Wage Inequality, Footloose Capital, and the Home Market Effect

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Abstract

Wage inequality between high-skilled and low-skilled workers is investigated in a two-country footloose capital model. When countries differ only in their sizes, the larger country attracts more than proportionate share of firms in differentiated goods sector in equilibrium. The relative wage of high-skilled workers is always higher in the larger country due to the home market effect. As the iceberg transport costs of differentiated goods decline, the extent of agglomeration first increases, and then diminishes. Wage inequality between high-skilled and low-skilled workers also follows the inverted-U pattern accordingly.

JEL classification: F16; R12
Keywords: footloose capital; home market effect; wage inequality

1 Introduction

Increasing foreign direct investments among developed nations affect labor market outcomes in both capital-exporting and importing countries. With regard to the direction of capital flows, the New Economic Geography stresses the "home market effect": without exogenous differences in technology and factor proportions among nations, the larger country attracts more than proportionate share of manufacturing firms. Agglomeration of firms generates higher demand for high-skilled workers who are fortunate enough to find jobs in these high-tech firms, while it rarely trickles down to low-skilled workers employed in other sectors of the economy. International capital flows thus can have a severe effect on within-country wage inequality.

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Empirical research so far has mixed results as to how economic agglomeration affects wage inequality. To name a few, Figini and Görg (2011) show that capital inflow increases wage inequality for the case of developing nations, while the opposite holds if they choose developed nations as sample. Aitken, Harrison, and Lipsey (1996) and Blonigen and Slaughter (2001) investigated the case of the United States in the 1980s to conclude that inward foreign investment does not have significant effect on wage inequality.

As a theoretical foundation of international capital movements under the increasing returns to scale technology, Martin and Rogers (1995) proposed the "footloose capital" model. In their setting, firms in differentiated manufacturing goods sector need some fixed amounts of capital to start up a factory. Each country has fixed endowment of capital which can be installed either domestically or in foreign countries. Capital is allocated where its reward is higher without incurring any costs. In equilibrium, rate of returns on capital are equalized between home and foreign with the larger country having more than proportionate share of firms.

Some theoretical research applied this footloose capital model to analyze the effects of international capital flow on domestic wages.[1] Takahashi, Takatsuka, and Zeng (2013) show that the home market effect always leads to higher wage in the larger country than in the smaller country in a model with single type of labor. They argued that as trade freeness increases (i.e. iceberg transportation cost declines), wages first rise and then decline in the larger country. Intuitively, agglomeration raises labor demand until some point, but as wages become too high in the "core" country, some firms find it more profitable to relocate in the smaller country, mitigating the home-foreign wage differentials. In the extreme case of perfectly free trade, the home market effect vanishes: each country ends up with proportional share of manufacturing firms and equal level of wages in equilibrium.

Although Takahashi, Takatsuka, and Zeng (2013) investigated endogenous wage difference between countries, their model says nothing about wage inequality between high-skilled and low-skilled workers. Public debates on "who gains and who loses from globalization" mainly concern this kind of within-country phenomenon. This is what we focus in the present paper.[2]

[1]Compared with the well-known debate on the effect of international trade on wages in the 1990s, few attentions are payed to capital flow so far.

[2]Some researchers use other theoretical frameworks to investigate wage inequality. Marjit and Kar (2013) assumed the constant returns to scale technology in the manufacturing sector, while Pi, Zhou, and Yin (2013) introduced differences in capital intensity among sectors. However, they analyzed capital flow only by means of

Specifically, we use a footloose capital model with two distinct types of labor, following the setup of Pflüger (2004). Wages of high-skilled workers are exogenously fixed for institutional reasons in Pflüger (2004), while we assume perfectly flexible wages. By this modification, we can show that wage inequality in the larger country, as well as the wage difference between home and foreign high-skilled workers, follows the inverted-U pattern similar to that of Takahashi, Takatsuka, and Zeng (2013).[3]

The remainder of this paper is organized as follows. Section 2 introduces our model. Equilibrium conditions are described in section 3. We add some simplifying assumptions to derive analytical results in section 4. Finally, section 5 concludes with discussions on some related topics and future research.

2 Setup of the model

We follow Pflüger (2004) in many respects in this paper. Our model crucially differs from his in the treatment of labor markets.

2.1 Basic structure

There are two countries: home and foreign. Each country produces two types of final goods: homogeneous, freely tradeable goods A, and differentiated goods M which is tradeable with iceberg cost τ.[4]

There are three types of production factors in the model: physical capital K, high-skilled workers H, and low-skilled workers L. All factor markets are perfect.[5] High-skilled workers H are fully employed in sector M; low-skilled workers L are employed either in sector A or in sector M. Each of them supplies one unit of labor of their own types inelastically. Production of each variety of M needs capital K as fixed input, besides variable inputs H and L (specified below). Both types of workers H and L are not allowed to move between countries, while capital K is freely mobile internationally. Each capital owner who cannot move between the countries has one unit of capital. As in the standard footloose capital model of Martin and

comparative statics and do not explain the cause and direction of capital flows.

[3]Notice again they focus only wage inequality between countries and that of between worker's skill types is abstracted completely.

[4]As in the standard new trade theory and New Economic Geography models, home producers must ship $\tau > 1$ units of goods to deliver 1 unit of its product to their foreign customers.

[5]Unemployment is of course an important issue, although we leave the labor market imperfections for future research. Studies on economic agglomeration and unemployment include Francis (2009) and vom Berge (2013), among others.

Rogers (1995), all of the capital income are repatriated to the owner's country no matter where it is actually used.

2.2 Consumption

All consumers have identical utility function over two types of goods:

$$U = \mu \ln M + A, \tag{1}$$

where $\mu > 0$ is a utility parameter and M is the composite of manufactured varieties:

$$M = \left\{ \int_0^n x_i^{\frac{\sigma-1}{\sigma}} di + \int_0^{n^*} \left(x_j^*\right)^{\frac{\sigma-1}{\sigma}} dj \right\}^{\frac{\sigma}{\sigma-1}}. \tag{2}$$

In equation (2), n is the number of home varieties (i.e. firms), x_i is the consumption level of each product, and $\sigma > 1$ is the elasticity of substitution between varieties. The number of foreign varieties n^* and consumption of foreign-made products by home agents x_j^* are marked with an asterisk.

Budget constraint of consumers is straightforward. We set the price of homogeneous goods A equals to 1, thus an agent with income y faces the following budget constraint

$$PM + A = y, \tag{3}$$

where P is the price index of manufactured goods in the home country,

$$P \equiv \left\{ \int_0^n p_i^{-(\sigma-1)} di + \int_0^{n^*} \left(\tau p_j^*\right)^{-(\sigma-1)} dj \right\}^{-\frac{1}{\sigma-1}}. \tag{4}$$

Note that p_i is the price of each variety made in home, τ is the iceberg trade cost, and p_j^* is the mill price of foreign made varieties. Utility maximization results in demand functions:

$$A = y - \mu, \tag{5}$$

$$M = \frac{\mu}{P}, \tag{6}$$

$$x_i = \mu p_i^{-\sigma} P^{\sigma-1}, \tag{7}$$

$$x_j^* = \mu \left(\tau p_j^*\right)^{-\sigma} P^{\sigma-1}. \tag{8}$$

Because there are three types of income, y in equation (5) is w_L for low-skilled workers, w_H for high-skilled workers, and r for capital owners. The demand for homogeneous goods A thus differs among consumers, while that for differentiated products (6) is the same among all consumers as a result of quasi-linear utility.

2.3 Production

In the homogeneous goods A sector, 1 unit of low-skilled worker L produces 1 unit of good A. As this sector is perfectly competitive, the wage of low-skilled workers w_L is also 1 as long as good A is produced in the home country.[6]

In the differentiated goods M sector, firms need 1 unit of capital K as fixed input to start producing a new variety i. After incurring this fixed cost, the production function of each variety i is

$$X_i = {l_i}^{\beta} {h_i}^{1-\beta},$$

where l_i (h_i) is employment of low-skilled (high-skilled) workers by firm i, and $\beta \in (0,\ 1)$ is a production parameter.[7] Firms pay w_H to high-skilled workers, which is endogenously determined in the labor market. Because the wage of low-skilled workers is always equal to 1, we can interpret w_H as the index of within-country wage inequality.

Each firm solves the cost minimization problem to get the following factor demand functions:

$$l_i = \left(\frac{\beta}{1-\beta} w_H\right)^{1-\beta} X_i, \tag{9}$$

$$h_i = \left(\frac{1-\beta}{\beta}\frac{1}{w_H}\right)^{\beta} X_i. \tag{10}$$

Using these factor demands, we have the variable cost function of producing X_i unit of manufactured variety i,

$$C\left(X_i\right) = X_i w_H^{1-\beta} \beta^{-\beta} (1-\beta)^{-(1-\beta)}. \tag{11}$$

As varieties i's are differentiated in M sector, each firm can set monopoly price p_i under the demand function (7) and the variable cost function (11),

$$p_i = \frac{\sigma}{\sigma - 1} \beta^{-\beta} (1-\beta)^{-(1-\beta)} w_H^{1-\beta}. \tag{12}$$

As long as firms earn positive operational profits, the benefit of setting up a firm will be reflected in higher capital return r. In the monopolistic competition equilibrium, profits are driven down to zero, thus we can represent each firm's production level X_i as a function of

[6] We rule out the case of perfect specialization in sector M throughout this paper.
[7] We assume β to be the same across all firms in both the home and foreign.

factor prices:

$$r = p_i X_i - C(X_i)$$
$$\rightarrow X_i = r(\sigma - 1)\beta^{\beta}(1-\beta)^{1-\beta} w_H^{-(1-\beta)}. \tag{13}$$

Equation (13) means that when the relative wage of high-skilled workers w_H is high, firms shrink their size X_i from cost-saving motives. Having stated optimal behavior of both consumers and firms, we proceed to market equilibrium conditions in the next section.

3 General equilibrium

3.1 Factor markets

We now consider market clearing conditions for three factors in turn. First, the supply of low-skilled workers L equals its demand in sectors A and M. Note that the total demand for low-skilled workers in sector M is l_i, shown in equation (9), times the number of domestic firms n. If we substitute for X_i by using (13),

$$nl_i = nr(\sigma - 1)\beta.$$

On the other hand, the demand for low-skilled workers in sector A consists of its domestic demand A_d and foreign (i.e. export) demand A_e. To sum up, the market equilibrium condition for the low-skilled workers in the home country is

$$L = A_d + A_e + nr(\sigma - 1)\beta. \tag{14}$$

In the same manner, we obtain the market clearing condition for high-skilled workers, but in this case there are no demand in sector A by assumption:

$$H = nh_i = nr(1-\beta)(\sigma - 1)\frac{1}{w_H}. \tag{15}$$

Note that similar conditions must hold for foreign labor markets L^* and H^*.

If we use the equilibrium condition of high-skilled labor market (15) and its foreign counterpart, the relative wage of the home and foreign high-skilled workers can be related to the ratio of the number of firms in the two countries:

$$\frac{w_H}{w_H^*} = \frac{n}{n^*}\frac{H^*}{H}. \tag{16}$$

Intuitively, a higher n means higher demand for home high-skilled workers, which tends to drive up their wages. On the other hand, a higher H means large supply of home high-skilled workers, thus leads to lower w_H, other things being equal. The equation (16) is one of the fundamental relationships in this model. Note that number of firms n and n^* on the right-hand side of (16) are the key endogenous variables to be determined in what follows.

Although labor markets are closed in each country, the capital market in this model is fully integrated between two countries. The equilibrium condition for capital is therefore

$$K + K^* = n + n^*, \tag{17}$$

which states the total endowment of capital are used anywhere in the world. As capital owners pursue higher return, capital is allocated to equate r internationally.

3.2 Goods markets

To close the model, we describe the market clearing condition for differentiated goods.[8] Each agent demands the amount x_i in equation (7). recall that x_i does not depend on income because the upper utility is quasi-linear, . Domestic demand for good i is obtained by multiplying x_i with the number of the home consumers: H high-skilled workers, L low-skilled workers, and K capital owners. Taking account of foreign demand together, the total demand for a home-made variety i is

$$d_i = (L + H + K)x_i + (L^* + H^* + K^*)\,\tau x_i^*. \tag{18}$$

Note that foreign consumer's demand x_i^* is multiplied by τ (i.e. inclusive of the iceberg trade costs).

Because the supply of variety i obtained in (13) is equal to total demand (18) in equilibrium, we can derive the following market clearing condition.

$$\sigma r = \frac{\mu(L + H + K)}{n + \phi n^* \left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}} + \frac{\mu\phi(L^* + H^* + K^*)}{\phi n + n^* \left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}}, \tag{19}$$

where $\phi \equiv \tau^{-(\sigma-1)} \in [0,\ 1]$ means the "freeness of trade". Obviously, similar condition holds for each foreign-made variety j,

$$\sigma r^* = \frac{\mu\phi(L + H + K)\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}}{n + \phi n^* \left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}} + \frac{\mu(L^* + H^* + K^*)\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}}{\phi n + n^* \left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}}.$$

[8] The market of homogeneous goods A also clears by the Walras's law.

As capital flows to the country where its return is higher, we have $r = r^*$ in equilibrium, which yields another key equation of this model:

$$\frac{\mu(L+H+K)\left\{1-\phi\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}\right\}}{n+\phi n^*\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}} = \frac{\mu(L^*+H^*+K^*)\left\{\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}-\phi\right\}}{\phi n+n^*\left(\frac{w_H}{w_H^*}\right)^{(1-\beta)(\sigma-1)}}. \tag{20}$$

According to Takahashi, Takatsuka, and Zeng (2013), we can interpret equation (20) as follows. The left (right) -hand side represents the attractiveness of home (foreign). With respect to the numerator on the left-hand side, $\mu(L+H+K)$ means the market size of home, and the third factor describes the price competitiveness of the home-made variety against the imported goods. The denominator represents the degree of market competition of the home; the arguments on the right-hand side are its foreign counterparts. In short, equation (20) means that capital flows bring about some balance between the ratio of "the advantage of better market access" to "the disadvantage of tighter market competition" between the two countries.

Note that n and n^* are not independent in this model, because the total number of firms is fixed by the left-hand side of (17). If we substitute for n^* from (17) and using (16), equation (20) can be solved for the number of firms in the home n accordingly. Once we have the equilibrium number of firms n (and n^*), other endogenous variables ($r,\ w_H,\ w_H^*$) follow immediately. However, as equation (20) is nonlinear in n, we cannot have a closed-form solution of n in general.

4 Capital flow and wage inequality

When the home and foreign country differ only in their sizes, where will capital flow? And how capital movements affect wage gap between high-skilled and low-skilled workers? To address these issues, we add some simplifying assumptions for the rest of this paper.

Assumption 1. Factor endowment ratio is the same in home and foreign, i.e., if we denote the world factor supply with superscripts W and home's share with $\theta \in (0,\ 1)$,

$$L = \theta L^W,\ L^* = (1-\theta)L^W,$$
$$H = \theta H^W,\ H^* = (1-\theta)H^W,$$
$$K = \theta K^W,\ K^* = (1-\theta)K^W.$$

Assumption 2. The parameter β of the production function and the elasticity of substitution between varieties σ satisfy the following condition.

$$(1-\beta)(\sigma-1)=1.$$

Assumption 1 states that there are no difference in factor proportions between the two countries. Assumption 2 may be more controversial, though we can derive many analytical results only with the help of it. Namely, the equilibrium conditions (20) and (16) are simplified under these assumptions as follows.

$$\frac{n}{n^*}=\frac{\theta}{1-\theta}\cdot\frac{\theta\{\theta\phi+(1-\theta)\}+(1-\theta)\phi\{\theta+(1-\theta)\phi\}}{\theta\phi\{\theta\phi+(1-\theta)\}+(1-\theta)\{\theta+(1-\theta)\phi\}}. \tag{21}$$

By investigating this representation, we can show the home market effect in this model. If the second factor on the right-hand side of equation (21) is equal to 1, then each country has proportional share of firms. The home market effect of this model is present, therefore, when the second factor of (21) is larger than 1.

Proposition 1. If $\theta>\frac{1}{2}$, then the home has more than θ share of firms (the home market effect).

proof. It is straightforward to show that the second fraction on the right-hand side of (21) is larger than 1 if and only if $\theta>\frac{1}{2}$. Because the capital endowment ratio is $\frac{\theta}{1-\theta}$, this means capital flows from the smaller country (foreign) to the larger country (home). □

The mechanism underlying the home market effect is the same as Takahashi, Takatsuka, and Zeng (2013). Suppose firm's share is the same as capital endowment ratio $\frac{\theta}{1-\theta}$, then the larger country is more attractive for firms as they consider the balance between the advantage of market size and the disadvantage of tight competition. Thus foreign capital flows into the larger home country. Moreover. it turns out that high-skilled wages are pushed up by this capital inflow.

Proposition 2. Wage of high-skilled workers is higher in the larger country.

proof. Under assumption 1, equation (16) is $\frac{w_H}{w_H^*}=\frac{n}{n^*}\frac{1-\theta}{\theta}$. From proposition 1, when $\theta>\frac{1}{2}$ it follows that $\frac{w_H}{w_H^*}>\frac{\theta}{1-\theta}\frac{1-\theta}{\theta}=1$. □

Takahashi, Takatsuka, and Zeng (2013) showed that the home market effect always results in higher wage in the capital-importing country. In the present paper, it is only high-skilled worker's wage that is raised by capital inflow. Notice also that wages of low-skilled workers are the same between home and foreign, as long as neither country is perfectly specialized. In other words, proposition 2 states that wage inequality is severer in the larger country.

The next question is how capital flows are affected when trade liberalization takes place. In this model, any improvements in transport infrastructures or reductions in import tariffs are captured by a decline in the iceberg cost τ. It is more convenient to use the trade freeness parameter ϕ instead of τ in what follows.

Proposition 3. If $\theta > \frac{1}{2}$, as the iceberg transport cost declines, the ratio of numbers of firms $\frac{n}{n^*}$ first increases and then decreases.

proof. By differentiating (21) with respect to ϕ, we can show its derivative is positive when $\phi < \hat{\phi}$ and negative when $\phi > \hat{\phi}$, where

$$\hat{\phi} \equiv \frac{1}{1-\theta+\theta^2}\left\{\sqrt{\theta(1-\theta)} - \theta(1-\theta)\right\}.$$

We can also show that $\hat{\phi}$ is a constant between 0 and $\frac{1}{2}$. □

Proposition 4. As the iceberg transport cost declines, wage inequality between high- and low-skilled workers in the home country changes in exactly the same manner as $\frac{n}{n^*}$.

proof. We can solve for w_H by using (15) and (19):

$$w_H = \frac{\mu\left(L^W + H^W + K^W\right)}{\sigma H^W}\left\{\frac{\theta}{\theta+\phi(1-\theta)} + \frac{\phi(1-\theta)}{\theta\phi+(1-\theta)}\right\}. \tag{22}$$

By differentiating this with respect to ϕ, we can show that its sign replicates that of $\frac{n}{n^*}$, namely, positive when $\phi < \hat{\phi}$ and negative when $\phi > \hat{\phi}$. □

The inverted-U pattern of capital flow is also seen in the model of Takahashi, Takatsuka, and Zeng (2013). Intuitively, as trade cost declines, the larger market continues to attract firms until a certain point. However, if high-skilled wage is raised too much, firms begin to leave the larger market to setup plants in the smaller foreign country where they can employ cheaper high-skilled workers.

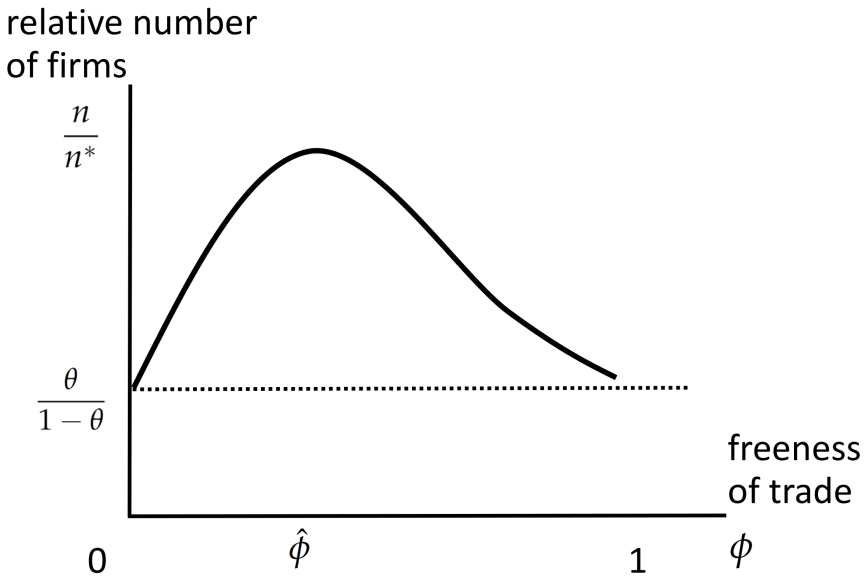

Figure 1: Relative number of firms when $\theta > \frac{1}{2}$.

This result is quite in line with empirical evidence. In general, developing countries may be thought to have relatively higher trade barriers (i.e. $\phi < \hat{\phi}$ to begin with). For these large countries, trade liberalization induces capital inflow together with increasing domestic wage inequality.[9] On the other hand, in developed large countries where the degree of trade liberalization is already quite high ($\phi > \hat{\phi}$), further tariff reduction will push the firms out of that country, reducing wage inequality.

The results of our propositions are summarized in figure 1. If the home has relatively large share of factor endowments ($\theta > \frac{1}{2}$), trade liberalization attracts more than proportionate share of firms. The home market effect first strengthens and then gradually diminishes, until it returns to the original proportional share of firms in the limit case of perfectly free trade ($\phi \to 1$).[10] Because the difference in the wage of high-skilled workers between the home and foreign is governed by equation (16), the degree of intra-national wage inequality also follows the same pattern.

[9]Recall that Figini and Görg (2011) obtained positive impact of capital inflows on domestic wage inequality only for the case of the developing countries sample.

[10]It is straightforward to show that the relative number of firms in the limit case of both sides ($\phi \to 0$ and $\phi \to 1$) coincides with each other by equation (21).

5 Conclusion

In this paper, we set up a two-country footloose capital model to investigate the impact of trade liberalization and firm's relocations on domestic wage inequality. The larger country attracts more than proportionate share of firms as a result of the home market effect. Because firm's agglomeration raises demand for high-skilled workers, wage inequality is always larger in the capital-importing country. As the transport costs decline, the degree of wage inequality first widens and then gradually attenuates toward the limit case of perfect trade liberalization.

The present paper is entirely based on the footloose capital model of Pflüger (2004). One limitation is that capital used in one country necessarily leaves the other country. To put it differently, if a firm decides to setup a factory abroad, it must close its ongoing domestic production facility. Admittedly, this feature of the footloose capital model is quite at odds with the way many multinational enterprises do business in practice. Egger and Pfaffermayr (2005) and Larch (2007) introduces multinational firms in the analysis of wage inequality and economic geography, although their models abstract from international capital movement.[11] In this sense, the present paper complements their analysis.

Another argument to be studied further is the issue of labor market imperfections. Recall that Pflüger (2004) assumed exogenously fixed wages for high-skilled workers to investigate the impact of labor market regulations on firm's location decisions. If national minimum wages are driven up, then firms would leave those countries from cost-minimizing motives.[12] Or if labor unions bargain over wages with firms, the threat of firms to relocate its domestic plants abroad would undermine the bargaining position of workers.[13] Although these channel from capital movements to wage levels is persuasive, these studies pay little attention to the domestic wage inequality between high-skilled and low-skilled workers. Whether these consideration affect the result of the present paper is left for future research.

[11] In these studies, firms choose whether to set up a domestic company or a multinational company. A multinational company in one country can ship their products costlessly to consumers in both countries, although they need higher fixed costs.

[12] The analysis of Méjean and Patureau (2010) clearly captures this possibility.

[13] Boulhol (2009) discuss the wage bargaining in the presence of firm's threat to relocate abroad.

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