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Labor market effects of knowledge spillovers[1]

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Abstract

This paper studies the diffusion of technology that occurs from Multinational Enterprises to domestic firms via worker mobility. It concentrates on the wage and unemployment implications of diffusion of knowledge through labor mobility in the local labor market. We construct a heterogeneous search and matching model where the labor mobility is restricted by the existence of binding contracts. Findings of the model reveal that knowledge spillovers through the movement of workers from foreign to local firm lower the firm premium and the skill premium. Further results indicate that technological progress raising the productivity gap between the foreign and the local firm leads to an increase in the unemployment rate, the firm premium and the skill premium.

Key words: Foreign direct investment, skill premium, firm premium, knowledge spillover, search and matching models.

JEL classification: F23, F16, J60.

1. Introduction

Many countries attempt to encourage the entry of Multinational Enterprises (MNEs) by offering substantial incentives, with the belief that advanced technologies introduced by the MNEs may spillover to local firms and increase their productivity. The existence of spillovers from MNEs to local firms is mainly attributed to the multinational's ownership of firm specific assets implying that they have superior technology and knowledge of marketing and managerial techniques[2]. As MNEs are considered to be an

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[2] The industrial organization theory of multinational firm's existence points out that firms become multinational due to some firm specific advantage (Dunning 1993, Markusen and Venables, 1997).

important mechanism for productivity and knowledge diffusion to local markets, an impressive body of empirical evidence has developed around the spillover effects of MNEs to identify the potential channels of spillovers. These spillovers can occur either vertically or horizontally, where labor mobility between the domestic and foreign firms is one of the means through which these spillovers could occur[3].

Even though a significant number of studies have analyzed the spillovers arising from the entry of MNEs, the impact of spillovers via labor mobility on the productivity and wages in the host countries has hardly been studied. Only a few theoretical studies have analyzed productivity transfers via worker mobility, most of them analyzing the labor mobility within full employment, general equilibrium models (see for example, Ethier and Markusen, 1996; Fosfuri et al., 2001; Markusen, 2001; and Glass and Saggi, 2002). Several papers, among which one could include those by Gerschenberg (1987), Pack (1993), Görg and Strobl (2005), Martins (2005), Balsvik (2006), Hale and Long (2006), Lenger and Taymaz (2006), Poole (2006) and Pesola (2007), document empirical evidence regarding labor mobility and its productivity and labor market implications. The more recent papers, which are most relevant for our work include those by Malchow-Møller et al. (2006) and Markusen and Trofimenko (2009), provide both a theoretical set-up and empirical evidence. Yet, similar to the above listed literature their models also continue to assume full employment in the labor market, an assumption that is challenged by the extensive labor-search literature. However, these studies do document four fundamental issues. First, empirical evidence supports that productivity spillovers do arise via labor mobility. Second, workers who have a foreign firm work experience have a productivity advantage. Third, foreign firms pay a wage premium. Fourth, workers who have experience in multinationals earn more than their colleagues in local firms, suggesting that the wage premium offered by multinationals become persistent.

Indeed, labor mobility can serve as a mechanism for a local firm to acquire the externally-developed knowledge. Workers in foreign firms will be exposed, at least partially, to the firm specific assets in MNEs. Knowledge diffusion takes place whenever these workers move to the local firms and manage to bring all or some part of this knowledge acquired in the foreign firm. The application of this valuable knowledge at local firms may then generate higher productivity.

Görg and Greenaway (2001) suggest that the productivity improvement generated by the movement of labor from MNEs to local firms

[3] Vertical spillovers are created by the backward and forward linkages between foreign affiliates and local firms operating in different sectors (Lall, 1995; Rodriguez-Clare, 1996; Aitken and Harrison, 1999; Görg and Greenaway, 2004; Alfaro and Rodriguez-Clare, 2004; and Javorcik, 2004), whereas horizontal spillovers arise as a result of imitation, demonstration effects, reverse engineering or competitive pressure exerted by foreign firms operating in the same sector as the local firms (Mansfield and Romeo, 1980; Blömstrom, 1986).

can be realized via two mechanisms. First, skilled labor tends to raise the productivity of the unskilled labor. Second, workers who have a foreign firm experience that move to local firms may directly carry with them the knowledge of new technology. On the other hand, consequences of potential labor mobility could damage the firm specific advantages of the multinationals. Hence, they may try to prevent such knowledge diffusion by paying higher wages or by offering binding employment contracts to ensure their assets will not be passed to domestic competitors (Ethier and Markusen, 1996; Markusen, 2001; Fosfuri et al., 2001; Glass and Saggi, 2002 and Nicholson, 2002).

Taking cue from these abovementioned studies we set out to construct a model with labor mobility where (1) the full employment assumption is dropped, (2) following Görg and Greenaway's (2001) point, workers with past foreign firm experience are able to carry their knowledge with them across firms and (3) to avoid such mobility and possible loss of proprietary knowledge firms provide employment contracts with differing extents of binding features. As such we construct a search and matching model allowing for some unemployment and frictions in the labor market, and where the extent of labor mobility is modeled via the flexibility of binding contracts. This model considers the restricted access of foreign workers to the local labor market due to the enforcement of contracts[4]. Many studies model the existence of binding employment contracts as a mechanism that deters transmission of knowledge with the aim of protecting the firm specific assets (Ethier and Markusen, 1996; Markusen, 2001 and Nicholson, 2002); however, none of them incorporate contracts within the spirit of search and matching models where the labor market is frictional as we do in the below model.

We are specifically interested in how the possible knowledge transmission through workers' mobility affects the labor market outcomes when the labor market frictions are realistically modeled and different extent of labor mobility across firms is accounted for by modeling the degree of binding clauses in employment contracts as a proxy for labor mobility. For example, under such a framework what is the impact of increased labor mobility on the wages paid by foreign and local firms? What will the response of the unemployment rate be when the mobility of workers from foreign to local firms is permitted? How do these results differ with the technological gap between foreign and local firms?

This framework contributes to the literature in three important respects. First, this study theoretically formulates the behavior of foreign and local wages under differing extents of labor mobility. While there are previous works on the link between labor mobility and wages they all view labor mobility dichotomously; in other words, labor either moves or does not move across firms (see Görg and Strobl, 2005; Martins, 2005; Lenger

[4] "Foreign workers" refers to workers employed in foreign firms.

and Taymaz, 2006; Poole, 2006 and Pesola, 2007, among others). In this paper however labor mobility is not a one-zero event, there are varying extents of labor mobility between the local and foreign firms, where this extent depends on the clauses in the employment contracts. Secondly, the theoretical frameworks constructed so far looking into the labor market implications of labor mobility between local and foreign firms ignore the labor market frictions and unrealistically assume full employment. Our model allows relaxation of this unrealistic assumption and by carrying the important features of search models into this framework adds value to the literature. Finally, while the literature mainly focuses on the absolute wages we are able to discuss relative wages between workers who are exposed to the proprietary knowledge of foreign firms and those that are not exposed to the foreign superior knowledge. One could think of these relative wages as either the "foreign firm premium", defined as the relative wage of workers in foreign firms to those in local firms, or the "skill premium", defined as the relative wages between the workers exposed to foreign knowledge and those that are not exposed. Alongside these additional wages we are also able to discuss the unemployment effects of labor mobility, an issue usually ignored in the literature. Following Malchow-Møller et al. (2006) and Markusen and Trofimenko (2009), in the remainder of the paper, we will label those workers that have been exposed to superior knowledge available at the foreign firms as "informed" workers and those that have never worked in a foreign firm as "uninformed" workers.

Our main findings can be summarized as follows: First, we find that increased labor mobility (via less binding employment contracts by foreign firms) leading to knowledge spillovers reduces the informed wages and increases the uninformed wages in the local firm. This leads to a rise in the average wages in the local firm, which supports the empirical evidence underlined by Görg et al. (2007), Martins (2005) and Malchow-Møller et al. (2006). Second, our results suggest that the foreign firm premium decreases as the local workers are informed on the technology available in the foreign firm via increased labor mobility. Third, in response to knowledge spillovers through labor mobility the "skill" premium between the informed and uninformed workers melts down in the local firm. Fourth, if the MNEs do not offer binding contracts to protect their firm specific advantage and allow for the mobility of workers, the unemployment rate will be lower. Therefore, even though many countries try to attract MNEs to benefit from their job creation, this paper finds that the employment generation effect of foreign firm entry depends on the degree the foreign firm would like to share its firm specific asset with the local firms and hence on the flexibility of the employment contracts they offer.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 analyzes the equilibrium outcomes and discusses the results obtained. Section 4 displays the numerical example and the last section concludes.

2. Model

Workers could be a source of spillovers if they acquire superior knowledge at a foreign owned firm and bring this knowledge with them to benefit the local firm when they change jobs. However, MNEs may prevent the knowledge diffusion not to lose their firm specific advantage by offering restrictive employment contracts. Thus, existence of such contracts acts as a proxy for labor mobility.

Within this context, to draw a complete picture on the workers' mobility, a search model with a matching process is provided. The basic building blocks of the model comes from the search theory and the matching function, following the studies of Gautier (2002), Albrecht and Vroman (2002) and Dolado et al. (2009). The model is enriched by allowing for two sided on-the-job search and different job creation costs between domestic and foreign firms. The model can be summarized as follows. There are a number of job seekers, who are either unemployed or employed. Vacancies are posted by local and foreign firms looking for workers, where the job creation costs differs between local and foreign firms. Job seekers and firms meet according to a matching function. When a worker and firm meet, the wage is set in accordance with the Nash bargaining approach.

2.1. Basic assumptions

Consider a continuous time model in which workers are infinitely lived and risk neutral. The measure of workers is normalized to one. There are two types of jobs: local (*L*) and foreign jobs (*F*). Let y^i denote the flow output of a job of type *i* (=*L,F*). Foreign firms are more productive than local firms, which is a well-established empirical finding in the literature, where the source of this higher productivity is due to the MNEs firm specific assets such as newer technology, production process, managerial technique or organizational form (Dunning, 1993; Caves, 1996; Doms and Jensen, 1998 and Conyon et al., 2002):

$$y^F > y^L$$

The exogenous job destruction rate is δ. During unemployment workers receive an unemployment benefit *b*. Denoting the costs of job creation in the local and foreign firms as c_L and c_F, respectively, we assume $c_F > c_L$.

The mobility from foreign to local workers is restricted by binding employment contracts, where the extent of restrictions of the contracts are captured by the parameter *g*, where $g \in [0, 1]$. If employment contracts are binding then $g=0$, on the other hand if contracts are not binding then $g=1$. The main interpretation is that if the contracts are binding then it is difficult for foreign workers to switch into local jobs, leading to lower mobility of foreign workers and fewer workers having an experience in the foreign firm.

As for the local firm, this lowers the probability of being informed about the technology in the foreign firm. In this framework the only channel through which local firms gain access to advanced knowledge in the multinationals is through workers who have experience in multinationals and switch from MNEs to local firms.

Employment contracts control the mobility of workers. In fact they are designed to deter workers from moving and carrying information with them. Firms may try to prevent labor mobility due to several reasons. For example, in some circumstances innovative ideas can hardly be protected, particularly when they are at the development stage (see for example, Carnoy et al., 1997 and Hyde, 2000). This threat of competition due to the information leakage leads firms to look for ways to avoid labor mobility (see for example, Gaston and Nelson, 2002 and Baccara and Razin, 2004). For example, if MNEs are subject to exit threats from their workers, they put a great effort to design contracts that deter workers from moving to protect their technological advantage over local firms (Ethier and Markusen, 1996 and Markusen, 2001). Several clauses in employment contracts could limit labor mobility. For example, as Adnett et al (2004) points out, non-portable pension contribution plans and employer provided health insurance coverage reduce worker's incentive to move between jobs (Adnett et al., 2004).

The probability of being in the informed state[5] for the local worker is denoted by α, where $\alpha \in [0, 1]$. This depends on the existence of enforcing contracts in the foreign firm, g. If the contracts are binding, the labor mobility will be limited. Hence the probability of being informed will be low since there will be less interaction between former foreign firm workers and local workers. The transmission of knowledge occurs through interactions between individual workers, an empirically supported fact[6]. That is, workers get access to valuable knowledge on the job and the knowledge diffusion occurs when the former MNE workers join local firms. The greater the labor turnover from foreign firms to local firm, greater the number of possible individual interactions in the local firm and greater the potential transfer of knowledge (see Fosfuri et al., 2001; Markusen, 2001; and Markusen and Trofimenko, 2009, among others).

The link between α and g could be formalized as follows:

$\alpha=0$ if $g=0$ and $0<\alpha<1$ if $g=1$ and $\alpha'(g)>0$

In other words, with probability α, which depends on the flexibility of the employment contracts, the effective productivity of a worker can increase as they possibly become informed.

[5] Informed state means the worker is aware of the technology in the foreign firm.

[6] See Markusen and Trofimenko (2009), Balsvik (2006), Hale and Long (2006), Görg and Strobl (2005) and Poole (2006).

2.2. Matching

Suppose that the total number of matches between a worker and a firm is determined by a constant returns to scale matching function:

$$q[v_L + v_F, u + e_L + e_F] = (u + e_L + e_F)^p (v_L + v_F)^{1-p} \quad (1)$$

where v_L denotes the mass of local vacancies and v_F is the mass of foreign vacancies; u is the mass of unemployed workers; e_L stands for the number of workers performing local jobs, e_F is the number of workers in the foreign firm; and p corresponds to the elasticity of matching with respect to the mass of job seekers. It is assumed that q [,] is strictly increasing in both arguments and θ denotes the labor market tightness, $\theta = (v_L + v_F / (u + e_L + e_F))$. Accordingly, the rate at which firms meet a job-seeker is equal to $q(\theta)=q(1,(1/\theta))$; similarly, workers may meet a job at rate, $\theta q(\theta)=q(\theta,1)$. The properties of the matching function imply that the matching rate of workers (firms) is increasing (decreasing) in θ. To define the matching rates of workers it is also convenient to define a variable η $(=v_L / (v_L + v_F))$, which represents the share of local vacancies in total vacancies.

The variables u, e_L and e_F should satisify the appropriate flow conditions:

$$\theta^{1-p} u = \delta(1 - u) \quad (2)$$

where a flow θ^{1-p} of unemployed workers find employment in firms, which equals the flow of workers into unemployment due to the job destruction, $\delta(1-u)$.

Since on-the-job-search is allowed for both workers in the local and foreign firms, we have equations for local and foreign firms stating that in the steady state the flow of workers into the local firm, $\theta^{1-p} u\eta + \theta^{1-p}\eta g e_F$, is equal to the flow of workers out of the local firm, $(\delta + \theta^{1-p}(1-\eta))e_L$. The flow $\theta^{1-p}(1-\eta)(u + e_L)$ of employed workers into the foreign firm equals the flow out of the foreign firm, $(\delta + \theta^{1-p}\eta g)e_F$, where g, existence of restrictive contracts, determines the extent of labor mobility.

$$\theta^{1-p} u\eta + \theta^{1-p}\eta g e_F = (\delta + \theta^{1-p}(1-\eta))e_L \quad (3)$$

$$\theta^{1-p}(1-\eta)(u + e_L) = (\delta + \theta^{1-p}\eta g)e_F \quad (4)$$

2.3. Workers and firms

Let's consider the problem of workers. The value of unemployment U satisfies:

$$rU = b + \theta^{1-p}\eta(W_L - U) + \theta^{1-p}(1-\eta)(W_F - U) \quad (5)$$

where unemployed workers have the unemployment benefit (*b*), and a probability of having an employment opportunity in local and foreign firms, respectively, captured by the second and the third terms. The value of being employed in local and foreign firms, W_L and W_F respectively, verifies the following equations:

$$rW_L = \propto(g)\left(wf + e(g)\right) + \left(1 - \propto(g)\right)wl + \delta(U - W_L) + \theta^{1-p}(1-\eta)(W_F - W_L) \quad (6)$$

$$rW_F = wf + \delta(U - W_F) + \theta^{1-p}\eta g(W_L - W_F) \quad (7)$$

Equation (6) provides the value of being employed in a local firm. The value of employment in the local firm incorporates the assumption that wages for the workers who have the knowledge of the foreign firm is $wf + e(g)$, where the workers, who have no access to available knowledge, earn *wl*. *wf* is the wages in the foreign firm. Therefore we assume that workers who have foreign firm experience are rewarded by the local firm at the rate of *e(g)* higher wages. In other words, to encourage workers to be in the informed state, the premium $e(g)$ is paid when the informed worker moves to the local firm, which depends on the restrictions on labor mobility through g[7]. This is in accord with the empirical evidence documenting that workers who have an experience in the foreign firm or have interactions with former foreign firm workers, i.e. workers who are informed, will be more productive and earn higher wages[8]. The third term refers to the value of job destruction and the fourth term is the value of completing a successful on-the-job-search.

In equation (7), *wf* is the wages in the foreign firm, the second term stands for the value of job destruction and the third term considers the fact that the MNE may prevent the diffusion of knowledge by limiting the labor mobility via enforcement of contracts.

We next consider the problem of firms. The value of employing a worker for a local firm is J_L and for a foreign firm J_F. These values satisfy the following equations:

$$rJ_L = \propto(g)\left(y^F - wf - e(g)\right) + \left(1 - \propto(g)\right)(y^L - wl) + \left(\delta + \theta^{1-p}(1-\eta)\right)(V_L - J_L) \quad (8)$$

$$rJ_F = y^F - wf + (\delta + \theta^{1-p}\eta g)(V_F - J_F) \quad (9)$$

where the first term in equation (8) denotes the net benefit to the firm of working with informed workers and the second term is the value of working with an uninformed worker. In equation (9), the value of employing a

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[7] Note that $e(g) \geq 0$. That is, if the restrictions on contracts are binding, local firms have to pay more to attract workers. But, the numerical example is also carried out for the case where $e(g) < 0$, this could be provided upon request.

[8] See Görg et al. (2007); Martins (2005); Malchow-Møller et al. (2006); Balsvik (2006) Pesola (2007), and Markusen and Tofimenko (2009).

worker is $y^F - wf$ and the third term stands for the job destruction and considers the situation if workers leave the firm to join local firms, which is extensively determined by *g*. Equations (8) and (9) reveal that the movement of workers from the foreign to local jobs play a key role in the value of employment in both local and foreign firms.

Let V_L and V_F be the value of a job when looking for a worker, i.e. the value of a vacancy, which is given as follows for local and foreign firms, respectively:

$$rV_L = c_L + \theta^{-p} \frac{(\theta^{1-F}g+\delta)(g+\theta^{1-F}(1-\eta))}{(\theta^{1-F}g+\delta)(\theta^{1-F}+\theta^{1-F}(-1+g)\eta+\delta)}(J_L - V_L) \quad (10)$$

$$rV_F = c_F + \theta^{-p} \frac{(\theta^{1-F}g\eta+\delta)}{(\theta^{1-F}g+\delta)(\theta^{1-F}+\theta^{1-F}(-1+g)\eta+\delta)}(J_F - V_F) \quad (11)$$

The values of vacant jobs depend on the job creation costs, c_L and c_F, labor market tightness, θ, job destruction rate, δ, and the existence of binding contracts, *g*, and the value of employing a worker, J_i, where *i=L,F*.

2.4. Equilibrium

Equilibrium is determined by flow conditions given by equations (2) and (4) and two job creation conditions represented in equations (10) and (11), where $V_L = 0$ *and* $V_F = 0$. We can solve for the unemployment rate *u*, as a function of labor market tightness (θ) and the job destruction rate δ by the help of equation (2), which gives,

$$u = \frac{\delta}{\delta + \theta^{1-p}} \quad (12)$$

where the unemployment is positively related with the job destruction rate and negatively with the labor market tightness. In other words, as the local and foreign firms offer more positions for job seekers the unemployment rate will be lower.

2.5. Wage determination

The wage is chosen so as to split the total surplus in some proportion between the firm and the worker, the generalized Nash bargaining solution, where S_i is the total surplus:

$S_i = W_i + J_i - V_i - U$ where *i=L,F*

Then, it is convenient to assume that wage is chosen so that the surplus of a match, S_i, between a job of type *i (=L,F)* is given as nonnegative, that is,

$W_i + J_i \geq V_i + U$

When a match is formed, the wages are determined by a linear sharing rule:

$$W_i - U = \beta [W_i + J_i - V_i - U] \quad (13)$$

where $\beta \in (0,1)$ is the exogenous surplus share of workers.

Due to the complexity of the notation, the derivation of wages is given in the Appendix. Wages for the uninformed worker and wages in the foreign firm are jointly determined. Wages are weighted averages of the productivity of the worker, unemployment benefits and the alternative wages, as reported in the wage equations provided in the appendix. In this context, it is hard to derive an analytical solution and to provide comparative statics for these wages. Therefore, we will provide a numerical example.

3. Numerical example

This section provides a numerical example to illustrate the properties of the model. The numerical example allows us to capture effects of different degrees of contract enforcement (labor mobility) on the job creation conditions, wages and unemployment in the local economy. It furthermore allows examination of the effects of the productivity gap between foreign and local firm on wages and unemployment by allowing different degrees of labor mobility through the enforcement of contracts.

The example uses the matching function, $q(\theta) = \theta^{p}$ together with the baseline parameter values, given by Table1.

Table 1
Definition of the Baseline Parameter Values

b	Unemployment benefit, 0.1
r	Interest rate, 0.05
p	Elasticity of matching with respect to the mass of job seekers, 0.5
β	Bargaining power of workers, 0.5
δ	Job destruction rate, 0.1
y^i	Productivity of worker in a job of type i(=L,F), $\frac{y^F}{y^L} = 1.10$
c_i	Job creation cost for a job of type i(=L,F) $c_L = 0.5$ and $c_F = 0.7$

All these parameter values are reasonable and in line with the other studies including Albrecht and Vroman (2002), Gautier (2002) and Dolado et al. (2009)[9]. Moreover, we assume that $\propto (g) - \varphi g^{1/2}$ and

[9] Numerical simulation results- given these parameter values- point out that relative wages are in line with real data provided in studies by Barry et al., (2005), Balsvik (2006), Malchow-Møller et al., (2006) and Markusen and Trofimenko (2009).

$e(g) = \varphi(\frac{1}{g})^{1/2}$, where $0 < \varphi < 1$. In the baseline example, the productivity gap between foreign and local firms, $(\frac{y^F}{y^L} - 1)$ is assumed to be 10%. Previous studies suggest that the productivity gap between foreign and local firms ranges from 10% to 100% (see Aitken and Harrison, 1999; Conyon et al, 2002 and Kimura and Kiyota, 2007, among others). It seems reasonable to assume that foreign jobs are more costly to create than local jobs, where $c_L = 0.5$ and $c_F = 0.7$ (see Faggio and Konings, 2003; Carlsson et al., 2006; Russo et al., 2005 and Vanhala, 2004, among others).

Under this choice of parameters the baseline solution, summarized in Figure 1, shows that the share of local vacancies increase as labor becomes more mobile, i.e. when the contracts become less binding. Since less binding contracts allows workers to move freely between jobs the local firm offers more positions to gain access to the foreign firm's firm specific knowledge. Increased mobility of workers leads to a fall in the unemployment rate, approaching to 10%. However, as contracts become more binding (as *g* approaches to 0), that is labor turnover from foreign to local is restricted, local firm creates less vacancies. In this case the unemployment rate will be higher, numerically around 16%. In this context, one can conclude that as the workers become more mobile via relaxing employment contracts the unemployment rate declines. In other words, if the MNEs do not offer binding contracts to protect their firm specific advantage, thus, allow for the mobility of workers, the unemployment rate will be lower.

As for the absolute wages, the baseline case shows that wages in the foreign firm wf and wages paid to informed workers in the local firm $wf + e(g)$ fall as the contracts offered by foreign firms become less binding (labor becomes more mobile). This is due to the fact that firms do not need to pay more to attract the workers since there is no restriction on the job-to-job movement. Uninformed wages in the local firm increase as workers become more mobile. This is in part due to an increase in the number of vacant positions offered by local firms, so several unemployed workers have an opportunity to work in local firms. Due to the increased labor mobility, local firms do not need to pay more for the informed workers. Overall, average wages $(AVEW)$ defined as the simple average of informed and uninformed wages in the local firm increase with increased labor mobility. Furthermore, after a threshold level of labor mobility, in this case *g=0.8*, average wages in the local firm may be higher than the wages in the foreign firm. This reveals that the wage gap between the foreign and the local firms depends on the level of labor mobility.

Figure 1
Labor Market: Job Opportunities, Unemployment and Wages, $c_L = 0.5$, $c_F = 0.7$

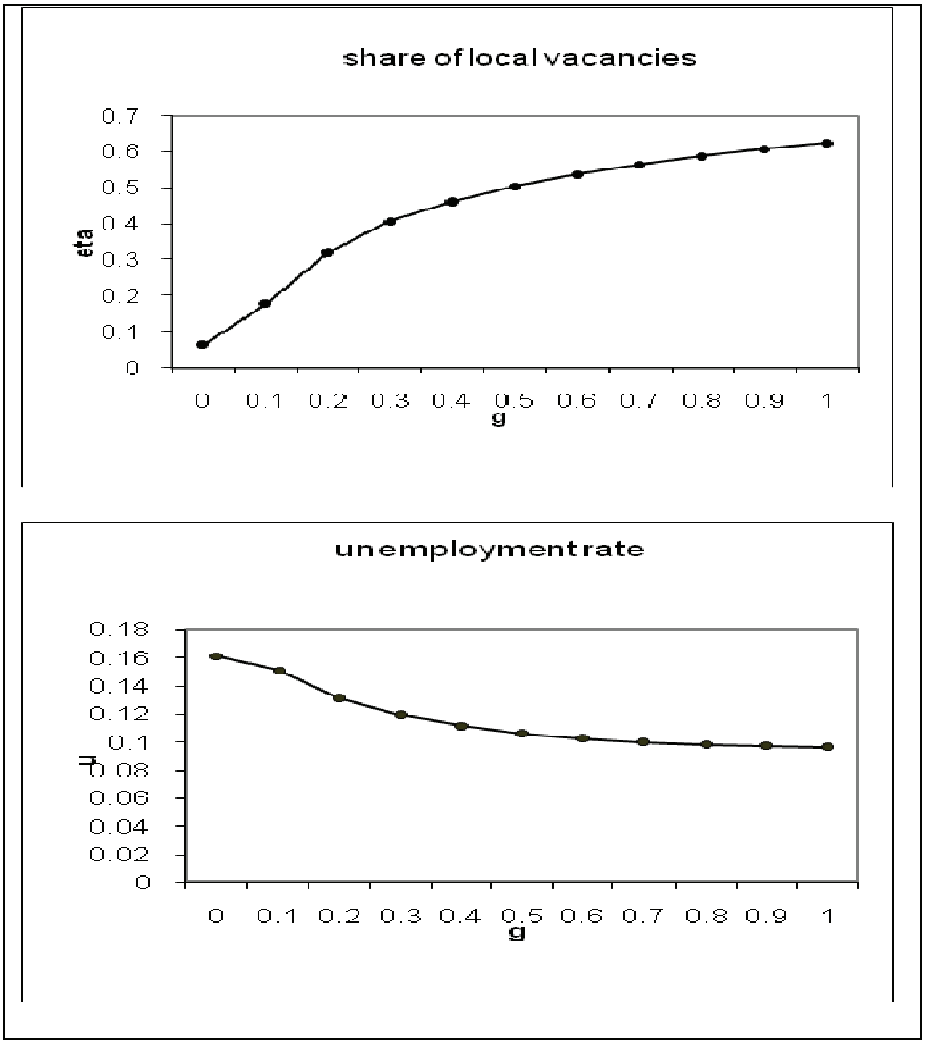
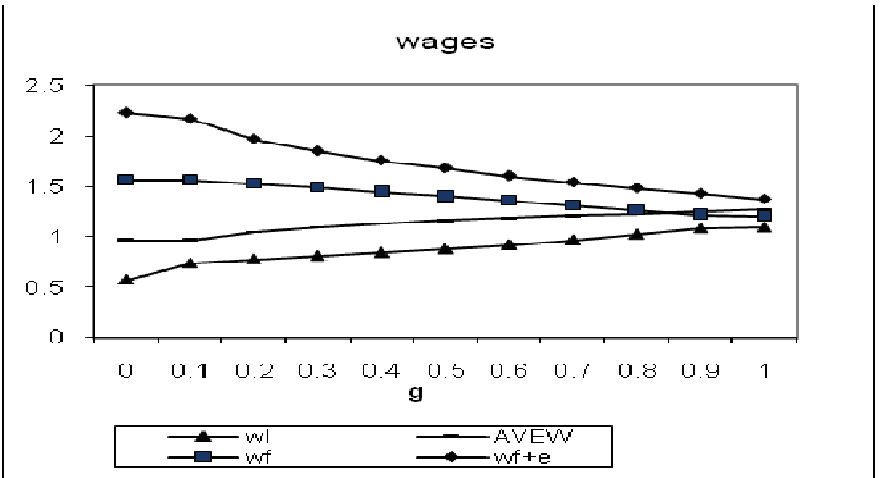
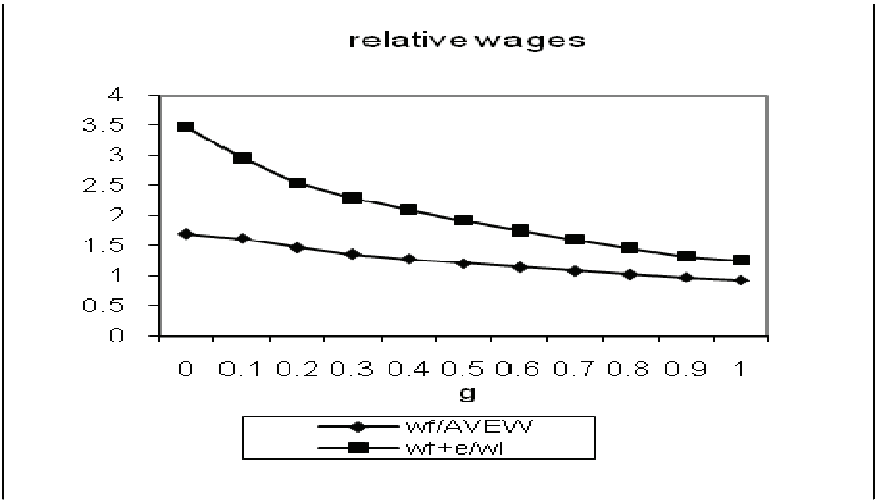


Figure 1 (continued)





As for the relative wages, as contracts become more binding (g approaches to 0), the wage gap between foreign and local firms, $\frac{wf}{AVEW}$, becomes 1.6 and relative wages- or skill premium, in the local firm, $\frac{wf+e(g)}{wl}$, is around 3.5. In other words, when the workers become more mobile, the firm premium, $\frac{wf}{AVEW}$ and skill premium, $\frac{wf+e(g)}{wl}$ decrease.

We next consider the role played by the labor market frictions, i.e. costs of job creation (c). Figure 2 considers the case where both firms face

equal job creation costs. The share of local vacancies increase while unemployment rate decreases when the restriction on contracts decreases, which is the same as in Figure 1, where $c_F > c_L$. But, due to the lower job creation costs for the foreign firm foreign firms post more vacant positions. This leads to a sharper fall in the unemployment rates.

The foreign wages and informed wages fall as *g* increases, reflecting more labor turnover from foreign to local firms. Similarly, the skill premium and the firm premium decreases as labor become more mobile. As for the absolute wages, earnings of the uninformed workers in the local firm increases slightly, while there is a more dramatic rise in the benchmark case. Wages in the local firm increase while wages in the foreign firm decrease as the restrictions on the movement of labor from foreign to local firm are relieved. In the case of equal job creation costs, foreign firms always pay more than average local wages, which is the main difference between Figure 1 and Figure 2. One should note that the results of interest (the relationship between labor mobility and absolute and relative wages) remain qualitatively unchanged when labor market frictions change. One important result though is that the level of employment contract flexibility (*g*), proxying labor mobility, at which the wages paid by the local firms exceed that paid by foreign firms exceeds the boundaries for *g*, i.e. foreign firms always pay more than the local firms at all levels of labor mobility when the labor market frictions are the same for the foreign and local firms.

In similar fashion we next test the role played by the technology gap in our results. Figure 3 focuses on the case of how the effects of labor mobility on local labor markets depend on the productivity gap between the local and foreign firms. Technological progress in the foreign firm may increase the productivity gap between local and foreign firms. Once again, we find that our main results are independent from the extent of technological gap between the foreign and local firm. However, the extent of technological gap affects the levels of these relationships. At each *g*, increased technological gap increases the share of foreign firm vacancies, increases unemployment, increases foreign firm wages, informed worker wages and local firm average wages, but decreases the uninformed worker wages. As foreign firms become more productive through the technological progress they create more vacancies which lead to a rise in wages in the foreign firm. To access the new technology in the foreign firm local firms need to pay more wage premium to hire the informed workers in the foreign firm. The negative unemployment effect through the technological progress may stem from the fact that foreign job creation may substitute the local job creation, which may lead to a slight change in the total vacancy creation.

Figure 2
Labor Market: Job Opportunities, Unemployment and Wages, $c_L = 0.5$, $c_F = 0.5$

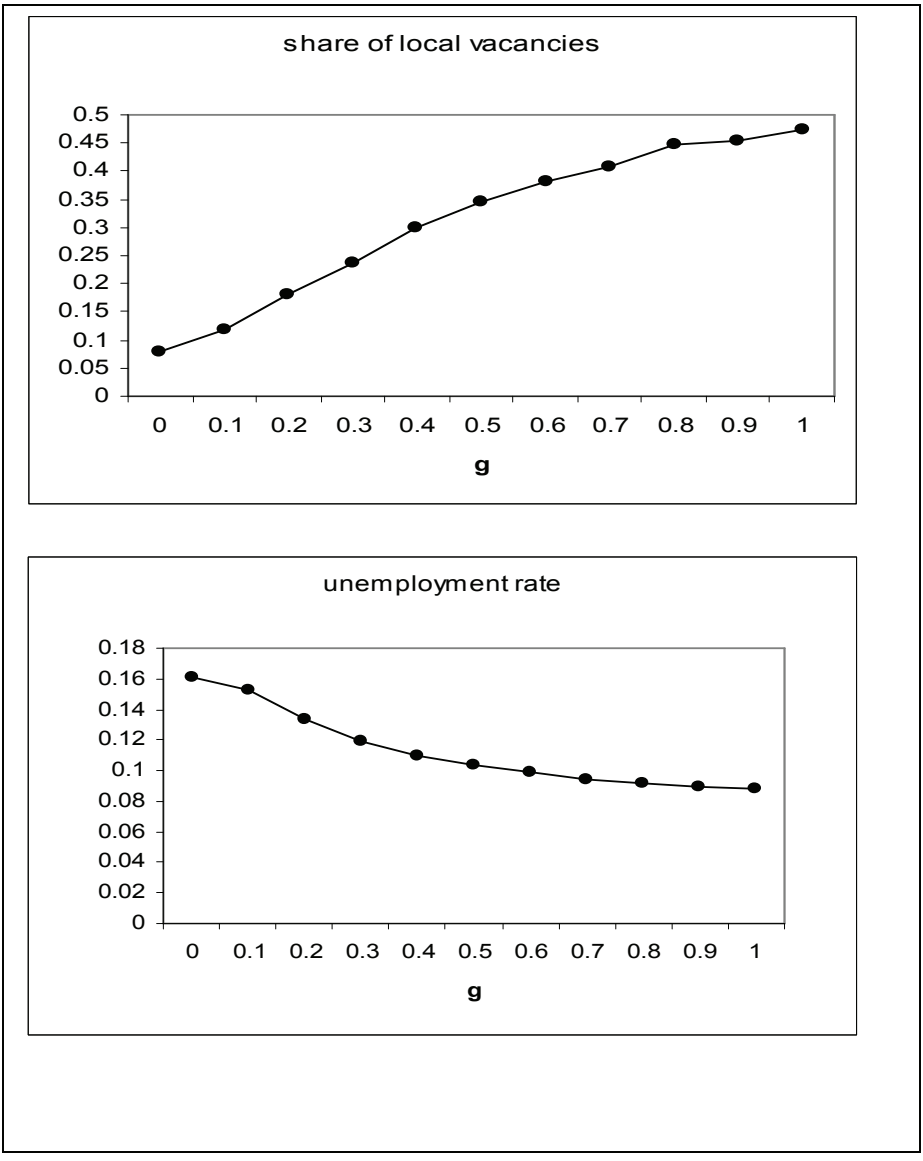
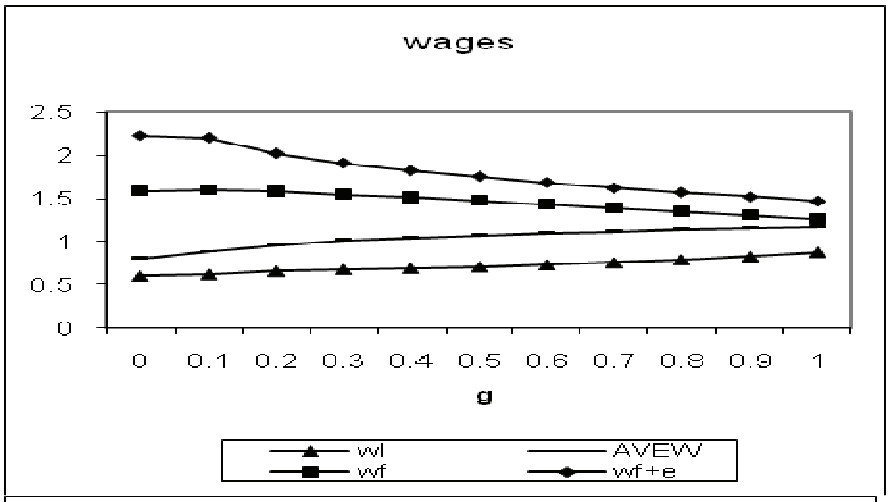
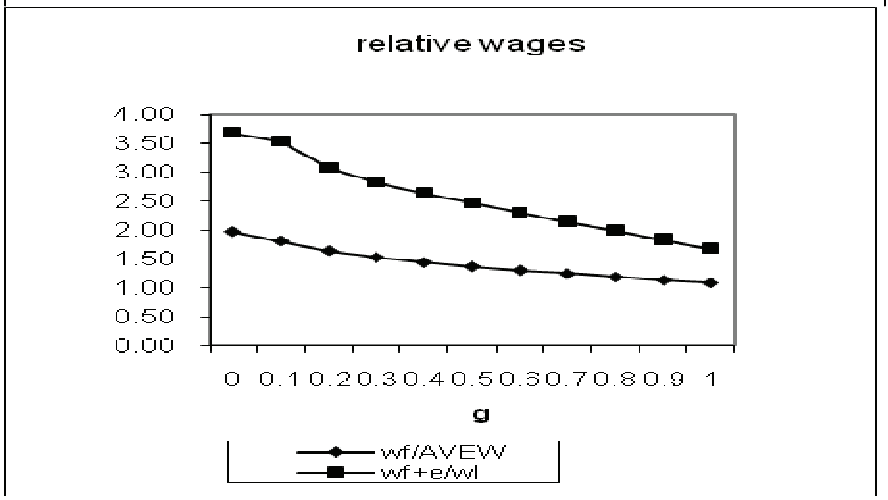


Figure 2 (continued)





According to the Figure 4, wages in the foreign and local firms increase in response to the rising technological gap between foreign and local firm. Also, foreign wages tend to fall and local wages tend to increase slightly due to the increased labor mobility as the contracts become less binding. That is, the response of absolute wages to the increased labor mobility follow the same pattern regardless of the productivity gap between foreign and local firm.

Figure 5 shows that earnings of the uninformed workers decrease as the technological gap between foreign and local firms gets wider. Regardless of the productivity gap between foreign and local firms, wages of the uninformed workers in the local firm tend to increase as labor becomes more

mobile through the introduction of less binding contracts and the wages offered to informed workers in the local firm decrease. Also, note that *wf+e(g)* rises as the technological gap between foreign and local workers increases. This reveals that when the technological gap between the foreign and local firms is too wide then local firms have to pay more to be informed about the superior technology available in the foreign firm.

Figure 3
Labor Market: Job Opportunities, Unemployment, Technological Gap

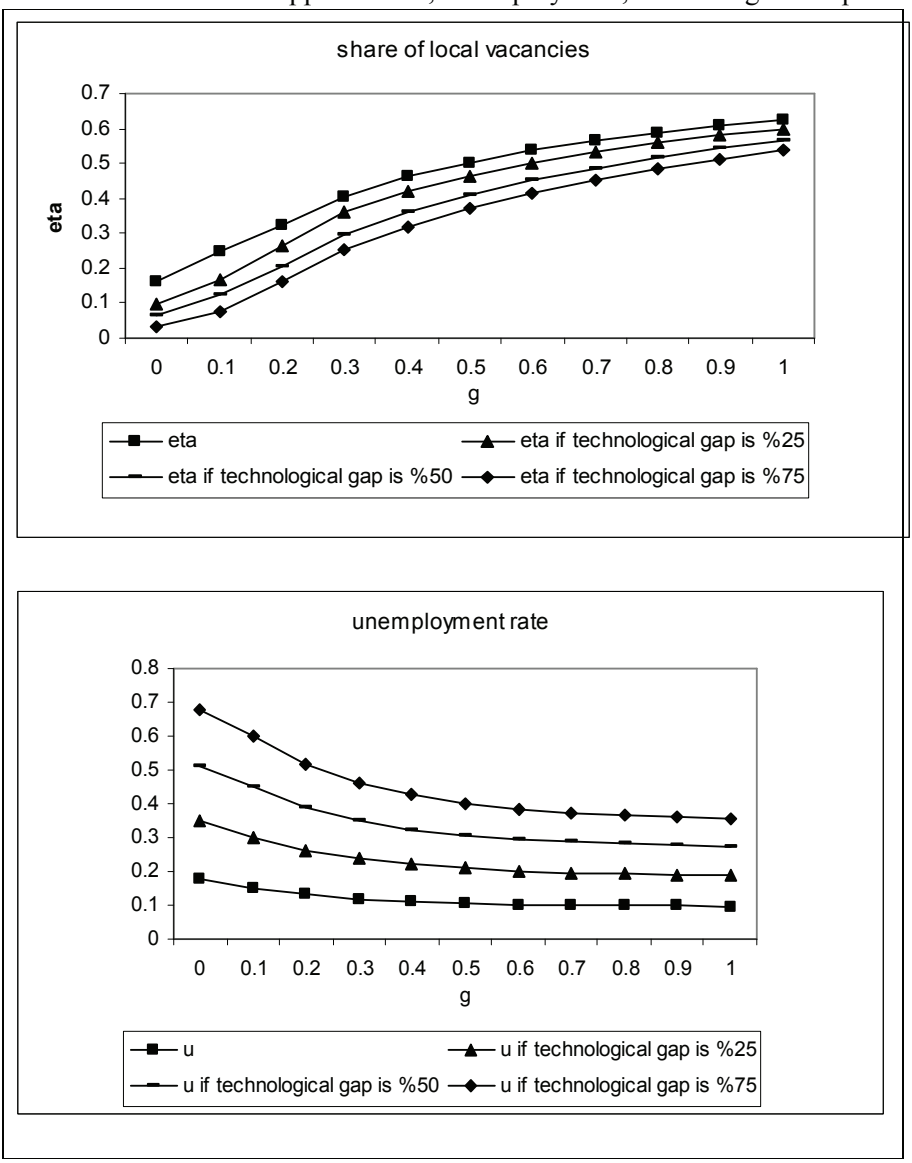


Figure 4
Labor Market: Foreign versus average local wages, the role of technological gap

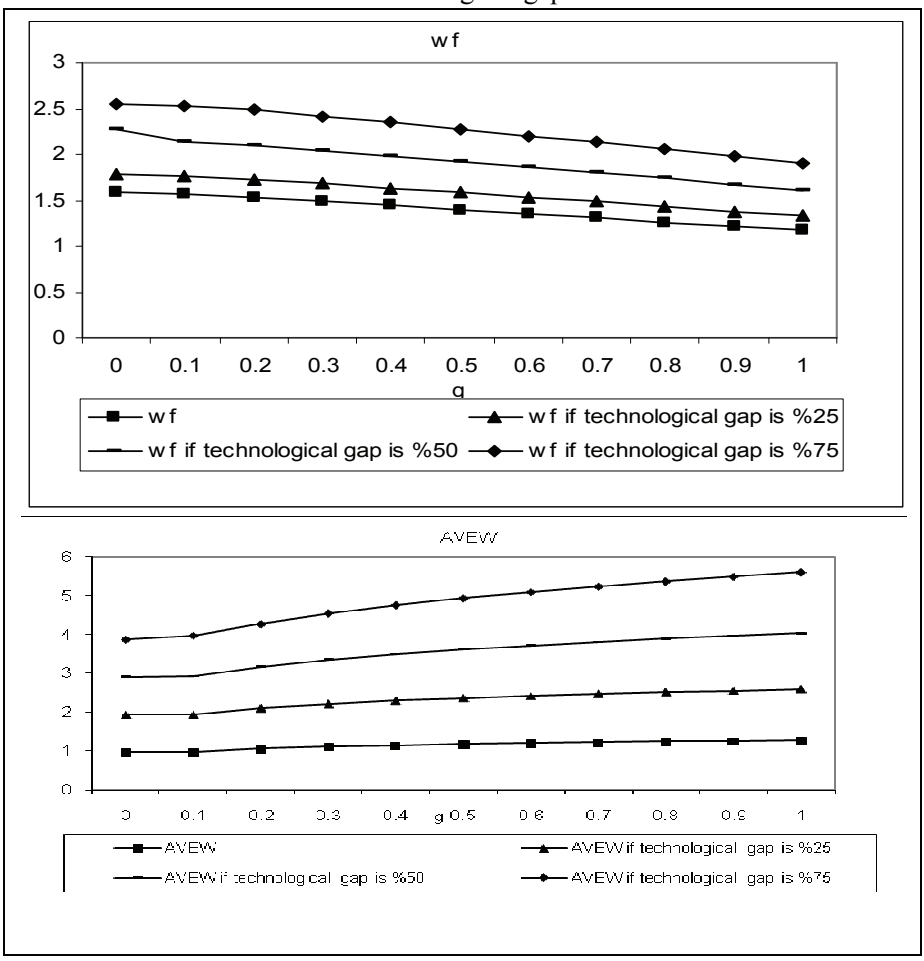
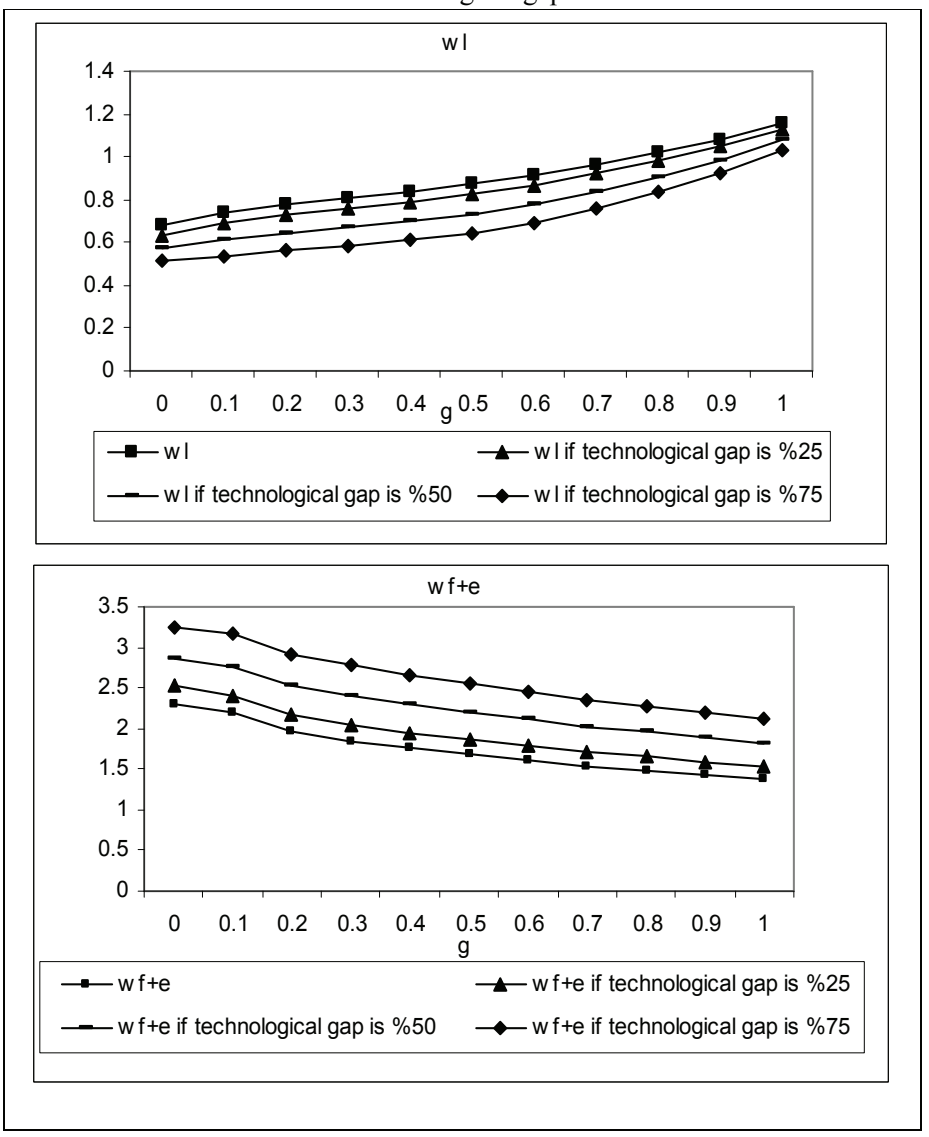


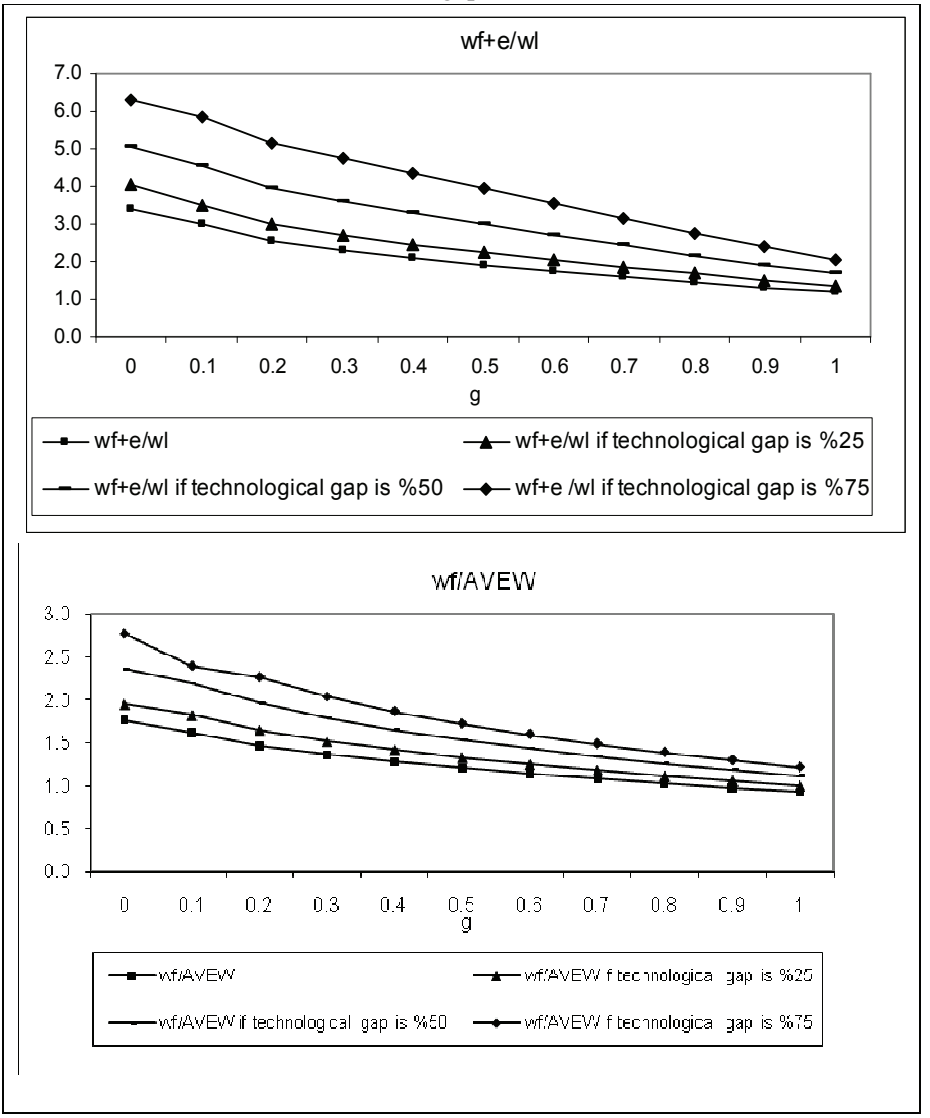
Figure 6 shows the evolution of the firm premium and skill premium under different extents of restrictive contracts and a higher technological gap than the baseline. Both the firm premium and skill premium slightly melts down due to the rising labor mobility. The greater the technological gap between foreign and local firms, the higher will be the firm premium and the skill premium. For a given labor contract restrictiveness (*g)* an increase in the technological gap between foreign and local firms increases wages in the local firm. Similarly, wages in the local firm increase in response to rising mobility from foreign to local firms for a given level of technological gap.

Figure 5
Labor Market Opportunities: wages in the local firm, the role of technological gap



The more technologically advanced foreign firms become compared to local firms, the more local firms need to pay to transfer informed workers from the foreign firms leading to a rise in the wages of informed workers. As local firms now hire more informed workers this deteriorates the position of uninformed workers, by decreasing the earnings of the uninformed workers (See Figure 5). These changes lead to a rise in the wage gap

Figure 6
Labor Market Opportunities: relative wages in the local firm, technological gap



between informed and uninformed workers in the local firm (See Figure 5). Therefore, one can conclude that technological progress raises the wage inequality and lowers the wages of less informed workers (See Figure 6). Findings of this exercise in part support the Skill Biased Technological Change hypothesis where new technology, leading to a rise in the demand for highly skilled workers, increases the wage inequality. Results are in accord with Card and Dinardo (2002), Bound and Johnson (1992) and Katz

and Murphy (1992) documenting technological change as an explanation for the rise in wage inequality, specifically in the US.

To sum up, we can conclude that restrictions on labor mobility play a crucial role in examining the effects of foreign firm presence on wages and unemployment. The main results point out that increased labor mobility reduces the wage gap between informed and uninformed workers and also decreases the wage paid by foreign firms. This leads to a decrease in the foreign firm premium paid to informed workers. Most importantly, the unemployment rate falls in response to a rise in the labor turnover.

4. Conclusion

Since MNEs are associated with firm specific assets in the form of advanced technology, local firms aim to reap the benefits of superior knowledge by hiring workers from MNEs. When a former MNE worker moves to a local firm, he can transfer, at least, part of this superior technology. The ease of workers to move from the foreign to local firms depends on the employment contract given to the worker by the foreign firm. The more binding these contracts are the more difficult it is for the workers to move between foreign and local firms. One of the novelties of this paper is that by modeling the extent of how binding these employment contracts we are able to capture labor mobility as a continuous measure rather than a one/zero event, as previous papers have done. In this context we are able to study the labor market effects of labor mobility between local and foreign firms.

The model points to the following findings. Increased labor mobility between the foreign and local firms leads to increased job creation by local firms, where local firms increase their vacant positions with the hope of attracting more informed workers from the foreign firms. The increased ease at possibly hiring informed workers causes local firms to pay lower wages to the informed workers, accompanied by higher wages to uninformed workers. The two wage changes result in increased average wages paid by the local firms. Defining the skill premium as the relative wages of the informed to uninformed workers, results point out that increased labor mobility decreases the skill premium. Finally, the results point to decreasing foreign firm premium upon increased labor mobility, possibly due to the lower incentive of foreign firms to pay higher wages to their workers who can now move much more easily dominating the lower incentive of local firms to pay higher wages to attract these informed workers who can now move with much more ease to the local firm. It remains for future research to identify whether these theoretical findings prevail in empirical evidence, and to further extend the theoretical framework to incorporate explicit production functions where the complementarity of informed and uninformed workers are explicitly modeled.

Appendix

Substituting (5), (6), (8), (10) into (13) and imposing the free-entry condition for local vacancies, $V_L = 0$, we obtain the uninformed workers wage rate from the matching of a worker with a local firm:

$$wl = \frac{\omega_{y^L}\left(\alpha y^F + (1-\alpha)y^L\right) + b\omega_b^L - (wf + e(g))\omega_{w^F}^L}{(1-\alpha)(r+\delta+\theta^{1-\gamma}(1-\eta+\beta\eta))}$$

where

$\omega_b^L = (1-\beta)(r+\delta+\theta^{1-\gamma}(1-\eta))$,

$\omega_{y^L} = \beta(r+\delta+\theta^{1-\gamma})$ and $\omega_{w^F}^L = r+\delta+\theta^{1-\gamma}(1-\eta+\beta\eta)$.

The average wage level in the local firm, which is denoted by $AVEW$, could be given as follows:

$$AVEW = (1-\alpha)wl + \alpha\,(wf + e(g)) = \frac{\omega_{y^L}\left(\alpha y^F + (1-\alpha)y^L\right) - b\omega_b^L}{(r+\delta+\theta^{1-\gamma}(1-\eta+\beta\eta))}$$

Substituting (5), (7), (9), (11) into (13) and imposing the free-entry condition for foreign vacancies, V_F, we obtain the wage rate from the matching of a worker with a foreign firm:

$$wf = \frac{\omega_b^F + \omega_{y^F} y^F}{A}$$

where

$A =$

$$\frac{1-\beta}{(r+\delta+\theta^{1-\gamma}(1-\eta))} + \frac{\beta}{r+\delta+\theta^{1-\gamma}\eta g} - \frac{\theta^{1-\gamma}\eta\alpha(1-\beta)}{(r+\delta+\theta^{1-\gamma})(r+\delta+\theta^{1-\gamma}(1-\eta))} - \frac{\theta^{1-\gamma}\eta g(-1+\beta)(-1+\alpha)}{(r+\delta+\theta^{1-\gamma}(1-\eta))(r+\delta+\theta^{1-\gamma}+\theta^{1-\gamma}(-1+g)\eta)}$$

and

$$\omega_b^F = \frac{b(1-\beta)}{(r+\delta+\theta^{1-\gamma}(1-\gamma))} + \frac{\theta^{1-\gamma}\eta(-1+\beta)(b+w^L(-1+\alpha)-\alpha\varepsilon)}{(r+\delta+\theta^{1-\gamma})(r+\delta+\theta^{1-\gamma}(1-\eta))} - \frac{\theta^{1-\gamma}\eta g(-1+\beta)(b+w^L(-1+\alpha)-\alpha\varepsilon)}{(r+\delta+\theta^{1-\gamma}(1-\gamma))(r+\delta+\theta^{1-\gamma}+\theta^{1-\gamma}(-1+g)\eta)}$$

$$\omega_{y^F} - \frac{\beta}{r+\delta+\theta^{1-\gamma}\eta g}$$

Wages of the workers in the local and foreign firms are mainly the weighted average of the worker's reservation value (or unemployment benefit), b, which is treated as a constant and the productivity in the current match. Though at a different extent, wages in the local and foreign firms depend on the bargaining power of workers, β, the mass of local and foreign vacancies, which is captured by the labor market tightness, θ, and the share of local vacancies in total vacancies, η. In addition to labor market determinants, the existence of binding contracts and the probability of being in the informed state or not play a major role in wage determination, denoted by the parameters *g* and α.

To understand the overall story behind the wage determination and to realize the effect of the labor mobility on wages, the corresponding weights for wages ω_{y^L}, ω_b^L, ω_b^F and ω_{y^F} should be examined. Wage differentials

arise since we assumed an asymmetric technology, where the output from a match between a worker and a local job is not the same as the output that would result from a match between a worker and a foreign job. Furthermore, the extent of labor mobility is restricted by the value of g and the job creation costs also play an important role in the wage gap between workers in the local and foreign firms through their effect on vacancy creation.

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Özet

Teknolojik yayılımların işgücü piyasalarına etkileri

Bu makalede Çok Uluslu Firmalar (ÇUF) ile yerel firmalar arasındaki işçi hareketliliğinden oluşan teknolojik yayılımların işgücü piyasalarına etkileri incelenmiştir. Daha önce ÇUFlarda çalışan işçilerin yerel firmalarda çalışmaya başlamasıyla birlikte oluşan teknolojik yayılımların ücretler ve işşizlik üzerine etkileri heterojen eşleşme modelleri (search and matching) ışığında çalışılmıştır. Bu çerçevede, makalenin analitik ve nümerik çözümü teknolojik yayılımların firma primini (ÇUFlar ve yerel firmalar arasındaki ücret farklılıkları), vasıf pirimini (yerel firmalardaki vasıflı ve vasıfsız ücret farklılıkları) ve işsizliği azalttığını ortaya çıkarmıştır. Bunun yanısıra nümerik çözüm ÇUFlarda ortaya çıkan teknolojik ilerlemenin, yerel firmalar ve ÇUFlar arasındaki verimlilik farkını arttırarak, işsizliği, firma pirimini ve vasıf pirimini arttırdığını göstermektedir.

Anahtar kelimeler: Doğrudan yabancı yatırımlar, vasıf primi, firma primi, teknolojik yayılımlar, eşleşme modelleri.

JEL kodları: F23, F16, J60.