Tax Policy, Migration and Labor Productivity

Wataru Johdo*

Tezukayama University, Japan

Abstract We construct a two-country model including the migration of imperfectly competitive workers and examine how real shocks affecting the relative wages between the countries influence international migration. We find that a rise in the home country’s wage tax rate leads to the emigration of some workers from the home country to the foreign country. Importantly, we also find that the international migration of imperfectly competitive workers is independent of any differences in relative labor productivity.

Keywords: Migration, two-country model, monopolistic competition, wage tax, labor productivity

JEL classification: F16, F22, H24, H26, J61

1. Introduction

Recently, under greater international skilled worker mobility, the expansion of international wage differences between developed and developing countries have increasingly stimulated the international movement of skilled (or heterogeneous) workers away from developing countries to developed countries (see, for example, Borjas, 1994 and Friedberg and Hunt, 1995). It is therefore important to investigate the effects of real shocks affecting the wage differentials between countries in an open economy model in which the international migration of heterogeneous workers matters.

In the international trade literature, static trade models with perfect competitive markets have been widely used. For example, Rivera-Batiz (1982), Djajić (1986, 1989), Djajić and Milbourne (1988) and Quibria (1988) examine the economic effects of international migration using a small open economy model. In addition, Krauss (1976), Bhagwati and Srinivasan (1983), Calvo and Wellsiz (1983), Rivera-Batiz (1983), Bond and Chen (1987) and Brecher and Choudhri (1987) consider the effects of migration using a two-country perfect competition model. However, existing studies all assume perfectly competitive and identical workers in labor markets. Therefore, few studies address the impact of real shocks on the international migration patterns of monopolistically competitive workers. To address this issue, we develop a two-country monopolistic competition model à la Blanchard and Kiyotaki (1987) and Bénassy (1996) that incorporates endogenous migration by imperfectly competitive workers and homogenous outputs (home and foreign goods), and investigate how wage taxation and country-specific productivity growth affect the migration patterns of heterogeneous monopolistically competitive workers.
Two related literatures incorporate monopolistically competitive workers within a general equilibrium model à la Blanchard and Kiyotaki (1987) and Bénassy (1996). First, in the real business cycle literature, Erceg et al. (2000), Huang and Zheng (2002), Smets and Wouters (2003), Christiano et al. (2005), Rabanal and Rubio-Ramírez (2005) and Gali (2008) consider the impact of real and monetary shocks on observed inertial inflation and persistent output. However, because they all began with the assumption of a closed economy, they cannot consider the impacts of real shocks on the migration patterns of workers across countries. Second, in the new open economy macroeconomic literature, Corsetti and Pesenti (2001), Kollmann (2001) and Chu (2005) allow for monopolistically competitive workers within a two-country general equilibrium model. However, because they also assume the international immobility of workers, they cannot consider the impacts of real shocks on the migration patterns of workers.

Our contribution to the literature is to present a simple formal analysis incorporating the migration of imperfectly competitive and heterogeneous workers and homogenous outputs (home and foreign goods) within a two-country general equilibrium model. In this model, the driving force in international worker mobility is the differential in worker wages between the two trading countries. This implies that real shocks affecting the wage differential bring about the migration of workers across borders. In addition, the movement of workers affects the relative prices of goods produced in both countries. This is because the migration affects relative wages through changes in the wage setting by monopolistically competitive workers, thereby changing relative prices through adjustments in the goods market. Accordingly, the model allows us to show the interaction between migration patterns and international relative prices.

The main findings of our model are: (i) a rise in the home country’s wage tax rate leads to the relocation of some workers away from the home country toward the foreign country; and (ii) the international migration of workers is independent of any difference in labor productivity between the two countries.

The remainder of this note is structured as follows. Section 2 outlines the features of the model. Section 3 describes the equilibrium and examines the impacts of a wage tax and country-specific productivity growth. The final section summarizes the findings and concludes the paper with some suggestions for future research.

2. The Model

In this paper, we remove money from Blanchard and Kiyotaki’s (1987) model and assume perfect competition in the final goods market to facilitate the analysis. Instead, we extend Blanchard and Kiyotaki (1987) to a two-country model and incorporate the international migration of heterogeneous workers into a nonmonetary open model. In this model, heterogeneous consumer–workers—“workers” for short—exist continuously in the range $[0, 1]$, where each worker sells a type of labor that is an imperfect substitute for all other types. Thus, each worker has some monopoly power. Furthermore, we assume that the home country consists of those workers in the interval $[0, n]$, and that the remaining $[n, 1]$ workers are in the foreign country, where $n$ is endogenous. The workers in each country consume two types of homogeneous final goods, home and foreign goods, and we focus on the case where there is no impediment to the international trade in goods. A representative firm in each country specializes
in the production of a single type of good (or homogeneous final output) using differentiated labor inputs. Finally, we assume the worker’s preferences and the production technology are symmetric, both within and across countries.

2.1 Firm’s Decisions

The representative firm acts competitively. The firm in the home country, indexed by $h$, has the following technology:

$$y_h = \theta \left[ \int_0^\infty \ell_j^{(\sigma-1)/\sigma} \, dj \right]^{\sigma/(\sigma - 1)}, \quad \sigma > 1,$$

where $y_h$ denotes the output, $\ell_j$ denotes the quantity of labor of type $j$, $\theta$ represents the country-specific productivity parameter (a larger value of $\theta$ implies the higher productivity of labor in the home country), and $\sigma$ is the elasticity of substitution between the different types of labor. The firm’s profit maximization is conveniently solved in two stages. In the first stage, for a given level of output and subject to (1), the firm minimizes the following production cost by optimally allocating labor inputs:

$$\min l_j \int_0^\infty W_j \ell_j \, dj,$$

where $W_j$ denotes the wage associated with labor type $j$. From the first-order conditions, we obtain the following labor demand functions:

$$\ell_j = \theta^{-1} (W_j/W)^{-\sigma} y_h,$$

where $W = \left[ \int_0^\infty W_j^{1-\sigma} \, dj \right]^{1/(1 - \sigma)}$. Analogous demand functions hold for the foreign country, that is, $\ell_j^* = \theta^{-1} (W_j^*/W^*)^{-\sigma} y_h^*$, where $W^* = \left[ \int_0^\infty W_j^{*1-\sigma} \, dj \right]^{1/(1 - \sigma)}$. In the second stage, and subject to (2), the firm chooses output to maximize the following profit maximization problem:

$$\max_{y_h} \Pi_h = P_h y_h - \int_0^\infty W_j \ell_j \, dj = \left( P_h - \theta^{-1} W \right) y_h.$$

The optimal output level is then given by:

$$y_h = 0 \quad \text{if} \quad P_h < \theta^{-1} W,$$

$$0 < y_h < \infty \quad \text{if} \quad P_h = \theta^{-1} W,$$

$$y_h = \infty \quad \text{if} \quad P_h > \theta^{-1} W.$$

Analogous equations hold for the foreign firms.
2.2 Worker’s Decisions

The utility function is given by:

\[ U_j = \mu C_j - \ell_j^\beta, \beta > 1, \]  

where \( C_j = C_{hj}^\gamma C_{jf}^{1-\gamma} \) where \( C_{hj} \) and \( C_{jf} \) denote goods produced in the home and foreign country consumed by worker \( j \), respectively, and \( \gamma \) is a parameter lying between zero and one. The second term in (4) gives the disutility from work where \( \beta \) is the disutility elasticity of labor supply and is assumed to be greater than unity (see Blanchard and Kiyotaki, 1987). The budget constraint is given by:

\[ P_h C_{hj} + P_f^* C_{jf} = (1 - \tau) W_j \ell_j + z, \]  

where \( \tau \) denotes the tax rate imposed on the wage of workers residing in the home country, and \( z \) is the lump-sum income per capita transferred from the home government. The worker’s utility maximization is again conveniently solved in two stages. In the first stage, and taking the prices of goods as given, in order to maximize \( C_j = C_{hj}^\gamma C_{jf}^{1-\gamma} \), each worker solves the composition of a given level of income \( E_j = P_h C_{hj} + P_f^* C_{jf} \) between \( C_{hj} \) and \( C_{jf} \). The first-order conditions give the following demand functions:

\[ C_{hj} = \gamma E_j / P_h, \quad C_{jf} = (1-\gamma) E_j / P_f^*. \]  

Analogous demand functions hold for the foreign country:

\[ C_{hj}^* = \gamma E_j^* / P_h, \quad C_{jf}^* = (1-\gamma) E_j^* / P_f^*. \]  

Substituting (6) into \( C_j \) yields \( C_j = E_j / P \), where \( P = P_h C_{hj} + P_f^* C_{jf} \). In the second stage, and taking the average wage (= \( W \)) as given, each worker chooses \( W_j \) to maximize (4):

\[ \max_{W_j} U_j = \mu (E_j / P) - \ell_j^\beta, \beta > 1, \]  

subject to \( \ell_j = \theta^{-1} (W_j / W)^{-\gamma} y_h \) and \( E_j = (1-\tau) W_j \ell_j + z. \)

From the first-order conditions, we obtain a wage rule analogous to Blanchard and Kiyotaki (1987):

\[ W_j / W = [(1-\tau)^{-1} (\sigma/(\sigma-1))(\beta/\mu)(P/W)(y_h/\theta)^{\beta-1}]^{1/((\alpha-1)+1)} \equiv W_h/W. \]  

Eq. (8) implies that each worker residing in the home country supplies the same quantity of labor, i.e., \( \ell_j = \ell, \forall j \), thereby receiving the same labor income. From the workers’ symmetric utility function, we obtain \( C_{hj} = C_h \) and \( C_{jf} = C_f, \forall j \), and hence, from \( E_j = P_h C_{hj} + P_f^* C_{jf} \), we obtain \( E_j = E, \forall j \). Analogous wage rules hold for the foreign country:

\[ W_j^*/W^* = [((\sigma/(\sigma-1))(\beta/\mu)(P^*/W^*)(y_f^*/\theta^*)^{\beta-1}]^{1/((\alpha-1)+1)} \equiv W_f^*/W^*, \]
where \( P^* = P_h^*P_f^*/\gamma^{1/(1-\gamma)} \). From (9), we also obtain \( C_{hi}^* = C_h^* \) and \( C_{fj}^* = C_f^* \), \( \forall \ j \), and hence \( E_j^* = E^* \), \( \forall \ j \). Finally, the government budget constraint in the home country is \( \tau W_h \ell = z \).

2.3 Wage-Equality Condition

We assume that workers are permitted to move costlessly across borders. Hence, for an equilibrium where workers are located in both countries, the following wage-equality condition is required:4

\[
(1-\tau)W_h/P = W_f^*/P^*.5
\]

3. General equilibrium

We define the relative price as \( \omega = P_f^*/P_h \). Then, both the equilibrium distribution of workers, \( n_e \), and the equilibrium relative price, \( \omega_e \), are as follows:

\[
n_e = \left(\frac{1}{\gamma} + 1\right)^{-1}, \tag{11}
\]

\[
\omega_e = \left(\frac{\theta/\theta^*}{\gamma/(1-\gamma)}\right)^{1/(\sigma-1)}\left(1-\tau\right)^{\sigma/(\sigma-1)} \tag{12}
\]

From (11) and (12), in the perfect symmetric equilibrium where \( \gamma = 1/2, \tau = 0 \) and \( \theta = \theta^* \), we obtain \( n_e = 1/2 \) and \( \omega_e = 1 \). We first consider the effects of increasing the wage tax rate in the home country \( (d\tau > 0) \). Eq. (11) implies that an increase in the home wage tax drives workers out of the home country, i.e., \( dn_e/d\tau < 0 \). This is because an increase in \( \tau \) leads to \( (1-\tau)W_h/P < W_f^*/P^* \) and thereby induces some workers to relocate toward the foreign country. In addition, from (12), we obtain \( d\omega_e/d\tau < 0 \): an increase in the wage tax lowers the relative price. The intuition is as follows. An increase in the wage tax decreases \( n \) because of the relocation of workers toward the foreign country. Therefore, for a given labor supply of each worker and a given \( W_h \), it raises the average wage in the home country \( W \) and decreases the foreign average wage \( W^* \) \( \tag{3} \). In addition, \( P_h \) and \( P_f^* \) depend positively on \( W \) and \( W^* \), respectively, from (3). Therefore, through either an increase in \( P_h \) or a decrease in \( P_f^* \), the increase in \( \tau \) lowers \( \omega = P_f^*/P_h \). Thus, we obtain \( d\omega_e/d\tau < 0 \).

We next consider the effects of a home country's productivity growth. As shown in (11), we find that the equilibrium distribution of workers is independent of the domestic productivity shock, i.e., \( dn_e/d\theta = 0 \). Intuitively, on the one hand, for a given \( y_h \), an increase in domestic productivity decreases domestic labor demand through the increase in the marginal product of labor, thereby allowing monopolistically competitive workers to decrease their wage rates \( W_h \) (see equation (8)). On the other hand, for a given average wage \( W \), an increase in domestic productivity decreases the price of home goods facing workers in both countries through equation (3), and therefore, \( d\omega_e/d\theta > 0 \), because \( \omega_e = P_f^*/P_h \) (see equation (12)). The rise in \( \omega_e \) then causes world demand to switch from foreign goods to home goods, and therefore raises the relative share of home production.\( ^8 \) This production shift then increases home labor demand, and thereby allows the home monopolistically competitive workers to raise their wage rate \( W_h \) (see equation (8)). Thus, an increase in domestic labor productivity has two opposing effects on the home wage rate, \( W_h \).
However, from (11), although an increase in domestic productivity decreases $W_h$ through the increase in the marginal product of labor, offsetting changes in the world demand shifting by preventing $W_h$ from decreasing. Therefore, the two opposing effects on the home wage $W_h$ are exactly offset. Accordingly, because a home country’s productivity growth does not affect the home wage rate and $P = P^* = P_h^{1-\gamma}[\gamma(1-\gamma)^{1-\gamma}]^{-1}$ always holds, no workers have the incentive to move to the other country because $(1-\tau)W_h/P = W_f^*/P^*$, and hence, the distribution of monopolistically competitive workers is independent of home-specific productivity growth.9

The above results then indicates the following policy implication: in an environment in which workers can flexibly migrate between countries, if the aim of wage tax policy in one country is to reduce (attract) foreign workers' inflow, then the tax must be increased (decreased), regardless of any difference in the labor productivity of both countries.

4. Conclusion

This paper presents a two-country trade model for analyzing the effects of real shocks affecting relative wages between two countries on the migration of monopolistically competitive workers. Two interesting results arise from the analysis. First, a rise in the home country’s wage tax rate leads to the relocation of some workers away from the home country towards the foreign country. Second, with a domestic productivity shock, we find that the negative wage effect (because of an increase in the marginal product of labor) exactly offsets the positive wage effect (because of an increase in the world consumption demand for home goods). Accordingly, this analysis makes it clear that the migration of monopolistically competitive workers is independent of any difference in the labor productivity of both countries.

We believe that one benefit of the present model is its simplicity and tractability. This suggests many directions for future research. First, the migration mechanism for workers in this framework is rather simple as we postulate that worker relocation depends only on cross-country after-tax wage differences. This formulation may be unrealistic because many other factors also determine the international relocation of workers. Therefore, incorporating other factors affecting the migration of workers (consumption taxes, public goods, the work environment, immigration regulation, and so on) may be important. Second, although one of the main purposes of the paper is to analyze the effects of an increase in an exogenously fixed wage tax, interactions between the two governments in setting optimal wage taxes are not considered.10 Therefore, extending the present model to a noncooperative game theoretic analysis and taking the wage tax as a strategic variable may be interesting. Finally, this paper has attempted to shed light on the theoretical aspects of real shocks affecting relative wage rates. Therefore, whether its findings are consistent with empirical evidence is a question that we must next consider. These issues remain open for future research.

Endnotes

* Wataru Johdo, Faculty of Economics, Tezukayama University, 7-1-1, Tezukayama, Nara 631-8501, Japan. E-mail address: johdo@tezukayama-u.ac.jp. I am grateful to an anonymous referee for thoughtful comments. Financial support from Tezukayama University is gratefully acknowledged.
1. In what follows, we mainly focus on the description of the home country because the foreign country is described analogously.

2. An asterisk identifies foreign country variables.

3. We use the index \( h \) to denote the symmetric values within the home country and the index \( f \) for the foreign country.

4. In this paper, we focus on the effects of wage taxation in the home country. However, because of the symmetry of the model, we can treat a foreign wage tax effect analogously.

5. In a two-sector urban–rural model with unemployment, Harris and Todaro (1970) assume a very similar form of the equilibrium condition.

6. See the Appendix for the derivation of \( n_e \) and \( \omega_e \).

7. The average wage in the home country can be rewritten as \( W = n^{-1/(\sigma-1)} W_h \). Therefore, for a given \( W_h \), a decrease in \( n \) raises \( W \). This is because the fewer the number of workers residing in the home country, the larger the monopoly power of each worker for his/her own differentiated labor input against the domestic firm. This result is also consistent with the evidence found in the empirical literature on international migration and wages (e.g., Mishra, 2007).

8. Intuitively, the world demand-shifting effect arises because a decrease in the relative price of home goods for workers in both countries causes world consumption demand to switch towards home goods.

9. Because of the symmetry of the model, foreign-specific productivity growth effect is treated analogously.


References


**Appendix**

In this paper, we define the relative price as $\omega = P_f^*/P_h$. Then the home and foreign product prices in terms of consumption goods are as follows:

$$\frac{P_h}{P} = [\gamma(1-\gamma)^{1-\gamma}] \omega^{\gamma-1}, \quad \frac{P_f^*}{P} = [\gamma(1-\gamma)^{1-\gamma}] \omega^\gamma, \quad (A1)$$

From (8) and (9), we obtain $W_j = W_h \forall j$ and $W_j^* = W_f^* \forall j$. Then we obtain:

$$\frac{W_h}{W} = n^{1/(\sigma-1)}, \quad \frac{W_f^*}{W^*} = (1-n)^{1/(\sigma-1)}, \quad (A2)$$

from the wage indexes. In addition, from (A1), (A2) and (3) (and its foreign counterpart), the home and foreign wages in terms of consumption goods are as follows:

$$\frac{W_h}{P} = \left(\frac{W_h}{W}\right) \left(\frac{W}{P_h}\right) \left(\frac{P_h}{P}\right) = \theta^{\gamma}(1-\gamma)^{1-\gamma} n^{1/(\sigma-1)} \omega^{\gamma-1}, \quad (A3)$$

$$\frac{W_f^*}{P^*} = \left(\frac{W_f^*}{W^*}\right) \left(\frac{W^*}{P_f^*}\right) \left(\frac{P_f^*}{P^*}\right) = \theta^* \gamma^{\gamma}(1-\gamma)^{1-\gamma} (1-n)^{1/(\sigma-1)} \omega^\gamma. \quad (A4)$$

By substituting (A3) and (A4) into (10), the equal-wage condition can be rewritten as:

$$\omega = (1-\tau)(\theta/\theta^*) [n/(1-n)]^{1/(\sigma-1)}. \quad (A5)$$

Substituting (A1), (A2) and (3) into (8) and (9), respectively, and taking the ratio yields:

$$[n/(1-n)]^{\alpha(\beta-1)+1}/(\sigma-1) = (1-\tau)^{-1}(\gamma/(1-\gamma))^{-1} \omega^{\beta}(\theta/\theta^*)^{-\beta}. \quad (A6)$$

Hence, this model yields a system of two equations: equation (A5), which stems from the wage-equal condition, determines $n$ given $\omega$; and equation (A6), which stems from the wage rules, determines $\omega$ given $n$. These equations together determine the equilibrium values of both $n$ and $\omega$. From (A5) and (A6), the equilibrium distributions of labor, $n_e$, and relative prices, $\omega_e$, are as follows:

$$n_e = \left(\left(\frac{1-\gamma}{\gamma}\right)(1-\tau)^{-1} + 1\right)^{-1}, \quad (A7)$$

$$\omega_e = (\theta/\theta^*) \gamma/(1-\gamma))^{1/(\sigma-1)}(1-\tau)^{\sigma/(\sigma-1)}. \quad (A8)$$

(A7) and (A8) are equivalent to (11) and (12).