Intersectoral Linkage of Labor Markets of Tradeables and Nontradeables Sector *

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Abstract

Based on a search-matching model of a small open economy with a nontradeables sector, this paper analyzes how rising job destruction rate in one sector affect the equilibrium rate of unemployment through its impacts on labor markets of each sector. If job destruction rate rises in tradeables sector, sectoral unemployment rates rise in both tradeables and nontradeables sector because the undermined bargaining position of workers in tradeables sector spills over to nontradeables sector. We can also show that when the job destruction rate in the nontradeables sector is sufficiently high, sectoral rate of unemployment is higher, and equilibrium wage is lower in nontradeables sector than in tradeables sector.

JEL classification: E24; F16; J64

Keywords: search-matching model; nontradeables; job destruction; intersectoral labor mobility

1 Introduction

As the volume and range of international trade expands, each country becomes more and more affected by the change in economic situations outside the border. Recently, the interdependence of countries is blamed as a cause of job destruction *1. Based on search-matching theory of labor markets, this paper examines the relation between trade and unemployment, with particular emphasis on the role of nontradeables sector and differences in job destruction rates among sectors.

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*1 For example, in Japan the surge in the rate of unemployment since 2008 is said to be a consequence of recession in the U.S. economy.
Theoretical research on trade and equilibrium unemployment, especially those using the search-matching framework, have been presented since the 1990s \(^2\). With interindustry trade in mind, these literature separate the effects of trade on the equilibrium rate of unemployment as follows: a direct effect on sectoral rates of unemployment, and an indirect effect through sectoral shifts. Dutt et al. (2009) show that when the labor market parameters are the same across sectors, the second effect does not exist; hence, trade expansion in accordance with the structure of comparative advantage leads to higher value of outputs, more vacancy, and lower rate of unemployment. On the other hand, Helpman and Itskovich (2009) emphasizes the intersectoral differences in labor markets. If the country has a comparative advantage in the relatively “high-unemployment sector” of the economy, its expansion may raise the economy-wide rate of unemployment, even if sectoral rates of unemployment decline.

As analyses of trade and the economy-wide rate of unemployment, however, previous literature overlook the role of nontradeables sector. The presence of nontradeables sector as employment opportunities in developed countries is getting larger and larger \(^3\). Without investigating the labor market of the nontradeables sector, we can say little about the net effect of trade on economy-wide unemployment. Kon (2008) is an attempt to incorporate nontradeables sector into the search-matching framework; however, the static setting adopted there does not allow analyzing job destruction in an adequate manner.

The purpose of this paper, therefore, is to construct a dynamic search-matching model with nontradeables sector to examine the net effect of international trade on equilibrium unemployment. More specifically, we add a nontradeables sector to the model of Dutt et al. (2009), and investigate the impact of changes in international price of tradeables on unemployment through labor market of each sector. Dutt et al. (2009) considered two tradeables sectors in a small open Ricardian economy, hence in their model the home country specializes in one of the tradeables sector in which it has a comparative advantage. In contrast, we have nontradeables sector besides the tradeables with comparative advantage. This country, therefore, has two sectors operating even in a small open Ricardian setting. This enables us to investigate another mechanism through which international trade affects unemployment; that is, the intersectoral linkage of labor markets.

Under the assumption of the free mobility of labor across the sectors, unemployed workers search for jobs in the sector with the highest expected return. This arbitrage of labor markets makes the situation of the two sectors interdependent, and the effect of exogenous shocks to one labor market spill over to the other sector. In particular, the job destruction rate in nontradeables (such as personal services) sector is known to be higher than in tradeables

\(^2\) Davidson et al. (1999) is an early contribution. Their model, however, is built on some strong assumptions, such as no vacancy cost and linear matching technology.

(such as manufacturing) sector in developed countries *4, and is getting higher in Japan: see figure 1. This paper analyses how the job destruction rate in nontradeables sector affect wage and unemployment in face of changing international price of tradeables *5.

We can show the following results; as the price of tradeables rises, economy-wide rate of unemployment declines in general; wages and sectoral rates of unemployment move in the same direction in response to the exogenous change in international price; if the job destruction rate of nontradeables sector is sufficiently high, unemployment rate is higher and wage is lower than in the tradeables sector. The last property has not been common in the existing literature on trade and unemployment.

The next section presents the model, and section 3 shows the results of comparative statics with respect to labor market parameters. In section 4, we investigate the impact of rising tradeables price on the economy-wide rate of unemployment. Finally, section 5 concludes the paper.

2 Model

This section describes the structure and equilibrium of the model. We follow the setups of Dutt et al.(2009); the substantial difference from their model is the existence of nontradeables.

2.1 Basic Setups

There are three goods-sectors in this small open economy: tradeables X which is chosen to be numéraire, tradeables Y, and nontradeables Z. Total labor force is normalized to $L = 1$, and there is no heterogeneity in worker’s productivities and preferences. We assume free mobility of labor across the sectors *6. Labor is the only production factor in this model.

Labor market in each sector is characterized by search-matching frictions. We assume the number of successful matches is determined by a standard matching function of the Cobb-Douglas form:

$$M_i(v_i, u_i, L_i) = \mu v_i^\gamma u_i^{1-\gamma} L_i,$$

for sectors $i = X, Y, Z$, where $v_i$ is vacancy rate of firms, $u_i$ is unemployment rate, $L_i$ is the number of workers attached to sector $i$, $\mu < 1$ is the parameter of matching technology, and $\gamma \in (0, 1)$ is the vacancy intensity of the matching function. A firm hires only one worker

*4 Goméz-Salvador et al.(2004) finds this for the European economy in the 1990s.

*5 We treat the job destruction rate to be exogenous in this paper. As to why job destruction rate is higher in some sector than other, we can infer from previous cross-country studies that firing costs (Blanchard and Portugal, 2001) or firm-specific human capital (Miyamoto and Shirai, 2006), among others, may be the reason.

*6 Models without intersectoral mobility of labor are presented by, for example, Moore and Ranjan (2005) and Andersen (2005).
Each worker-firm matching produces $A_i$ units of good $i$. Using these sectoral rates of unemployment $u_i$, the economy-wide rate of unemployment can be expressed as

$$u = \sum_i u_i L_i.$$  \hfill (2)

Define the labor market tightness in sector $i$ as $q_i = v_i / u_i$, and we have the expression for the employment probability for a worker in sector $i$:

$$\frac{M_i}{u_i L_i} = \mu \theta_i^{\gamma},$$  \hfill (3)

which is an increasing function of $\theta_i$. Similarly, the vacancy filling rate for a firm searching a suitable worker in sector $i$ is

$$\frac{M_i}{v_i L_i} = \frac{\mu}{\theta_i^{1-\gamma}}$$  \hfill (4)

which is decreasing in $\theta_i$.

We assume that home country has a comparative advantage in tradeables $Y$. Sector $X$ is not viable accordingly and this country imports tradeables $X$ and produces only goods $Y$, which is exported as well as consumed domestically, and nontradeables $Z$. International price $p_y^*$ is given to this small open economy, while $p_z$ is determined endogenously. Consumer preference is assumed to be Cobb-Douglas with expenditure share $a_i$ for good $i$.

### 2.2 Labor markets of tradeables sector $Y$

We begin the analysis by looking at the labor market of tradeables sector $Y$. The labor market tightness $\theta_y$ and equilibrium wage per worker in this sector $w_y$ is determined regardless of the conditions in nontradeables sector $Z$ in this small-open economy. Denote by $V_y$ the discounted present value of a vacancy and by $J_y$ the value of an occupied job, and we have the Bellman equations for risk-neutral firms:

$$r V_y = -\delta_y + \frac{\mu}{\theta_y^{1-\gamma}} (J_y - V_y),$$  \hfill (5)

$$r J_y = A_y p_y^* - w_y + \lambda_y (V_y - J_y),$$  \hfill (6)

where $\delta_y$ is the cost of posting a vacancy, $\lambda_y$ is the job destruction rate, and $r$ is the interest rate; all of them are exogenous parameters.

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*7 This is a strong, but widely used assumption (Pissarides, 2000).

*8 This recursive structure is common in the literature: see Helpman and Itskhoki (2009). The key assumption behind this property is that cost of vacancy is measured in terms of numéraire, as described below.

*9 The cost of vacancy is expressed in terms of good X; however, we assume this cost to be intangible and requires no real consumption of good X for simplicity.
Under the assumption of free entry of firms in sector Y (i.e. \( V_y = 0 \)), (5) can be solved for \( J_y \):

\[
J_y = \frac{\delta_y \theta_y^{1-\gamma}}{\mu}.
\]

(7)

From (6) and (7), we obtain

\[
\frac{A_y p^*_y - w_y}{r + \lambda_y} = \frac{\delta_y \theta_y^{1-\gamma}}{\mu},
\]

which is called the job creation condition. As the labor market tightness \( \theta_y \) goes up, it becomes difficult for a firm to find a suitable worker. This raises the expected cost of vacancy represented in the righthand side of (8). For firms to break even, therefore, the expected value of matching captured in the lefthand side has to also go up. This makes a firm afford less wage \( w_y \).

The Bellman equations for risk-neutral workers are also standard. Denoting by \( W_y \) the discounted present value of an employed worker and by \( U_y \) the value of unemployment, we have

\[
rW_y = w_y + \lambda_y (U_y - W_y),
\]

(9)

\[
rU_y = \mu \theta_y^\gamma (W_y - U_y).
\]

(10)

Wages are determined by Nash bargaining with worker’s bargaining power \( \beta \):

\[
w_y = \arg \max (W_y - U_y)^\beta (J_y - V_y)^{1-\beta}.
\]

By the free entry of firms \( V_y = 0 \), the first order condition of the wage bargaining leads to

\[
W_y - U_y = \frac{\beta}{1 - \beta} J_y,
\]

(11)

and from (9) and (11), we obtain the expression for \( U_y \):

\[
rU_y = \frac{\beta}{1 - \beta} \theta_y \delta_y.
\]

(12)

Solve (9) for \( W_y \), and substitute into (11), together with (12), yields

\[
w_y = \beta \left( A_y p^*_y + \theta_y \delta_y \right).
\]

(13)

This is called the wage curve in the literature. As \( \theta_y \) goes up, worker’s bargaining position is strengthened, hence a worker can get higher wage \( w_y \).

The equilibrium labor market tightness \( \theta^*_y \) and wage \( w^*_y \) is determined at the intersection of the job creation condition (8) and the wage curve (13), as depicted in figure 2.

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*10 This term, as well as “the wage curve” introduced below, is used commonly in Pissarides (2000) and others.
2.3 Intersectoral linkage of labor markets

The basic structure of the labor market of nontradeables sector Z is the same as that in sector Y discussed above; they differ only in the labor market parameters $\delta_z$ and $\lambda_z$. Under the assumption of free mobility of labor across the sectors, the discounted present value of unemployment in both sectors are equalized by the arbitrage of workers:

$$U_y = U_z.$$  \hspace{1cm} (14)

This means workers are equally better off whether they seek jobs in sector Y or Z. Substitute (12) and the counterpart of the sector Z into (14) to obtain

$$\theta^*_y \delta_y = \theta_z \delta_z.$$ \hspace{1cm} (15)

This is a key equation of the model and shows the intersectoral linkage of labor market tightness $^{\ast}$; other things being equal, higher vacancy cost $\delta_i$ leads to lower tightness in their own labor market $\theta_i$. More intuitively, (12) states that the value of unemployment $U_i$ is proportional to the ratio of total vacancy cost to the number of unemployment:

$$\theta_i \delta_i = \frac{v_i \delta_i}{u_i},$$

or equivalently, the average hiring cost for each unemployed worker. We get the equilibrium value of $\theta^*_z$ from the $\theta^*_y$ determined in the previous subsection and (15):

$$\theta^*_z = \frac{\delta_y}{\delta_z} \theta^*_y.$$ \hspace{1cm} (16)

With labor market tightness $\theta^*_y$ and $\theta^*_z$ in hand, the wage rate $w_z$ and equilibrium price $p_z$ of the nontradeables is determined at the intersection of the job creation condition and the wage curve of sector Z (see figure 3):

$$w_z = A_z p_z - (r + \lambda_z) \frac{\delta_z (\theta^*_z)^{1-\gamma}}{\mu},$$ \hspace{1cm} (17)

$$w_z = \beta (A_z p_z + \theta^*_z \delta_z).$$ \hspace{1cm} (18)

In tradeables sector Y, these two curves are depicted in the $(\theta_y, w_y)$ plane with given international price $p_y^*$. In contrast, they are in the $(p_z, w_z)$ plane for the case of the nontradeables sector Z, because the labor market tightness $\theta^*_z$ is predetermined as a result of intersectoral linkage of labor markets. To put it another way, the price of nontradeables Z is determined endogenously in this model, which is the main difference of this paper from the literature.

$^{\ast}$ This condition is the same as Dutt et al.(2009).
The job creation condition is upward sloping because higher prices enable firms to offer higher wages to break even. The wage curve is also upward sloping because workers can get some fraction of the increase in the value-added of each firm-worker pair.

2.4 Steady-state equilibrium

In the steady state, the inflow and outflow of unemployment is equalized in each labor market:

\[ u_i = \lambda_i (1 - u_i) - \mu \theta_i^r u_i = 0. \]

This can be solved for the equilibrium rate of sectoral unemployment \( u_i^* \):

\[ u_i^* = \frac{\lambda_i}{\lambda_i + \mu (\theta_i^r)^r}, \] (19)

which implies that \( u_i \) goes up as labor market becomes looser (i.e. lower \( \theta_i \)). In this dynamic setting, the job destruction rate \( \lambda_i \) also affects the equilibrium rate of unemployment; this effect is not present in static models \(^{12}\).

With respect to the goods markets, we impose the trade balance condition in the steady state. Because home country exports good Y and imports good X,

\[ (Y^S - Y^D) p_y^* = X^D, \] (20)

where superscripts S and D stand for aggregate supply and demand respectively; recall that tradeables X is numéraire. \( Y^S \), the supply of tradeables Y, can be represented as per-worker production times the number of matching. The demand for each tradeables is some constant fraction of total income \( I^* \) under the assumption of Cobb-Douglas preference. With these fractions denoted by \( \alpha_i \), the equation above can be written as

\[ \left(1 - u_y^*\right) A_y L_y \frac{\alpha_y}{p_y^*} I^* = \alpha_x I^*. \] (21)

The goods market clearing condition of nontradeables Z is

\[ Z^S = Z^D, \]

and similar arguments as tradeables sectors apply to this sector as well:

\[ (1 - u_z^*) A_z L_z = \frac{\alpha_z}{p_z^*} I^*. \] (22)

\(^{12}\) The traditional approach to labor mobility across the sectors by Harris and Todaro (1970) does not capture this argument; see Kon (2008) and the discussion below.
As labor force is \( L = L_y + L_z = 1 \), (21) and (22) lead to the following equation which determines the sectoral composition of labor:

\[
(1 - u_y^*) A_y \frac{L_y}{L_y} = \frac{\alpha_x + \alpha_y p_z^*}{\alpha_z} \frac{p_z^*}{p_y^*},
\]

(23)

Given equilibrium prices \( p_i^* \) and sectoral unemployment rates \( u_i^* \), this equation can be solved for \( L_y \); note that the sectoral composition is not affected by the total income \( I^* \) in this model \(^{13}\). Finally, we obtain the economy-wide rate of equilibrium unemployment (2) of this small-open economy:

\[
u = u_y^* L_y + u_z^* (1 - L_y).
\]

(24)

3 Comparative statics

In this section, we analyze how changes in labor market parameters affect the rate of sectoral unemployment. First, the case of rising job destruction rate of tradeables sector Y is compared to that of nontradeables sector Z graphically. Then we briefly discuss similar arguments with respect to vacancy costs in each sector.

3.1 Rising job destruction rates

We begin our analyses of comparative statics with the case of an exogenous rise of the job destruction rate in tradeables sector Y.

With the recursive structure of this model in mind, we first look at the equilibrium condition of labor market of sector Y. From (8), the job creation condition shifts downward as \( \lambda_y \) rises. On the other hand, (13) shows that the wage curve is unaffected. As shown in figure 4, hence, both wage \( w_y \) and labor market tightness \( \theta_y \) decline. Higher job destruction rate means shorter expected duration of a job, which induces firms to post less vacancy or pay lower wage.

Because of the intersectoral linkage of labor markets, we see from (16) that labor market tightness \( \theta_z \) also declines. Intuitively, as labor market becomes looser in tradeables sector Y, the situation of unemployed workers in this sector is undermined. Through the intersectoral arbitrage by workers, this also lowers the value of unemployment in the other sector Z \(^{14}\); this is achieved by a decrease in \( \theta_z \).

\(^{13}\) In contrast, Kon (2009) stresses the role of income effect in demand structure using a non-homothetic preference. In that model, expenditure share of nontradeables Z becomes larger as income increases.

\(^{14}\) This kind of intersectoral linkage of labor market tightness is analyzed in Larsen (2001), although in some different context. In that model, two sector represents the “high-tech sector” and “technologically stagnant sector”, and long-term unemployed workers can search for a job only in the latter labor market. In present analysis, we do not divide the unemployment pool but allow all workers to search in any sector.
In the labor market of nontradeables sector Z, lower tightness $q_z$ shifts the job creation condition (17) leftward and the wage curve (18) downward; they are depicted in figure 5. Although labor market parameters are unchanged in nontradeables sector Z, the rise of $\lambda_y$ makes labor market of sector Z more loose, and lowers both price $p_z$ and wage $w_z$ of nontradeables. As $\theta_z$ decreases, (19) for sector Z means higher sectoral rate of unemployment $u_z$.

Next, turn to the case of a rise in job destruction rate in nontradeables sector $\lambda_z$. As labor market of tradeables sector Y does not depend on variables of nontradeables sector Z, neither labor market tightness $q_y$ nor wage $w_y$ is affected by the rise in $\lambda_z$.

Intersectoral linkage of labor markets implies that $\theta_z$ is unchanged in face of a rise in the job destruction rate $\lambda_z$. However, more unstable jobs in nontradeables sector shifts the job creation condition (17) rightward: see figure 6. As the expected duration of a job become shorter, firms in nontradeables sector Z require higher price $p_z$ of their products, given $\theta_z$ and $w_z$. The wage curve shows positive correlation between wage and prices, hence both $w_z$ and $p_z$ rise as a result of a rise in $\lambda_z$. Steady state condition (19) leads to higher sectoral rate of unemployment $u_z$.

### 3.2 Decreasing vacancy costs

The effect of decreasing vacancy cost in each sector can be examined in a similar manner. For the convenience of presentation, we show the results of a rise in $d_i$ (not shown graphically).

When $d_y$ rises, the job creation condition of sector Y shifts downward, same as the case of a rise in $\lambda_y$. The wage curve (13) rotates counterclockwise from the vertical axis, but the effects on the endogenous variables are qualitatively the same: both $q_y$ and $w_y$ decline.

Lower tightness $\theta_y$ leads to lower $\theta_z$ through the intersectoral linkage, which in turn shifts the job creation condition and the wage curve in nontradeables sector Z in the same direction as figure 5. Since labor market become looser in both sectors, sectoral rate of unemployment $u_y$ and $u_z$ rise.

The case of a rise in $d_z$ is as follows. The labor market of tradeables sector Y is not affected at all as well as the case of $\lambda_z$. Intersectoral linkage of labor market tightness (15) shows that to hold $\theta_zd_z$ constant, $\theta_z$ has to decline to offset the rise in $d_z$. The job creation condition (17) shifts rightward as $d_z\theta_z^{1-\gamma}$ rises, while the wage curve (18) does not shift as $\theta_zd_z$ remain constant. The qualitative effect is hence the same as depicted in figure 6; both $w_z$ and $p_z$ rise. The sectoral rate of unemployment $u_z$ rises because the labor market tightness of nontradeables $\theta_z$ has become lower.
4 Impacts of international trade

In this section, we explore the main question of this paper: what is the effect of international trade on the rate of economy-wide unemployment? More specifically, we investigate how changes in the international price of tradeables $Y$ affect the labor market of each sector in this small open economy \(^{15}\). After presenting the results of comparative statics follows some numerical example to illustrate the working of this model.

4.1 Qualitative analysis

The effects of a rise in international price $p^*_y$, can be examined graphically. From (8) and (13), both the job creation condition and the wage curve of tradeables sector $Y$ shifts upward as $p^*_y$ rises (as shown in figure 7). Because the shift of the former is larger, both labor market tightness $\theta_y$ and wage $w_y$ rise. As the value of matching increases, firms post more vacancies and pay higher wages.

The labor market tightness $\theta_z$ of nontradeables sector also rises through intersectoral linkage of labor markets. The job creation condition shifts rightward and the wage curve shifts upward accordingly (see figure 8). Because the worker’s bargaining position have improved, firms pay higher wages $w_z$ and need higher price $p_z$ of the production to break even.

Labor market tightness in both sectors rise, which leads to decline in sectoral rate of unemployment $u_i$ in both sectors. To examine the overall effects on economy-wide rate of unemployment (24), we need to investigate the remaining component of $u$: the number of workers attached to the tradeables sector $L_y$. The sectoral composition, however, cannot be examined analytically in this model. In (23), as $p^*_y$ goes up, $p^*_z$ also rises; hence the righthand side of (23) can be larger or smaller. In addition, the direction of the change in lefthand side is also indeterminate; both $u^*_y$ and $u^*_z$ get smaller. As a result, we cannot say anything about the change in $L_y$ and hence $u$.

As Helpman and Itskhoki (2009) point out, if “the high-unemployment sector” becomes larger in response to trade liberalization, the economy-wide rate of unemployment may rise due to the compositional effect \(^{16}\). We can compare sectoral rates of unemployment using

\(^{15}\) Wälde and Weiss (2006) also analyze the impacts of international price on unemployment. However, their model differ from this paper in many respects including specification of the production function and the description of labor markets.

\(^{16}\) Note that even if sectoral rates of unemployment are unchanged, sectoral shifts can alter the economy-wide rate of unemployment, given that labor market parameters differ sector by sector.
(19) for sectors Y and Z to show that when the inequality

$$\lambda_z > \left( \frac{\delta_y}{\delta_z} \right)^\gamma \lambda_y$$

holds, the sectoral rate of unemployment is higher in nontradeables sector Z. This relation can be also represented as follows:

$$\frac{\lambda_z}{\mu (\theta_z)^\gamma} > \frac{\lambda_y}{\mu (\theta_y)^\gamma}.$$ 

In words, if the sectoral ratio of the job destruction rate to the job finding rate is higher in nontradeables sector Z, then unemployment is also more prevalent in that sector: \( u_z > u_y \).

### 4.2 Numerical example

In order to investigate the effect of changes in international price on the economy-wide rate of unemployment, we conducted some numerical simulations of the model. The purpose of these simulations is twofold; firstly, to confirm that the rise in international price of good Y reduces unemployment in some parameter settings, and secondly, to compare the sectoral wages and rates of unemployment.

Parameters are set as in table 1\(^{17}\). The key feature of this setting is that the job destruction rate is higher and the vacancy cost is lower in nontradeables sector Z than in tradeables sector Y. This intends to capture the labor market characteristics of developed countries, such as recent Japan; in the nontradeables sector, the fraction of fixed-term contracts or nonregular employment is said to be larger than in tradeables sectors. In general, these jobs need less skill and hence the cost of vacancy or recruitment for firms may be lower. On the worker’s side, because they cannot acquire skills through these jobs, they tend to be laid-off frequently. The parameters are hence chosen to satisfy the condition (25). Based on the discussion of comparative statics with respect to the labor market parameters in section 3, these parameter settings are expected to result in high \( u_z \) and low \( w_z \).

\(^{17}\) The value of parameters are chosen partly from Satchi and Temple (2009). They try to describe the situation of Mexico; however, we don’t intend to represent any particular country in this paper.
The result of simulations is summarized in table 2, and the relationship between the international price $p_y^*$ and economy-wide unemployment $u$ is also plotted in figure 9.

We can see that as international price of good Y rises, both sectoral and economy-wide rate of unemployment decline monotonically. Furthermore, $u_z$ is always higher than $u_y$ because the condition (25) is satisfied. The intersectoral linkage of labor market tightness (15) implies the comovements of sectoral rates of unemployment.

Equilibrium wage, in turn, is lower in nontradeables sector Z than tradeables sector Y. The nontradeables sector Z in this model is therefore “high-unemployment and low-wage” sector. This is in sharp contrast with the static analysis of Kon (2008). In static models, intersectoral linkage of labor markets are governed by the equalization of expected wage across the sectors. This means in a high-unemployment sector, wage must be also higher to keep that sector as favorable for workers as other sectors. The same logic applies to the Harris and Todaro (1970) type models modified to dynamic settings, as long as the difference in value (i.e. productivity or price) of production among sectors are given exogenously.

In this numerical example, the cost of vacancy is lower in the nontradeables sector, which leads to high labor market tightness $\theta_z$ and low wage $w_z$, as in static models. However, the higher job destruction rate $\lambda_z$ leads to high unemployment $u_z$ and high wage $w_z$; hence the wage $w_z$ may or may not be higher than $w_y$. For the parameter setting shown in table 1, we have $w_z < w_y$.

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**Table 1: Parameter setting**

<table>
<thead>
<tr>
<th>parameter</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_y$</td>
<td>productivity in sector Y</td>
</tr>
<tr>
<td>$A_z$</td>
<td>productivity in sector Z</td>
</tr>
<tr>
<td>$\alpha_x$</td>
<td>expenditure share of good X</td>
</tr>
<tr>
<td>$\alpha_y$</td>
<td>expenditure share of good Y</td>
</tr>
<tr>
<td>$\alpha_z$</td>
<td>expenditure share of good Z</td>
</tr>
<tr>
<td>$r$</td>
<td>interest rate</td>
</tr>
<tr>
<td>$\lambda_y$</td>
<td>job destruction rate in sector Y</td>
</tr>
<tr>
<td>$\lambda_z$</td>
<td>job destruction rate in sector Z</td>
</tr>
<tr>
<td>$\delta_y$</td>
<td>cost of vacancy in sector Y</td>
</tr>
<tr>
<td>$\delta_z$</td>
<td>cost of vacancy in sector Z</td>
</tr>
<tr>
<td>$\beta$</td>
<td>worker’s bargaining power</td>
</tr>
<tr>
<td>$\mu$</td>
<td>matching technology</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>matching function parameter</td>
</tr>
</tbody>
</table>

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*18 This is consistent with the intersectoral wage differentials reported by Katz and Summers (1989) for the case of the U.S.

*19 See, for example, Lee (2008) and Zenou (2008).
Finally, as far as the sectoral composition is concerned, we have only minor change in $L_y$ for these parameter settings; it may be partly due to the preference parameters $a_i$. If we assume other form of preference such as Stone-Geary type, there may be another channel that induce larger sectoral shifts.\footnote{Kon (2009) emphasizes income effect of sectoral shifts in a static model. For the empirical relevance of these arguments, see a survey by Schettkat and Yocarini (2006).}

\begin{table}[h]
\centering
\begin{tabular}{lccc}
\hline
 & 0.8 & 1 & 1.2 \\
\hline
$p_y$ & 1.3370 & 1.7030 & 2.0730 \\
$\theta_y$ & 5.3480 & 6.8120 & 8.2920 \\
$w_y$ & 0.8811 & 1.1109 & 1.3419 \\
$w_z$ & 0.8765 & 1.1057 & 1.3364 \\
$p_z$ & 0.9509 & 1.1896 & 1.4289 \\
$u_y$ & 0.0582 & 0.0519 & 0.0473 \\
$u_z$ & 0.0690 & 0.0616 & 0.0562 \\
$L_y$ & 0.3949 & 0.3954 & 0.3959 \\
u & 0.0647 & 0.0578 & 0.0527 \\
\hline
\end{tabular}
\caption{Equilibrium value of endogenous variables}
\end{table}

5 Conclusion

In this paper, we presented a dynamic model of trade and equilibrium unemployment based on standard search-matching framework. The key feature is the role of nontradeables sector and intersectoral linkage of labor markets in face of international trade. We showed that as international price of tradeables rises, the economy-wide rate of unemployment declines in general. The model can explain that sectoral rate of unemployment is higher and wage is lower in the nontradeables sector than in the tradeables sector.

For next step, we should investigate further the intersectoral linkage of labor markets. The existence of “high-unemployment and low-wage sector” can be explained in other ways as well. For example, Sato (2000) assumes the congestion effect in each sector, while Coulson et al. (2001) introduces the cost of moving across the sectors on the worker’s side. Both approaches have regions rather than sectors in mind, hence we cannot apply them directly into the context of international trade. These difference notwithstanding, their analyses of sectoral labor markets deserves future investigation.

Another point that needs to be examined further is the intersectoral mobility of labor. Some studies divide labor force into two types of workers: skilled labor and unskilled labor. Skilled labor is assumed to be able to search for jobs in both sectors while unskilled labor cannot.
see, for example, Gautier (2002) and Filges and Larsen (2004). However, their focus is not on the international trade and all the prices are set exogenously. Integrating these partial immobility of labor into a small open economy model with nontradeables sector is left for future research.

References


Figure 1  Separation rates by industry: Japan (percentage). Separation rate is the number of job separation divided by the number of employed workers in each industry. The sample includes both regular and non-regular workers. Source: Surveys on Employment Trends (Koyo doko chosa), Ministry of Health, Labour and Welfare.

Figure 2  Labor market equilibrium in tradeables sector Y
**Figure 3**  Price and wage in nontradeables sector Z

**Figure 4**  The effect of rising job destruction rate in sector Y on labor market of sector Y

**Figure 5**  The effect of rising job destruction rate in sector Y on labor market of sector Z
Figure 6  The effect of rising job destruction rate in sector Z on labor market of sector Z

Figure 7  The effect of rising international price of tradeables Y on its labor market

Figure 8  The effect of rising international price of tradeables Y on labor market of sector Z
Figure 9  International price of good Y and unemployment rates