results and suggest future avenues for research.

2. The model

2.1. The basic structure

We consider a continuous time model of a world consisting of two countries, Home and Foreign, with all foreign country variables designated by an asterisk. Each economy consists of two sectors (X and Y) and two types of agents, workers and entrepreneurs. Each infinitely lived worker is endowed at each instant with one (indivisible) unit of leisure that is sold as labor (L). Each infinitely lived entrepreneur is endowed at each instant with one (indivisible) unit of capital (K) that is rented for production. At each instant, workers are either employed or unemployed and capital is either active or idle. Both factors are assumed to be mobile across sectors and thus when unemployed (idle), workers (capital) must choose a sector in which to seek a job (rental opportunity).³ We use I_{sh} to represent the number of type- i factors searching in sector h and I_{eh} to denote the number of type- i factors employed in that sector ($i = L, K; h = X, Y$). Therefore, $I_h = I_{sh} + I_{eh}$ is the number of type- i factors attached to sector h at any point in time and $I = I_x + I_y$ is the number of type- i factors in the economy.

In order to focus on the implications of factor market frictions, we assume that both countries have the same factor endowments and that the production technology, shared by both countries, is the same in both sectors. In each sector, it takes one unit of each factor to produce a unit of output. Accordingly, an unemployed worker is searching for an entrepreneur with idle capital. Once that capital is found, a match is created that lasts until an exogenous shock causes the partners to separate. Upon separation, both partners must reenter the factor market in search of a new match. In order to allow the duration of a match to vary across sectors and countries, we assume that the break-up rate is both sector and country specific with b_h denoting the break-up rate in sector h . The production technology implies that the output produced in a sector is equal to the number of agents of each type employed (matched):

$$h = L_{eh} = K_{eh} \text{ for } h = X, Y. \quad (1)$$

We also assume that in one sector matches might be relatively harder to find. We use e_h^i to denote the arrival rate of employment prospects for a type- i factor searching in sector h , and assume that

$$e_h^i = (1 - s_h)E_h^i \text{ for } h = X, Y, \quad (2)$$

³This is not to say that we require factors to commit to a sector. In fact, they may switch sectors at any time. However, at any instant a worker (or capitalist) can only search in one sector. Therefore, although unemployed individuals may feel no particular attachment to either sector, at any point in time their search decision identifies the sector to which they belong.

$$e_h^k = s_h E_h,$$

where $E_h > 0$ is a constant and s_h denotes the proportion of the sector h unemployment pool that is made up of labor [i.e., $s_h = L_{sh}/(L_{sh} + K_{sh})$].⁴ From (2), it becomes more difficult for an unemployed worker to find a match as the labor intensity of the searching population increases. In addition, as this labor intensity increases it becomes easier for an entrepreneur with idle capital to find a match. In (2), the constant term E_h can be interpreted as an index of aggregate arrival rates or employment probabilities in sector h .⁵ In what follows, we shall sometimes use e_h^i to represent the arrival rate, and sometimes use the specific functional form, depending upon which is more notationally convenient.

Finally, although we assume that search is required to find employment, product markets are assumed to be frictionless and competitive.

2.2. Factor returns

Our risk neutral searching agents seek matches in the sector that offers the highest expected lifetime utility. Agents can expect to spend a fraction of their lifetime searching (unemployed or idle) and a fraction matched. No agent receives income while searching. When employed, each partner earns a share of the revenue generated by the sale of the output they produce. We denote the share of revenue obtained by a type- i partner in sector h by α_h^i and use P_h to denote the unit price of good h . Therefore, a type- i sector h partner earns $\alpha_h^i P_h$. Of course, $\alpha_h^i + \alpha_h^k = 1$.

We are now in a position to derive the expected lifetime utility for a typical agent. Let V_{sh}^i denote the expected lifetime utility for a sector h type- i searcher and V_{eh}^i the expected lifetime utility for a sector h type- i agent who is currently matched. For a type- i searcher we have the asset value equation

$$\rho V_{sh}^i = e_h^i (V_{eh}^i - V_{sh}^i), \quad (3)$$

where ρ is the discount rate. In (3) the term $(V_{eh}^i - V_{sh}^i)$ represents the capital gain that would be earned if the agent became matched. This term is weighted by the probability of the capital gain occurring given that the agent is currently searching.

⁴In earlier work (Davidson et al., 1987) we examined the implications of a more general search technology for a closed economy. We use this linear form, which is a special case of a constant returns to scale matching technology, so that we may focus on the implications of differential turnover rates across national and international labor markets with as few distractions as possible. Empirical support for the assumption of constant returns to scale can be found in Pissarides (1990). The importance of this assumption for an open economy is discussed in footnote 7 below.

⁵Over a small period of time (Δ_t), the probability of success for a type- i worker who is looking for a job in sector h can be approximated as $e_h^i \Delta_t$. The mean probability of employment for sector h searchers is then $s_h e_h^k \Delta_t + (1 - s_h) e_h^i \Delta_t$. Substituting from (2) allows us to show that the probability that a searcher finds a job in sector X relative to the probability of finding a job in sector Y equals E_x/E_y .

Similarly, the asset value equation for an agent who is currently matched can be expressed as

$$\rho V_{eh}^i = \alpha_h^i P_h - b_h (V_{eh}^i - V_{sh}^i). \quad (4)$$

The first term on the right-hand side of (4) represents the instantaneous utility of an agent who is currently matched while the second term represents the capital loss that accompanies sudden separation of the partners. As before, the latter term is weighted by the probability of the capital loss occurring.

Eqs. (3) and (4) can be solved to obtain

$$\rho V_{sh}^i = e_h^i \alpha_h^i P_h / \Delta_{ih}, \quad (5)$$

$$\rho V_{eh}^i = (\rho + e_h^i) \alpha_h^i P_h / \Delta_{ih}, \quad (6)$$

where $\Delta_{ih} = \rho + b_h + e_h^i$.

To complete the description of our model we must explain how the revenue shares are determined. For most of our results, it does not matter what assumption we make at this point. The exception can be found in the section on the impact of trade on income distribution. We therefore delay a detailed discussion of this issue until then. The assumption that we use, which is common in the search literature,⁶ is that the revenue shares are determined by the Nash Cooperative Bargaining Solution. This solution evenly splits the surplus created by the match. Whenever a match occurs, the expected lifetime utility for the type-*i* partner rises from V_{eh}^i to V_{sh}^i . Therefore, the total surplus generated by a match is $(V_{eh}^l - V_{sh}^l) + (V_{eh}^k - V_{sh}^k)$. Splitting the surplus evenly yields

$$\alpha_h^i = \Delta_{ih} / \{2(\rho + b_h) + E_h\}. \quad (7)$$

Note that increasing e_h^i improves the bargaining position of a type-*i* agent and increases her share.

2.3. Autarkic equilibrium

We close this section with a description of the autarkic equilibrium. In this paper, we focus only on steady-state equilibria. To ensure that the composition of each sector is stationary over time, we need to guarantee that the flows into and out of employment are balanced for each type of agent in each sector. In other words, the number of matches that are dissolved by separation must equal the number of new matches that are created. This condition is given by

$$b_h I_{eh} = e_h^i I_{sh} \text{ for } h = X, Y \text{ and } i = L, K. \quad (8)$$

⁶See, for example, Diamond (1982), Mortensen (1982) or Pissarides (1990).

On the left-hand side we have the number of matches that dissolve due to the exogenous break-up rate. The right-hand side represents the number of new matches formed by factor i in sector h .

In addition to the steady-state conditions represented by (8), an equilibrium for this economy is characterized by utility maximization by all agents and zero excess demand in both product markets. Individual utility maximization requires that mobile factors search for matches in the sector that offers the highest expected lifetime utility. If both goods are to be produced in equilibrium, mobile factors must distribute themselves such that the expected lifetime return from search is equal across sectors; or, if factor i is mobile it must be the case that

$$V_{sx}^i = V_{sy}^i. \quad (9)$$

If we substitute (7) into (5) to obtain V_{sh}^i , we then find that factor i earns the same expected lifetime utility from searching in either sector if

$$e_x^i P / [2(\rho + b_x) + E_x] = e_y^i / [2(\rho + b_y) + E_y], \quad (10)$$

where $P \equiv P_x / P_y$.

Eq. (10) is the fundamental equilibrium condition in our model. For both goods to be produced (10) must hold for all mobile factors in the economy. Otherwise, one sector, say, for example, sector X, will offer searchers a higher expected lifetime reward and will attract all such searchers to that sector. Over time, as the established matches in sector Y break-up, the newly separated factors will switch sectors and start looking for sector-X matches. Eventually, production of Y will cease.

To complete our background discussion of the autarkic equilibrium, we must now discuss product market demand. Utility maximization requires workers to purchase the optimal mix of goods for consumption purposes. Individuals are not allowed to save and goods cannot be stored. We assume that all agents have the same homothetic utility function. As such, relative demands for the two goods are independent of the distribution of income, the economy's factor mix, as well as the level of unemployment. Given these assumptions about preferences, the relative demand for (X/Y) is simply a function of relative prices (P_x / P_y).

We are now in a position to characterize the autarkic equilibrium. Since labor and capital are mobile, (10) must hold for both factors. We can then use (10) to prove the following result.

Lemma 1. *The equilibrium composition of the searching population is independent of the sector. That is, $s_x = s_y = s$.*

Proof. Dividing the indifference condition for labor by that for capital reveals that $e_x^l / e_x^k = e_y^l / e_y^k$. Substitution from (2) then yields the desired result. ■

We can solve (10) to find the relative output price that would cause all factors to be indifferent when choosing a sector in which to search for a match. Upon doing so, we obtain the following result.

Lemma 2. *There exists a unique value of P (denoted as \bar{P}) consistent with the factor indifference condition. Furthermore, \bar{P} depends only on exogenous variables. In particular, \bar{P} is independent of s , the fraction of all searchers who are workers.*

Proof. We first rearrange (10) to yield

$$\bar{P} = \frac{2(\rho + b_x) + E_x e_y^i}{2(\rho + b_y) + E_y e_x^i} \quad (11)$$

From (2) and Lemma 1, $e_y^i/e_x^i = E_y/E_x$. Therefore, \bar{P} is independent of endogenous variables. ■

If $P > \bar{P}$, sector X offers searchers a higher expected lifetime utility than they could expect to receive in sector Y. In this case, only X is produced. If $P < \bar{P}$, the reverse is true, with the economy specialized in the production of Y. Based on this reasoning, we can infer that the economy's relative supply curve is horizontal at \bar{P} , as shown in Fig. 1.⁷

Given our assumptions about preferences, we can also draw the relative demand curve in Fig. 1 to determine equilibrium relative outputs. As Fig. 1 and Lemma 2 make clear, our model with unemployment has a decidedly Ricardian nature. The job dissolution and job creation technologies determine the (unique) relative price that is consistent with a diversified supply-side equilibrium and then preferences determine the relative outputs. This is summarized in Proposition 1.

Proposition 1. *Autarkic equilibrium exists and is unique.*

3. Comparative advantage

We now turn to the determinants of the pattern of trade. In standard trade models the primary determinants of comparative advantage are production

⁷If we had assumed a more general matching technology (such that e_h^i is not linear in s), the right-hand side of (11) would depend on s . As such, changes in s would result in changes in P and the relative supply curve would not be horizontal. In fact, we demonstrated in Davidson et al. (1991) that there exists the possibility of U-shaped relative supply curves when only one sector is characterized by unemployment. By choosing this search technology we are able to focus clearly on the impact of differences in the search technology as a basis for comparative advantage. In particular, this form of the search technology assures that differences in relative factor endowments have no independent role in determining the pattern of trade.

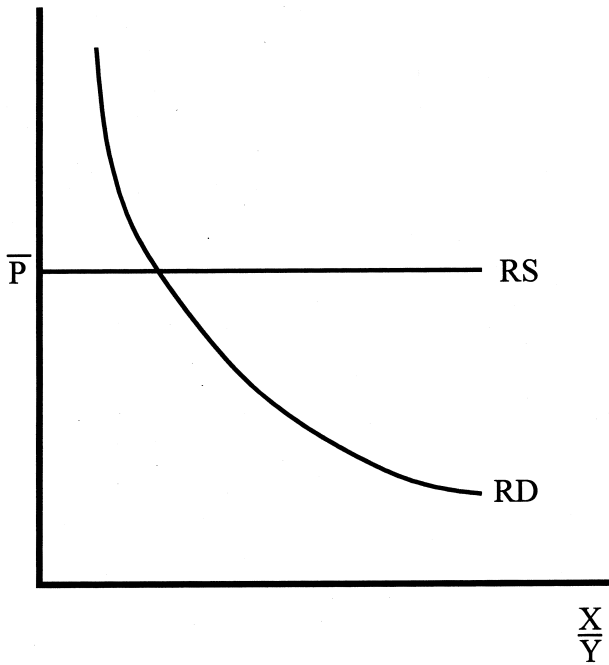


Fig. 1. Autarkic Equilibrium.

technologies and endowments. We have removed these factors from consideration by assuming that they are identical across countries. Therefore, the only factors that could cause international trade in our model are tied to the structure of the labor markets.

How would we expect the structure of the labor market to matter for trade patterns? In our model, it is clear that labor market turnover rates influence the autarkic prices that are required to induce factors to search for matches in a sector. If sector- h jobs are easy to find (E_h is high) or long lasting (b_h low), then the compensation needed to attract factors to that sector (P_h) is relatively low.

Things get more complicated when turnover rates vary across countries but *not* across sectors. Suppose, for example, that one country has a more efficient search technology in all sectors. Which good would this country be likely to export? Alternatively, suppose that one country has a more “dynamic” labor market in that the flows into *and* out of employment are higher in that country than in the labor market of their trading partner? How will this affect the pattern of trade?

We begin by noting that from the analysis of autarkic equilibrium, our model possesses Ricardian properties. From Lemma 2, the autarkic relative supply curve is horizontal at a relative price that is determined strictly by parameters associated with the job search and job dissolution technologies. As such, the offer curves of

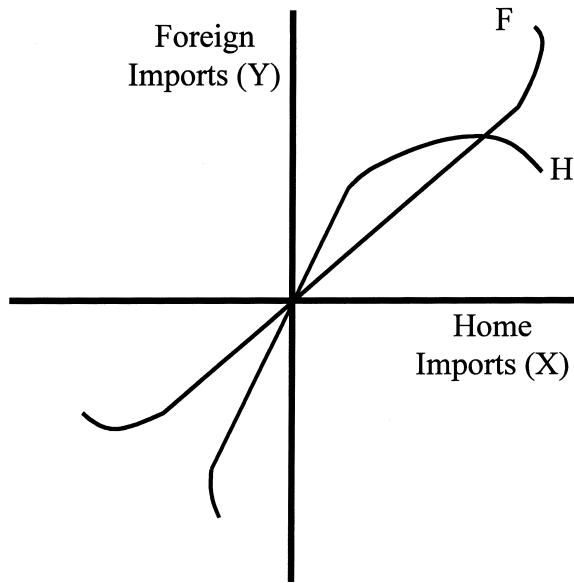


Fig. 2. Offer curves depicting a trading equilibrium for a small home country.

the two countries appear as in Fig. 2. The linear portions of the offer curves have slopes of \bar{P} and \bar{P}^* . As drawn, the home country has the comparative advantage in Y. We have also drawn Fig. 2 such that the home country is “small,” in the sense that differential shifts of its offer curve due to policy changes have no effect on its terms of trade.

As noted above, there are two ways in which the search technology can contribute to systematic differences in relative autarkic prices. First, parameters that vary across sectors might also vary across countries. Proposition 2 below summarizes the determinants of comparative advantage in this case. Second, it is possible that inter-country variation in parameters leads to different relative autarky prices even when there are no intersectoral differences. Propositions 3 and 4 below deal with this case.

For simplicity, we illustrate the combined effects of inter-sectoral and inter-country variation by assuming that both countries possess the same job search/job dissolution technologies in sector X, but different job search/job dissolution technologies in sector Y. We then have the following result.

Proposition 2. *Assume that $b_x = b_x^*$ and $E_x = E_x^*$. Then the home country has a comparative advantage in the production of Y if and only if the following relation is satisfied:*

$$\frac{\rho + b_y}{E_y} < \frac{\rho + b_y^*}{E_y^*}. \quad (12)$$

Proof. Follows immediately from (2), (11), and Lemma 1. ■

For low discount rates the expression $(\rho + b_h)/E_h$ is the ratio of the factor market turnover rates in sector h . To see this, note that since b_h is the break-up rate, $1/b_h$ is the expected duration of a job in sector h . In addition, since E_h is the average rate at which jobs are found in sector h (see footnote 5), the inverse is the average duration of unemployment.

The inequality in (12) is valid if, all else equal, the expected job duration in sector Y is higher in the home country than in the foreign country, or if the expected duration of unemployment in sector Y is lower in the home country than in the foreign country. In either case, searching for a Y-sector job in the home country is more attractive than comparable job search in the foreign country, so, compared with their foreign counterparts, home factors need less compensation to induce them into sector Y.

Comparative advantage can also derive from inter-country differences in parameters that do not vary across sectors. Suppose, for example, that $E_x = E_y = E$, $E_x^* = E_y^* = E^*$, and $E \neq E^*$. Further assume that the break-up rates differ between sectors, but not between countries. We then have

Lemma 3. *Suppose that there are inter-country but not inter-sectoral differences in aggregate search efficiency and that there are inter-sectoral but not inter-country differences in break-up rates. Then the country with the more efficient search technology (i.e., higher value of E) has a comparative advantage in the good produced in the sector with the high break-up rate.*

The proof of this lemma follows the same logic as the proof of Proposition 2 and is therefore omitted. Intuitively, the sector with the higher break-up rate requires a higher price to compensate workers. This follows since job acquisition rates are the same in both sectors. The higher the average rate of job acquisition (i.e., the larger the value of E), the smaller the amount of compensation needed to induce factors to enter the sector. In the limit, as E rises and the duration of unemployment goes to zero, any finite differences in the sector-specific breakup rates will be swamped by the fact that new employment is always obtained instantly, so relative price tends toward unity.

Although Lemma 3 links cross-country differences in search technologies to the pattern of trade, it does not link the pattern of trade directly to unemployment rates. The following lemma, along with Lemma 3, allows us to do just that.

Lemma 4. *Suppose that there are no inter-sectoral differences in aggregate*

search efficiency and that there are inter-sectoral differences in break-up rates. Then the sector with the high break-up rate is also the sector with the high unemployment rate and vacancy rate. That is, if $E_x = E_y$ then $b_x > b_y \leftrightarrow \mu_x \geq \mu_y \leftrightarrow \nu_x \geq \nu_y$ where $\mu_h = L_{sh}/(L_{sh} + H)$ is the sector h unemployment rate and $\nu_h = K_{sh}/(K_{sh} + H)$ is the sector h vacancy rate for $h = X, Y$.

Proof. Recognizing that $L_{eh} = K_{eh} = H$, we can use the steady-state conditions in (8) to show that $\mu_h = b_h/[b_h + (1 - s)E]$ and $\nu_h = b_h/[b_h + sE]$.⁸ It follows that if $b_x > b_y$ then $\mu_x > \mu_y$ and $\nu_x > \nu_y$. Thus, the high-unemployment sector is also the high-vacancy sector. ■

Combining Lemmas 3 and 4, we arrive at the following result.

Proposition 3. *The country with the more efficient search technology has a comparative advantage in the good produced in the high-unemployment/high-vacancy sector.*

Proposition 3 links differences in search technologies across countries to the pattern of trade and tells us that, with all else equal, the country with a more efficient matching process will have a comparative advantage in the high-unemployment/high-vacancy good.⁹ As we discuss below, there is reason to believe that the U.S. labor market is characterized by a more efficient matching process than either Europe or Japan. However, there is also evidence to suggest that break-up rates may be higher in the U.S. than elsewhere (see below). In other words, the U.S. has a more dynamic labor market than Europe and Japan in that flows into and out of unemployment are both higher in the U.S. Thus, before discussing the practical implications of our results, we provide one last result.

Proposition 4. *Suppose that $E_x = E_y = E$, $E_x^* = E_y^* = E^*$, and that $E = \beta E^*$. Suppose further that $b_h = \beta b_h^*$ for $h = X, Y$ and that $\beta > 1$. Then the home country has a comparative advantage in the good produced in the low-unemployment/low-vacancy rate sector.*

Proof. Suppose that $b_x > b_y$, so that Y is the low-unemployment/low vacancy rate sector. Then, since

⁸Note that these results make use of Lemma 1 which states that $s_x = s_y = s$.

⁹Note that Proposition 3 links the pattern of trade to differences in search technologies using sectoral unemployment and vacancy rates evaluated in the autarkic equilibrium. Thus, it appears at first that to test Proposition 3 we would need to know autarkic unemployment and vacancy rates. However, since s does not vary across sectors (Lemma 1), the ranking of sectors in terms of unemployment and vacancy rates does not change when trade is allowed – that is, there are no unemployment rate or vacancy rate reversals caused by trade. Thus, free trade rates are sufficient to test Proposition 3.

$$\bar{P} = \frac{2(\rho + b_x) + E}{2(\rho + b_y) + E}$$

it follows that increasing b_x , b_y , and E by a factor of β increases the autarkic relative price of X. ■

According to Proposition 4, if the home country has more turnover in its labor market (through job creation *and* destruction) than the foreign country, then it will have a comparative advantage in the good produced in low-unemployment/low-vacancy sector. This result contrasts sharply with Proposition 3 and can best be understood by considering the prospects of an unemployed worker trying to decide where to search for a job.¹⁰ With $E_x = E_y = E$, the expected duration of unemployment is the same in both sectors while with $b_x > b_y$, a job found in sector Y will last longer (on average) than a job found in sector X. Now, consider the income that this worker can expect to earn up to time T where $T = 1/E + 1/b_x$. During the spell of unemployment (which lasts, on average, $1/E$ periods) the worker earns nothing. Once a job is found, it lasts, on average $1/b_h$ periods if it is in sector H . Thus, up to time T the expected income earned by a worker searching in sector X is $\alpha_x^l P_x / b_x$ while the same worker can expect to earn $(T - 1/E)\alpha_y^l P_y / b_y$ if employed in sector Y. Now assume that there is a marginal increase in b_x , b_y , and E with all increasing proportionately. The increase in E shortens the expected duration of unemployment in both sectors. The increase in b_x also shortens the expected duration of a sector-X job, and therefore reduces the amount of income expected to be earned in that sector up to T . On the other hand, the amount of income expected to be earned in sector Y up to T actually rises – even though the duration of a job is now shorter, employment begins earlier and is not expected to end until after T . It follows that even though there is no change in the relative incomes from the two jobs, income earned in Y is pushed forward in time. With discounting, this time-shifting of income makes sector Y (the low-unemployment/low-vacancy sector) more attractive and allows that sector to offer less compensation to searching factors. As a result, the autarkic relative price of that good falls.

Our results to this point suggest that the structure of the labor market can play a role in determining the pattern of trade with the key features being the job creation and job destruction technologies. Since it takes time and effort for idle factors to meet, the longer it takes to meet in a sector, the higher the compensation must be for factors to seek employment in that sector. Similarly, the longer a partnership lasts in a sector, the lower the compensation can be and still attract workers to that sector. In practical terms, this suggests that labor market turnover costs may play a role in determining comparative advantage. Moreover, in a more elaborate model

¹⁰The argument works equally well for an entrepreneur with idle capital.

of unemployment, other turnover costs (e.g., training and recruitment costs) would surely influence equilibrium prices.

Are turnover costs significant enough to matter? Do they vary across sectors and across countries enough to make a significant difference? While a detailed answer to these questions is beyond the scope of this paper, a casual review of the labor economics literature suggests that the answer is probably yes. A review of turnover costs in Hamermesh (1993) indicates that in many sectors the turnover costs incurred by firms trying to fill vacancies are quite high. For example, one large pharmaceutical company estimated the present value of the cost of replacing a worker at roughly twice that worker's annual salary. A second study pegs the cost of replacing a truck driver at slightly less than half of that worker's annual pay. There are, of course, some sectors where these costs are quite low (the lowest of the hiring cost estimates reported by Hamermesh appears to be about three weeks worth of pay).

It is also well known that there are significant differences in the turnover rates across countries. The average duration of a job is much higher in Europe and Japan than it is in the U.S. – in a typical month in 1988 about 2% of Americans became unemployed while in Europe and Japan the rate was much lower at 0.4% (Freeman, 1994). In addition, workers find reemployment much more rapidly in the U.S. than they do in Europe – for example, in 1988 almost half (46%) of the Americans who were unemployed in a given month were no longer unemployed in the next month, while in Europe the rate of reemployment was only 5% (Freeman, 1994). Labor economists conclude that U.S. labor markets are much more flexible than their European counterparts. They have recognized for quite some time now that this difference in flexibility has important implications for a variety of issues including job training and macroeconomic performance (see, for example, Layard et al., 1991). It is not at all hard to imagine that there are important implications for the pattern of trade as well.

4. Trade and the distribution of income

One of the most debated issues concerning trade policy both publicly and in the profession is the impact of trade on the distribution of income. This has been a particularly hot topic recently with public debate about the welfare implications of NAFTA and the Uruguay round of GATT and debate within the profession as to whether or not international trade has played a significant role in the recent dramatic changes in the distribution of income in the United States.¹¹

If we turn to the textbook explanations of how trade affects income distribution there are two competing theories. In the traditional full employment two-factor

¹¹See, for example, the articles on income inequality and trade in the Summer 1995 *Journal of Economic Perspectives*.

two-good Heckscher–Ohlin model the impact of trade on income distribution is summarized by the Stolper–Samuelson Theorem. This theorem states that protecting an industry increases the real return to the factor that is used relatively intensively in that sector and lowers the real return to the other factor. In contrast, the traditional full employment Ricardo–Viner model predicts that free trade benefits the factor specific to the export sector, harms the factor specific to the import sector, and has an ambiguous impact on the welfare of the mobile factor.

In this section we ask whether the insights from the Heckscher–Ohlin model generalize to models with unemployment.¹² This is one question concerning trade and unemployment that has recently received some serious attention in the literature. Two papers, Davidson et al. (1988) and Hosios (1990), both provide partial answers to this question in an HO-setting. Thus, we begin this section by summarizing their findings. We then extend their results to provide a more complete picture of the link between welfare and trade in a Heckscher–Ohlin setting with unemployment.

While the analyses offered in Davidson et al. (1988) and Hosios (1990) are very similar, for our purposes, there is one key difference – the manner in which the surplus is split once a partnership is formed. In our earlier article, we followed the search literature tradition in using the Nash Cooperative Bargaining Solution which splits the surplus created by a match evenly between the partners. As is well known (see, for example, Diamond, 1982) this sharing rule leads to sub-optimal equilibria. In fact, we showed in our paper that with this sharing rule the factor mix attracted to each sector will not, in general, be optimal. Hosios, on the other hand, assumed efficient bargaining so that the factor mix attracted to each sector would, in fact, maximize the value of steady-state output.

To see why this matters, consider the standard Stolper–Samuelson argument. In the Heckscher–Ohlin model of trade the cost of producing a unit of output equals the price of that output, or

$$P_h = a_{lh}w_l + a_{kh}w_k, \quad (13)$$

where a_{ih} is the cost minimizing amount of factor i used to produce one unit of good h and w_i is the payment to factor i . Totally differentiating this expression for each sector, translating the terms into percentage changes and then subtracting across sectors leads to the familiar expression

$$(\hat{P}_x - \hat{P}_y) = \theta^*(\hat{w}_l - \hat{w}_k), \quad (14)$$

where θ^* ranks the sectors in terms of their value factor intensities ($\theta^* > 0$ implies that the X sector is relatively labor-intensive in value terms) and a circumflex above a variable represents a percentage change in that variable. Thus,

¹²For the link between trade and income distribution in the Ricardo–Viner model, see Davidson (1997).

an increase in P_x/P_y leads to an increase in w_l/w_k . This argument leads directly to the Stolper–Samuelson Theorem. However, it is important to note that in deriving (14) it is necessary to make use of the fact that, due to cost minimization, $w_l da_{lh} + w_k da_{kh} = 0$. That is, since factors are chosen to minimize the cost of producing output, small changes in the factor mix result in only second-order changes in the cost of production.

Now, turn to models with unemployment. Hosios shows that in a model quite similar to ours in which both factors are mobile an expression similar to (13) holds. In particular, he shows that

$$P_h = a_{lh}\rho V_{sh}^l + a_{kh}\rho V_{sh}^k, \quad (15)$$

where $a_{ih} = (I_{eh} + I_{sh})/h$ measures the total number of type- I workers attached to sector h (both employed *and* searching) per unit of output. Totally differentiating (15) and following the same procedure outlined above, Hosios derives an extension of the Stolper–Samuelson Theorem for models with unemployment. This theorem states that if a sector is protected the steady-state real return to the unemployed factor used relatively intensively in that sector rises and the steady-state real return to the other factor falls. However, in calculating factor intensities those who are searching in each sector must be included in the calculations. Moreover, the theorem tells us how the steady-state returns to searching factors are affected (i.e., V_{sh}^i). It says nothing of the impact of protection on the steady-state return to employed factors (i.e., V_{eh}^i). We return to this issue below and extend Hosio's analysis to see how the steady-state returns to employed factors are affected by trade.

In deriving this extended Stolper–Samuelson Theorem Hosios makes use of the fact that the equilibrium factor intensities in his sectors are optimal [and, thus, $\rho V_{sh}^l(da_{lh}) + \rho V_{sh}^k(da_{kh}) = 0$]. This follows from his assumption of efficient bargaining. In our article (Davidson et al., 1988) we showed that with the bargaining shares determined by the Nash Cooperative Bargaining Solution the Stolper–Samuelson Theorem could be overturned since changes in the (inefficient) factor mix exerts a second impact on steady-state factor rewards that may swamp the Stolper–Samuelson effects. It follows that the impact of trade on the distribution of income depends crucially on whether sectoral factor mixes are efficient.

Which assumption concerning bargaining is most realistic? While the answer to this question is beyond the scope of this paper there are a few comments that can be made. First, there is a solid non-cooperative foundation for the Nash Cooperative Bargaining Solution in that it has been shown to be the equilibrium outcome of a well defined, sensible bargaining process (e.g., Binmore et al., 1986). We know of no similar non-cooperative foundation for efficient bargaining. On the other hand, we know of no empirical evidence that search externalities cause significant inefficiencies in factor mixes. Although such externalities are easy to

analyze theoretically, it is extremely difficult, if not impossible, to measure them. Our own view is that it is unlikely that factor intensities are indeed optimal; but, it is also unlikely that changes in those factor intensities could generate secondary effects strong enough to overturn the extended Stolper–Samuelson Theorem described above.

Now, as noted above, the extended Stolper–Samuelson Theorem of Hosios (1990) holds for *searching* factors – it says nothing about how trade affects the steady-state welfare of employed factors. However, it is straightforward to generalize his results to employed factors. To see this, let $P^{\%}$ denote the price index that is used to turn nominal values into real values. Then, from (5)–(7) we have

$$\frac{\rho V_{eh}^i}{P^{\%}} = \frac{\rho V_{sh}^i}{P^{\%}} + \frac{\rho}{2(\rho + b_h) + E_h} \frac{P_h}{P^{\%}}. \quad (16)$$

As (16) makes clear, the impact of trade on the steady-state return to employed factors is determined by two forces. The first term on the right-hand side of (16) is the steady-state return to searching factors and, as we have seen above, changes in this term are governed by Stolper–Samuelson forces. The second term on the right-hand side of (16) rises for factors employed in the export sector and falls for those employed in the import sector. This term captures the benefit (loss) to employed factors for being fortunate (unfortunate) enough to be already matched in the sector that benefits (suffers) from free trade.

It follows that if a factor is employed *and* used intensively in the export sector, then it gains from trade. If a factor is employed *and* used intensively in the import sector, then it is harmed by free trade. The impact on the other two types of employed factors is ambiguous. A factor that is employed in the export sector but used relatively intensively in the import sector gains from being matched in the export sector but suffers from the Stolper–Samuelson forces. A factor that is employed in the import sector but used relatively intensively in the export sector gains from the Stolper–Samuelson effects but suffers from being matched in the import sector. Thus, we have

Proposition 5. *If bargaining between matched factors is efficient, then the steady-state real return to searching factors varies according to the Stolper–Samuelson Theorem. For matched factors it is somewhat more complicated. For the factor that is used relatively intensively in the export (import) sector, its steady-state real return varies according to the Stolper–Samuelson Theorem if it is matched in the export (import) sector. The effect of trade on the steady-state real return to the remaining matched factors is ambiguous.*

The intuition behind Proposition 5 is that when time and effort are required to find employment, an existing job creates a sectoral attachment since employed

agents are reluctant to quit their jobs in order to search for new employment elsewhere. Matched factors in this model are therefore analogous to the immobile factors in a Ricard–Viner model. By contrast, unemployed factors have no attachments to any sector and are therefore completely mobile. As a result, the gains and losses from trade that accrue to *searching* factors are precisely what would be found in a Heckscher–Ohlin model. On the other hand, the impact of trade on *employed* factors combines Specific Factor effects (through sectoral attachments) with Heckscher–Ohlin effects (since they will someday become unemployed again). It is clear from (16) that the Specific Factor effects are more likely to be dominant if employed factors have strong attachments to their sector. This occurs when b_n and E_n are low so that jobs are long lasting and difficult to find.

This proposition has implications for the empirical literature that has attempted to distinguish between the predictions of the Stolper–Samuelson Theorem and the Ricardo–Viner model. Magee (1980) tested the predictions of these two theories by examining whether labor and capital within a given industry tended to oppose each other on the issue of protection for that industry. One of the implications of the Stolper–Samuelson Theorem is that a factor's position with respect to free trade does not depend on the sector in which it is employed – all that matters is whether the factor is relatively scarce or abundant. Thus, different factors employed in the same industry should oppose each other on this issue. The Ricardo–Viner model suggests just the opposite. By examining the positions taken by labor and capital in 27 industries during their Congressional testimony with respect to the Trade Reform Act of 1973, Magee finds strong evidence that factors within an industry tend to be on the same side of the protection/free trade argument.¹³ Of the 27 industries studied, 15 are clearly consistent with the Ricardo–Viner model, three others lean heavily in that direction, six are ambiguous, and only two are consistent with the Stolper–Samuelson Theorem. He concludes that this test, along with the results of two others, support the Ricardo–Viner model at the expense of the Stolper–Samuelson Theorem.

Our results indicate that distinguishing between these two models is not quite so easy – when search is required to find a job a sectoral attachment is created by employment that muddles the distinction between these two theories. Industries in which job attachments are strong (i.e., the duration of a job and the duration of unemployment are both relatively long) should behave more like the Ricardo–Viner model since employment creates a strong tie to the industry and makes employed factors behave as if they were specific to the industry. In contrast, if jobs are relatively transitory or easy to find in an industry, then job attachments

¹³Magee actually provides data on 33 industries. However, for six of the industries the data is incomplete.

Table 1
Expected duration of a job in 12 of the industries considered by Magee (1980)

| Industry | SIC code | Data consistent with | Average job duration (months) |
|---------------|----------|------------------------|-------------------------------|
| Plastics | 2821 | Ricardo–Viner | 119.05 |
| Paper | 26 | Ricardo–Viner | 64.94 |
| Machine tools | 3541 | Ambiguous | 60.98 |
| Machinery | 35 | Ricardo–Viner | 58.14 |
| Textiles | 22 | Ricardo–Viner | 54.95 |
| Aviation | 3720 | Ricardo–Viner | 54.35 |
| Electrical | 36 | Ambiguous | 53.19 |
| Bearings | 3562 | Ricardo–Viner (weakly) | 47.17 |
| Stone | 32 | Ricardo–Viner | 46.73 |
| Rubber | 30 | Ambiguous | 44.25 |
| Trucks | 3713 | Ricardo–Viner | 38.76 |
| Apparel | 23 | Ricardo–Viner | 35.46 |
| Leather | 31 | Ricardo–Viner | 34.25 |
| Tobacco | 21 | Stolper–Samuelson | 33.33 |

Note: average job duration is the inverse of average monthly involuntary separations (per 100 workers). Data on involuntary separations (total separations less quits) is taken from Employment and Earnings (United States Government Printing Office, 1970, 1971, 1972, 1973, 1974).

will be weak and industry behavior is more likely to be consistent with the Stolper–Samuelson Theorem. Although a careful empirical analysis of this claim is beyond the scope of this paper, a quick look at some preliminary data suggests that this might be an avenue worth pursuing. In Table 1 we list the expected duration of a job in 12 of the industries that Magee considered. These are the only industries for which we could find labor market turnover data at the same SIC level that Magee reports in his Table 1. These expected durations were based upon the average monthly rate of involuntary separation (total separations less quits) in each industry over the period 1969–73 (the data is taken from the March issue of *Earnings and Employment* for each year). Expected job duration is then the inverse of this separation rate. Table 1 lists the industries according to expected job duration with the industry with the longest duration listed first. Note that the only industry consistent with the Stolper–Samuelson Theorem (tobacco) also turns out to be the industry with the weakest job attachment!^{14,15}

¹⁴In terms of our model, Table 1 reports data on $1/b_n$. Unfortunately, since data on industry-specific average durations of unemployment are not available, we could not derive estimates of E_n .

¹⁵We were unable to find involuntary separation rates for Petroleum, the other industry consistent with the Stolper–Samuelson Theorem in Magee’s Table 1, at the same SIC level as Magee (2911). However, we were able to find data at a different SIC level (291) that indicates relatively strong job attachment in that sector, contrary to what our model predicts.

5. Trade and the unemployed

The most heated debates concerning trade and unemployment typically arise during discussions about trade agreements between developed countries and their less developed counterparts. Arguments that reduced trade barriers would lead to job losses in the U.S. were central in the debate leading up to the establishment of NAFTA. In fact, careful scrutiny of the debate preceding the vote on NAFTA in the U.S. House of Representatives and the U.S. Senate reveals that of the 141 anti-Nafta statements made, 112 were of the form “NAFTA will destroy jobs” while of the 219 pro-NAFTA statements made, 199 were of the form “NAFTA will create jobs.”¹⁶ Similar fears and discussions can be found in Europe where there is concern about the admission of Turkey to the EC and in Asia where Japan risks increases in unemployment if it were to reduce trade barriers with its industrializing neighbors.

While traditional full employment models cannot directly address such issues, our model with unemployment offers an ideal setting to begin an examination of these concerns.¹⁷ Thus, in this section, we investigate the impact of free trade on unemployment and the steady-state welfare of the unemployed when a large, relatively capital-abundant country trades with a small, less developed, relatively labor-abundant neighbor. We assume that the large country has a more efficient labor market in the sense that it has a lower aggregate unemployment rate than its trading partner (these assumptions are made precise below).

We consider the impact of free trade between these countries in two steps. We begin by considering the impact of trade in goods, holding factor allocations fixed. We then move on to investigate the consequences of an integrated capital market for the flow of capital that such trade may induce and the ultimate impact of such flows on unemployment.

To capture the essence of the situation, we assume that the break-up rates are identical in the two countries, but differ across sectors, and that the large country has a more efficient search technology. This leaves us with a setting similar to the one used to derive Propositions 3 and 4 in Section 3 – we have $b_x = b_x^* > b_y = b_y^*$ and $E_x = E_y = E > E^* = E_x^* = E_y^*$. This implies that sector X is the high-unemployment sector and that the home country (which we take to be the large country) has the more efficient search technology. We also assume that after trade is liberalized, the small country ends up specialized while the large country remains diversified. Thus, from Lemma 2, free trade between these two countries does not affect the relative price level in the large country.

From Proposition 3 we know that in this setting the large country has a comparative advantage in the high-unemployment good and will therefore export

¹⁶These data were collected by Robert Baldwin and Christopher Magee while preparing Baldwin and Magee (1997) and was reported to us by Magee.

¹⁷For a different approach to these issues see Davidson et al. (1988) and Matusz (1996).

X. The small country will specialize in Y. Thus, in the large country free trade results in an increase in X/Y produced. To determine the impact on unemployment and the steady-state welfare of the unemployed in the large country, we differentiate the steady-state conditions in (8) to obtain:

$$\lambda^*(\hat{X} - \hat{Y}) = -D\hat{s}, \quad (17)$$

where $\lambda^* \equiv (\lambda_{lx} - \lambda_{kx})$, $\lambda_{ih} \equiv I_h/I$, $D \equiv [s/(1-s)]\{(\lambda_{lx}/a_{lx}) + (\lambda_{ly}/a_{ly})\} + \{(\lambda_{kx}/a_{kx}) + (\lambda_{ky}/a_{ky})\} > 0$, and $a_{ih} = I_h/H$ (as in Section 4) for $i = l, k$ and $h = X, Y$. Eq. (17) shows that the impact of this trade-induced change in production on s depends on the relative factor intensity of the export sector. To be consistent with our description of this situation at the beginning of this section, we assume that the export sector is relatively capital intensive – that is, $\lambda^* < 0$. This implies that trade leads to an increase in s (the fraction of the searching population that is made up of unemployed workers).

The consequences for unemployment can be determined by expressing the country's aggregate unemployment rate (μ) as a weighted average of the sectoral unemployment rates (μ_x and μ_y):

$$\mu = \lambda_{lx}\mu_x + \lambda_{ly}\mu_y.$$

As we demonstrated above, $\mu_h = [b_h/(1-s)E]$ is increasing in s . Thus, since $\mu_x > \mu_y$, the aggregate unemployment rate rises with s and free trade increases the unemployment rate in the large country.

Finally, (5) and (7) confirm that the increase in s lowers the steady-state welfare of all unemployed workers in the large country while increasing the steady-state welfare of all idle capital. We summarize these findings in Proposition 6.

Proposition 6. *Trade between a small country and a capital-abundant large country with a relatively more efficient search technology increases the aggregate unemployment rate in the large country, reduces the steady-state welfare of all unemployed workers in the large country, and raises the steady-state welfare of all idle capital in the large country.*

The second step in our analysis is to investigate the implications of such trade for capital flows when capital is mobile across countries. As we argued above, the fear of job destruction is often an important element of the discussion surrounding trade agreements, but this fear is often linked to the possibility of large foreign investment flows that could accompany liberalization. If capital flows freely between the two countries, its expected returns will be equalized in equilibrium. The relevant measure of expected returns, however, is the return to idle capital (V_{sh}^k). Suppose then that we begin with the free trade equilibrium in which capital is *not* mobile across international boundaries and then allow capital to move, in which direction will it flow? It will flow from the large country to the small

country if V_{sy}^k is relatively higher in the small country; or, from (5) and (7), if (note that we need only to consider capital's expected return from searching in sector Y since the small country specializes in Y):

$$sE/[2(\rho + b_y) + E] < s^*E^*/[2(\rho + b_y) + E^*].$$

The fact that $E > E^*$ tends to discourage capital outflow from the large country, since its factor markets are relatively more efficient at matching unemployed workers and idle capital. On the other hand, the fact that $s^* > s$ encourages capital to flow to the small country. Thus, if the small country is sufficiently more labor abundant than the large country, capital outflow is possible.

It follows that in our model there are two opposing forces that determine the flow of capital when trade is liberalized. In the small country a large ready pool of unemployed workers leads to short durations of vacant job openings and higher profits. On the other hand, working against this is a more efficient factor market in the large country that produces a relatively large number of new jobs given a fixed number of idle factors (with all else equal). (Note that one additional feature that is usually assumed to work *against* capital outflows from the large country is missing from our analysis – we have assumed that matched labor is equally productive in both countries. If labor in the small country is less productive, it becomes even more unlikely that capital will flow towards the small country.)

If capital does flow out of the large country, the impact on unemployment is obvious – as idle capital leaves, s rises and, as we demonstrated above, such an increase in s raises unemployment in the large country and makes unemployed workers worse off in the steady-state equilibrium.

6. Discussion

In this paper we have argued that trade economists should begin to seriously consider environments in which unemployment is carefully modeled. We have introduced such a model, derived several results, and compared those results to similar ones derived in full employment models. We have argued that some traditional results are probably too narrow (the determinants of comparative advantage) and that some results do not generalize to models with unemployment (the link between trade and income distribution for *employed* factors). We have also shown that in some important cases results do generalize (there is an extended Stolper–Samuelson Theorem that links trade to the distribution of income for *searching* factors) and that our model allows us to address some issues that traditional models cannot handle (the impact of trade on the welfare of the unemployed and the impact of trade on unemployment).

In deriving our results we have made several important modelling decisions and it is natural to ask just how robust our results are with respect to these choices. For

example, we have modeled unemployment as the outcome of a search process. How would our results differ if we had used another model of unemployment? We have also used a specific search technology and assumed that all factors are mobile across sectors. Would our results generalize to a more complex setting? In this section we explain the rationale behind our modelling choices and discuss how our results would be altered if these assumptions were dropped. We then close the paper by suggesting some future avenues for research.

6.1. Generality

Our model yields clean, sharp predictions about the links between labor market characteristics and trade due to its Ricardian nature. This feature of our model can be traced to two assumptions – the specific search technology that we used (with employment probabilities linear in s) and the assumption that both factors are mobile. The combination of these two assumptions results in Lemma 1 which states that the equilibrium factor intensity of the searching population is the same in both sectors. Without Lemma 1 the economy's relative supply curve would not be horizontal and the model would be more complex. In Davidson et al. (1987) we demonstrated that with a different search technology the complications that arise in deriving equilibrium are due to externalities that are inherent in the search process. Thus, if we were to use a different search technology, our model would indeed become much more complicated. However, our goal in this paper is to argue that models that include unemployment may behave very differently from full employment models *regardless of whether or not equilibrium is efficient*. That is, we do not want our results to depend on the presence of hard to measure search externalities or search generated inefficiencies. Although we find such arguments interesting, they have been dealt with elsewhere by a number of authors including us.¹⁸ This is precisely why we chose to use a linear search technology – it allows us to focus on the implications of labor market frictions for trade with few distractions.

An alternative way to investigate the robustness of our results with respect to the Ricardian nature of our model is to drop the assumption that both factors are mobile. For example, if we assume that capital is sector-specific, Lemma 1 will not hold and the relative supply curve will be upward sloping. While autarkic equilibrium is still unique, it is natural to ask if our other results generalize to such a setting. In a recent working paper, Davidson (1997) provides the answer to this question by showing how our propositions must be modified when capital is sector-specific. We briefly review his findings here to show that while Lemma 1 simplifies our analysis greatly, it does not lead to any fragile results.

Propositions 2–4 describe the role that labor market turnover rates can play in

¹⁸See, for example, Davidson et al. (1987), (1988), (1991).

determining the pattern of trade. The proofs of each of these propositions make use of Lemma 1, which no longer holds when capital is sector-specific. This introduces two new complications in the link between the structure of factor markets and the pattern of trade. First, changes in factor market parameters (e.g., turnover rates) may alter factor intensities which may have feedback effects on autarkic prices. Second, with capital sector-specific and factor intensities varying across sectors, the high-unemployment sector may no longer be the high-vacancy sector. While this second complication affects only Propositions 3 and 4, the first has implications for all three. Nevertheless, variants of Propositions 2–4 do hold in a Specific-Factors setting. Below we offer a detailed discussion of how Proposition 2 is altered followed by a somewhat more terse description of the impact on Propositions 3–5. The interested reader is referred to Davidson (1997) for details.

Proposition 2 states that a lower break-up rate or a higher job-acquisition rate in a sector makes it more likely that a country will have a comparative advantage in that sector's good. This is because a lower break-up rate or a higher job-acquisition rate makes the sector more attractive and reduces the level of compensation that must be offered to factors to satisfy the factor indifference condition. In other words, these changes in the factor market parameters lower the autarkic relative price for that good.

Identical forces are at work in a Specific-Factor setting, although changes in the factor market parameters now have additional effects as they alter sectoral factor intensities. Suppose, for example, that E_x increases. The immediate impact of this change is that the X-sector becomes more attractive and searching labor begins to relocate to this sector. This increases (X/Y) , shifting the relative supply curve to the right and lowers the autarkic relative price of X. However, this is not the only impact of the increase in E_x . Since E_x is now higher, more X-sector matches are created each instant. Since each match consists of one worker and one entrepreneur, these new X-sector matches remove an equal number of workers and entrepreneurs from the pool of X-sector unemployed, leaving the remaining pool more asymmetric. If $s_x < 1/2$, the reduction in s_x makes the X-sector even more attractive for labor (since it becomes easier for labor to find an X-sector match) and more unemployed labor moves to sector X. In this case, the change in s_x leads to a further increase in (X/Y) and a further reduction in P . However, if $s_x > 1/2$, making the X-sector more asymmetric makes it harder for workers to find an X-sector match and, as the sector becomes more asymmetric, unemployed workers may flow back towards sector Y. This secondary effect lowers (X/Y) and may swamp the direct effect (which increases X/Y), leading to an increase in P . This perverse outcome is more likely to happen if E_x is large so that the increase in E_x has a large impact on s_x . It follows that Proposition 2 will generalize to a Specific-Factors setting if $s_x < 1/2$ or if $s_x > 1/2$ and E_x is not too large.

Changes in the break-up rate alter autarkic prices in similar ways – an increase in b_h makes sector h less attractive for labor and makes sector h 's unemployment pool more symmetric (since break-ups release an equal amount of labor and capital back into the unemployment pool). It follows that an increase in the h -sector

break-up rate raises the autarkic relative price of good h unless $s_h > 1/2$ and E_h is sufficiently high.

Turn next to Proposition 3. This proposition holds in an Heckscher–Ohlin setting since if $E_x = E_y = E$ and if $b_x > b_y$, then an increase in E lowers P – thus, if a country’s matching process becomes more efficient the autarkic relative price of the good produced in the high-unemployment/high-vacancy sector falls. Two complications arise in trying to extend this result to a Specific-Factors setting. First, as with Proposition 2, changes in E alter the equilibrium factor intensities in the two sectors and this can cause feedback effects that dominate the direct effects of the change in E on X/Y . Second, since capital is sector-specific, the high-unemployment sector may no longer be the high-vacancy sector. In fact, since capital cannot move in response to changing incentives, the increase in E has a bigger impact on the sector with the highest vacancy rate (which may not be the high-unemployment sector). Proposition 3 therefore generalizes provided that (a) it is stated in terms of vacancy rates and (b) the feedback effects from changes in factor intensities do not swamp the direct effects from the changes in E .

As for our Proposition 4, the only modification that is required for its generalization is that, since the low-unemployment and low-vacancy sectors may no longer be the same, it must now be stated in terms of vacancy rates. This is due to the fact that the changes in the factor mixes brought about by the changes in the turnover rates generate forces that work in the same direction as those that lead to Proposition 4.

Finally, consider Proposition 5, which links trade to the distribution of income. As we showed above, in generalizing the forces at work in a full employment Heckscher–Ohlin model to a setting with unemployment, the only complication that arises is that employment creates an attachment to a sector that makes employed factors somewhat immobile. Thus, it should not be surprising that in a Specific-Factors setting the impact of trade on income distribution is exactly the same whether there is full employment or search generated unemployment.

In summary, all of our results generalize when Lemma 1 fails to hold, although it is necessary, in some cases, to put qualifications on them.

The other special feature of our model is the manner in which we introduce unemployment. We have chosen to model unemployment as the outcome of a search process for two reasons. First, we find the notion of unemployment arising due to trade frictions intuitively appealing. To us it seems natural to model the labor market as a market characterized by informational asymmetries that make it difficult for unemployed workers and firms with vacancies to find each other. Second, in our opinion, search theory is the only modern theory of unemployment that has been subjected to and withstood serious empirical scrutiny. It appears that minimum wages cannot explain a significant amount of adult unemployment.¹⁹ Efficiency wage models depend upon a link between unemployment and wages

¹⁹See, for example, Brown et al. (1982).

which is difficult, if not impossible, to pin down empirically.²⁰ On the other hand, the primitive feature of most search models is the matching function that links the number of new matches created to the number of searching factors on each side of the market. This matching function has been estimated by a number of authors and by now we have a fairly good understanding of its characteristics.²¹ In addition, search theory has been shown to be consistent with a fairly large number of stylized facts of both labor markets and business cycles (Mortensen and Pissarides, 1994).

Nevertheless, it would be useful to know if results similar to ours would hold in alternative models of unemployment. It seems clear that labor market turnover rates would emerge as a determinant of comparative advantage in any model of international trade with unemployment. In an efficiency wage model of international trade the average durations of unemployment and employment would play key roles in determining the efficiency wage which would in turn affect autarkic prices. In an insider/outsider model of unemployment these turnover rates would determine the relative strength of insiders over outsiders and would therefore affect equilibrium outcomes. Thus, it seems clear that the essence of Propositions 2–4 – that turnover rates matter for the pattern of trade – generalizes, although the specific nature of the link may be different in other settings.

Another insight that would surely carry over to other models of international trade with unemployment is the result that a job creates an attachment to a sector that makes employed factors similar to the immobile factors in a Ricardo–Viner model. This should be true in any model in which factors must incur costs to find employment. Thus, even if all factors are mobile, the returns to employed factors will depend, in part, on the fate of the sector in which they are employed. Whether or not there exists an extended Stolper–Samuelson Theorem for searching factors in other models with unemployment remains an open question.

6.2. *What next?*

We are not unique in suggesting that the labor market could have important implications for international trade. In fact, several recent papers have stressed this very point. For example, it is well documented that over the past 15 years there have been significant changes in the distribution of income in the United States and in unemployment in Europe. Some have argued that these changes can be traced, at least in part, to changes in international trade (see, for example, the

²⁰There have been a number of attempts to determine whether or not inter-industry wage data are consistent with the predictions of efficiency wage models (for a detailed survey see Katz, 1986). We are skeptical of this work for reasons that are carefully laid out in Topel (1989).

²¹See, for example, Blanchard and Diamond (1989), Chirinko (1982), and Pissarides (1990).

articles in the Summer 1995 volume of the *Journal of Economic Perspectives*). Krugman (1995) has argued that the two regions have responded to these changes in very different manners due to the different structures of their labor markets. The U.S., with its relatively competitive labor market, has seen the real wages of low-skilled workers decline while in Europe, where real wages are far more rigid, there has been a significant increase in unemployment among low-skilled workers. Similar arguments can be found in recent papers by Davis (1996a), (1996b) and Bloom et al. (1996). This paper builds upon this developing theme by stressing the importance of modeling the factors that underlie the natural rate of unemployment.

There are several possible avenues for future research that are suggested by our results. First, although we have argued that turnover costs *might* play a role in determining the pattern of trade, a careful empirical analysis is required to test this view. Since turnover rates by industry are available, such a test is certainly feasible. Second, a more rigorous extension of the test of the Stolper–Samuelson Theorem of Magee (1980) that takes into account the strength of sectoral attachment for factors is clearly in order. This would require finding more complete data on separation rates (for Magee's remaining 15 industries) and finding data that could be used to determine industry-wide expected durations of unemployment. In addition, an analysis similar to Magee's could also be carried out for the 1987/8 Trade and Competitiveness Act, since industry-specific data on labor market turnover is more complete for the 1980s than it was for the late 1960s.

There are two obvious theoretical extensions of our work as well. It is by now well known that unemployment comes through very strongly in virtually all work on the political-economy of protection. It comes through in time-series and cross-section analyses of levels of protection, in cross-section analyses of the incidence of administered protection, and in cross-section analyses of congressional voting on protection.²² Yet, as far as we know, there is not a single theoretical model of the political-economy of trade policy that includes unemployment.²³ The results that we report in Section 4 that link trade to the preferences of searching factors provide the framework upon which such a model could be built.

Finally, the analysis offered in this paper has focused on steady states. That is, we have ignored the transition path that leads the economy to the new steady state after a shock has occurred. Yet, there can be no doubt that there are significant private losses associated with trade shocks as the economy adjusts to its new steady state. Trade policies that alleviate or exacerbate such losses could be analyzed in an extension of our model that takes non-steady-state behavior into account.

²²See, for example, Baldwin (1976), Coughlin (1985), Magee (1987), Magee and Young (1987), McCarthur and Marks (1989), and Takacs (1981).

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