

WAGE IMPLICATIONS OF FOREIGN DIRECT INVESTMENT WITH SALARY ADJUSTMENT PROCESS

A Master's Thesis

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To My Family

WAGE IMPLICATIONS OF FOREIGN DIRECT INVESTMENT WITH SALARY ADJUSTMENT PROCESS

**Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University**

by

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of
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ANKARA**

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ABSTRACT

WAGE IMPLICATIONS OF FOREIGN DIRECT
INVESTMENT WITH SALARY ADJUSTMENT
PROCESS

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The main objective of this thesis is to analyse theoretically the implications of increasing foreign direct investment (FDI) on the wages of workers and on the profits of firms in the local country which is previously studied in Saglam and Sayek (2011). In this study, we modify the Kelso and Crawford's salary adjustment process. Firstly, capacity constraint of firms is introduced into the Kelso and Crawford's salary adjustment process. Secondly, we study the process where workers make offers. Existence of stable matching is explored. In the process where firms offer, the matching converges to a stable matching but in the process where workers offer, stability may not hold.

While analysing the implications of increasing FDI on the wages and on the profits in the local country, we use the firm-proposing salary adjustment process with capacity constraint. Our analysis shows that under certain assumptions workers and foreign firms benefit from increasing presence of foreign direct investment while domestic firms may lose profits.

Keywords: Matching Theory, Salary Adjustment Process, Stability, Foreign Direct Investment.

ÖZET

DOĞRUDAN YABANCI YATIRIMLARIN MAAŞ BELİRLEME ALGORİTMASI İLE MAAŞLAR ÜZERİNE ETKİSİ

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Bu tezin ana amacı, daha önce Sağlam ve Sayek (2011)'de çalışılmış olan, artan doğrudan yabancı yatırım aktivitelerinin işçi maaşlarına ve firma karlarına olan etkisi teorik olarak incelemektir. Bu çalışmada, Kelso ve Crawford (1982)'in maaş belirleme algoritması modifiye edilmektedir. İlk olarak, Kelso ve Crawford (1982)'in maaş belirleme algoritmasına firmaların kapasite kısıtları tanıtılmaktadır. İkinci olarak, çalışanların teklif yaptığı algoritma çalışılmaktadır. Bu algoritmaların kararlı dengelerinin varlığı incelenmektedir. Firmaların teklif yaptığı algorithmada, kararlı bir eşleşmeye ulaşılmaktadır ancak işçilerin teklif yaptığı algorithmada kararlılık sağlanmayabilir.

Artan doğrudan yabancı yatırım aktivitelerinin maaşlarına ve karlarına olan etkisini incelerken, kapasite kısıtlı firma-teklifli maaş belirleme algoritması kullanılmaktadır. Bizim analizimiz, bazı varsayımlar altında artan doğrudan yabancı yatırımların varlığından çalışanların ve yabancı firmaların yarar sağladığını ancak yerli firmaların kar kaybedebileceğini göstermektedir.

Anahtar Kelimeler: Eşleşme Teorisi, Maaş Belirleme Algoritması, Kararlılık, Doğrudan Yabancı Yatırımlar.

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CHAPTER 1

INTRODUCTION

International economic integration, or globalization, is generally regarded as one of the main forces that determine the economic well-being. Since trade, investment and worker flows have a substantial economic impact on labour market, labor market analysis is indisputable in this content. Consequently, it has been extensively studied by economists who have concentrated on globalization.

One particular focus of this topic is foreign direct investment (FDI) through which transfer of technology across countries can take place. Since technological progress plays a key role in economic development, growth rates of a country can be partially explained by a catch-up process in the level of technology. It is also important to make sure that FDI induces a rise in prosperity due to its essential impacts on welfare. The employment opportunities created by foreign owned firms and the higher wages they are able to pay are some of such impacts. However, FDI is not sufficient alone. The missing factor can be complemented with absorptive capability in the local country. In other words, there must be some workers that are capable of using new technology.

Fair distribution of benefits from FDI and its effects on domestic firms are big concerns. It is widely known that FDI affects the wages of workers

in a positive way in the local country. However, there is a controversy on whether increasing FDI activities affect domestic firms in a good way or not. Since foreign firms experience more advanced technological progress and management practices than local firms, foreign firms generally have higher level of productivity. Hence, when foreign firms enter the local market, they bring these experiences along with them that causes an increase in the level of domestic firms' productivity. On the other hand, the presence of foreign firms may make domestic firms suffer from the increasing competition. Even, they may reduce their output and lose profits.

In this study we will observe the implications of FDI on salaries of workers and the profits of firms. These questions have already been studied in several publications. Our contribution will be using different matching mechanism of firms and workers with a discrete time model. In order to achieve our goal, a discrete time labour search model with infinitely lived and risk neutral workers will be built. Kelso and Crawford (1982)'s salary adjustment process will be used to assign workers to firms and simultaneously determine the wages. There will be some changes in the Kelso and Crawford (1982)'s process like imposing capacity constraint which might yield unemployment. Then, the implications of increasing multinational enterprises activities to wages of workers and to wages of foreign and local firms will be analysed. Furthermore, a worker proposing version of Kelso and Crawford's salary adjustment process will be built and this new matching process will be analyzed.

CHAPTER 2

LITERATURE REVIEW

FDI plays a key role in many economies, in particular in developing economies. Therefore, FDI has taken considerable attention in international economics research. In this section the theoretical framework of our central issue will be given from the point of view of both international economics and microeconomic theory.

The positive effect of FDI on economic growth is widely accepted. The role of FDI in economic growth in developing countries with a cross-country regression framework is examined in Borensztein et al. (1998). Their results show that the beneficial effects of FDI on economic growth come through technological progress rather than from higher capital accumulation. Blomström and Sjöholm (1999) indicate that when multinational enterprises start to operate in a foreign economy, they bring with them their special knowledge and technology in order to compete with domestic firms that are accustomed to the local country's circumstances.

Nelson and Phelps (1966) emphasizes the roles of technological progress and absorptive capability in the local country for economic growth. There exists a technology gap between local and foreign firms. Glass and Saggi (2002) construct an oligopoly model with this technology gap to see the effect of technology transfer on wages of both domestic and foreign firms.

Another strand of the literature has focused on the effects of FDI presence on wages of workers and profits of firms including the studies Aitken et al. (1996), Barry et al. (2005), Saglam and Sayek (2011).

Aitken et al. (1996), analyzes the impacts of FDI on the wages of domestic firms in three countries: Mexico, Venezuela and the US. Increasing FDI activities lead to a raise in the wage of domestic firms in the US but a reduction in Mexico and Venezuela. They find the following fact which is valid for all three countries: higher level of FDI is relevant with higher level of wages. A similar study is done by Barry et al. (2005). They look into the role of FDI on wages and productivity of domestic firms in Ireland. The difference of this study from existing ones is the presence of domestic exporting firms and domestic non-exporting firms. FDI has no effect in domestic non-exporters but a negative effect on domestic exporters. That is to say, absorptive capacity is needed in order to benefit from technology transfer.

Saglam and Sayek (2011) documents the wage implications of increasing FDI activities. These activities cause a rise in the wages of workers that work for foreign firms but a decrease in the wages of all workers that work for local firms..

Another issue is how to assign workers to firms in the economy. This matching problem has been extensively studied among economists. The starting points of the analyses of the matching processes can be accepted as Gale and Shapley(1962), Shapley and Shubik(1972), Crawford and Knoer(1981). Gale and Shapley(1962) consider the matching problem in the markets like the marriage market and student-college market where the preferences of agents are exogenous. They use a "deferred acceptance algorithm" to match the agents and to show the existence of the core for both marriage problem and college-admission problem. Shapley and Shubik(1972) also continue to this research by introducing a divisible good, money, into the market. In their framework, utility functions of agents are depend on money linearly

which makes the utility function transferable. That means agents are able to compensate each other in contrast to Gale and Shapley(1962).

Crawford and Knoer (1981) has a different approach to the problem of Shapley and Shubik(1972). By considering the discreteness and divisibility of money, they construct a new discrete time algorithm which is called "salary adjustment process" which is useful to study labor markets with heterogeneous firms and heterogeneous workers.

Kelso and Crawford (1982) also use the salary adjustment process, which is one of the most realistic matching mechanism. This study demonstrates that an equilibrium exists and it is stable in such markets under certain circumstances. Intuitively, there does not exist any other matching in which firms and all workers will be better off and at least one of the workers or firms will be strictly better off.

While we are analysing the implications of increasing FDI activities on local country's economy, we will use Kelso and Crawfords the salary adjustment process. However, we have capacity constraint for each firm in our model and so unemployment. First, the robustness of the usual salary adjustment process results is checked. Then, we build a worker proposing version of salary adjustment process in which capacity constraints remain in force. The characteristics of the new matching process is also identified. We call this new process as worker-proposing salary adjustment process and former one as firm-proposing salary adjustment process. In most of the studies that use labour search models, the matching depends on the probabilities and wages are determined with a Nash bargaining solution. So, this matching process is somewhat formed with coincidences. We will use the firm-proposing salary adjustment process instead of the former ones in order to document the effects of increasing FDI activities on wages of workers and profits of firms.

CHAPTER 3

THE MODEL

There are workers and two types of firms -foreign (F) and domestic (D). The set of workers is $\mathcal{W} = \{w_1, \dots, w_n\}$ and the set of firms is $\mathcal{F} = \{F, D\}$. Each firm has capacity constraints (vacant positions $-v_F$ and v_D) and each worker is allowed to work for only one firm. We are considering a discrete time model in which workers are infinitely lived and risk neutral. The w 's utility of working for firm f at salary s is denoted by $u^w(s_{wf})$ that is assumed to be strictly increasing and continuous. Firm f 's gross product is given by the function $y^f : \mathcal{W} \rightarrow R$. Firm f 's profits from hiring the set of workers W at salary $s^f = (s_{wf})_{w \in W}$ is given by $\pi^f(W, s^f) = y^f(W) - \sum_{w \in W} s_{wf}$. Our matching problem can be described as $(\mathcal{W}, \mathcal{F}, \mu, s)$.

We have the following four assumptions about about production technologies of firms and preferences of workers:

Let $u^w(0)$ denote the worker w 's valuation of being unemployed hence of receiving no salary. Let σ_{wf} be defined by $u^w(\sigma_{wf}) = u^w(0)$. Thus, σ_{wf} is the lowest salary at which worker w would ever consider for working for firm f . Intiutively, σ_{wf} can be thought as the disutility of worker w from working for firm f .

Our first assumption is "marginal productivity":

$\forall w \in \mathcal{W}$ and $\forall W \subset \mathcal{W}$ with $w \notin W$, $\forall f \in \mathcal{F}$:

$$y^f(W \cup \{w\}) - y^f(W) - \sigma_{wf} \geq 0.$$

Each worker's marginal product is weakly greater than the lowest salary that the worker would ever consider for working for each firm. Then, naturally the firm would hire the worker at the lowest salary.

"No free lunch" is our second assumption:

$$\forall f \in \mathcal{F}, y^f(\emptyset) = 0$$

No free lunch assumption is a natural restriction which tells us that if there is no worker there is no output.

Third, we require that all workers are "gross substitutes" on the account of each firm. For any $f \in \mathcal{F}$, let $M^f(s^f)$ stand for the set of solutions that maximizes the profit of firm $f, \pi^f(W, s^f)$, subject to capacity constraint of f where the maximum is taken over all possible sets of workers. Take any two vectors of salaries s^f and $\tilde{s}^f$ faced by firm f . Let $T^f(W) = \{w \mid w \in W \text{ and } \tilde{s}_{if} = s_{if}\}$ Then we have:

$\forall f \in \mathcal{F}$, if $W \in M^f(s^f)$ and $\tilde{s}^f \geq s^f$, then there exists $\tilde{W} \in M^f(\tilde{s}^f)$ such that $T^f(W) \subseteq \tilde{W}$.

Gross substitute assumption says that when some of workers' salaries rise, a firm can never withdraw an offer from a worker whose salary has not risen.

Finally, we will assume that foreign firm is more productive than domestic firm with same set of workers:

$$\forall W \in \mathcal{W}, y^F(W) \geq y^D(W).$$

Definition 1. A *matching* μ is a correspondence from $\mathcal{F}$ to $\mathcal{W}$ satisfying

- (1) for any $f \in \mathcal{F}$ if $\mu^{-1}(f) \notin \mathcal{W}$, then $\mu^{-1}(f) = \emptyset$
- (2) for any $w \in \mathcal{W}$, if $\mu(w) \notin \mathcal{F}$, then $\mu(w) = \emptyset$,
- (3) for any $(f, w) \in \mathcal{F} \times \mathcal{W}$, $\mu(w) = f$ if and only if $w \in \mu^{-1}(f)$
- (4) for any $f \in \mathcal{F}$, $|\{w \mid \mu(w) = f\}| \leq v_f$.

Definition 2. Let $\mu : \mathcal{W} \rightarrow \mathcal{F}$ be the matching. The matching with a salary schedule s is called *individually rational* if the followings are satisfied

- (1) $u^w(s_{w\mu(w)}) \geq u^w(\sigma_{w\mu(w)}),$
- (2) $\pi^f(\mu^{-1}(f), s^f) = y^f(\mu^{-1}(f)) - \sum_{w \in \mu^{-1}(f)} s_{wf} \geq 0.$

If a worker w 's salary for working for firm f is less than his lowest salary for working for firm f , then he may prefer being unemployed to working for firm f . From the standpoint of firms, if a firm f 's profit is less than zero, then it may shut down the the production.

Definition 3. An individually rational matching μ with a salary schedule s is called *stable* if there are no firm and set of workers pair (f', W) satisfying $|W| \leq v_{f'}$ and (integer) salaries $r^{f'}$ that satisfy

- (1) for any $w \in W$, $u^w(r_{wf'}) \geq u^w(s_{w\mu(w)}),$
- (2) $\pi^{f'}(W, r^{f'}) \geq \pi^{f'}(\mu^{-1}(f'), s^{f'})$, with strict inequality holding for at least one member of $W \cup \{f'\}.$

If there exist a firm f' and a set of workers W such that each worker in W gets higher salary and so higher utility from working for firm f' than from working for the firm which he has been assigned and the firm f' gets higher profit from hiring the set of workers W than from the set of workers which it has hired, then since firms are profit maximizer and workers are utility maximizer, firm f' and the workers in the set W may prefer working together. Hence, (f', W) pair blocks the matching.

CHAPTER 4

ANALYSIS OF THE SALARY ADJUSTMENT PROCESS

4.1 The Firm-Proposing Salary Adjustment Process

In this section, we describe the firm-proposing salary adjustment process which is a modification of Kelso and Crawford's salary adjustment process. We also check the robustness of Kelso and Crawford's salary adjustment process results. The difference between the firm-proposing salary adjustment process and Kelso and Crawford's salary adjustment process is imposing capacity constraint to firms and its natural result, unemployment. The firm-proposing salary adjustment process is described by the following algorithm.

Step 1. In the very first step each firm faces a schedule of permitted salaries $s_{wf}(0) = \sigma_{wf}$ and permitted salaries at step t are given by $s_{wf}(t)$.

Step 2. In each step, each firm makes offers to the members of one of its profit maximizing sets of workers by taking into account the permitted salaries. Formally, firm f makes offers to the workers of $W^f[s^f(t)]$ where $W^f[s^f(t)]$ maximizes $\pi^f(W, s^f(t))$ subject to $|W| \leq v_f$. By gross substitute assumption, it is required that if an offer made by firm f is not rejected in step $t - 1$, it will be repeated again in step t .

Step 3. Each worker must accept the offer which maximizes his utility but reject the others. If he doesn't receive any offer, he has nothing to do.

Step 4. If worker w rejected an offer from firm f in step $t - 1$, $s_{wf}(t) = s_{wf}(t - 1) + 1$; otherwise $s_{wf}(t) = s_{wf}(t - 1)$. Each firm keeps on making offers to one of their profit-maximizing sets of workers given the salaries that satisfy its capacity constraint by considering its permitted salaries.

Step 5. The process stops when there is no rejection.

Now, the result on the existence of a stable matching will be given. We need some lemmas to prove the following theorem.

Theorem 1. *The firm-proposing salary adjustment process Step 1-Step 5 converges in finite time to a stable matching in the market for which it is defined.*

Lemma 1. *After a finite number of steps, the firm-proposing salary adjustment process stops.*

Proof. If a worker has at least one offer at some period, he will not become unemployed at the end of the process.

By Step 3, if he has multiple offers, then he must accept the best one but rejects others. The permitted salaries of rejected firms must rise one. Since for all firms $f \in \mathcal{F}$ and for all subsets of workers $W \subseteq \mathcal{W}$ $y^f(W)$ is finite, he eventually loses all but one offer.

If a worker doesn't have any offer at any period, he will become unemployed. □

Lemma 2. *The firm-proposing salary adjustment process converges to an individually rational matching.*

Proof. Let t^* be the step at which the process stops and let μ and W_μ^f denote the assignment to which it converges.

Claim. For any $f \in \mathcal{F} \cup \{\emptyset\}$ and for any $w \in \mathcal{W}$ with $\mu(w) = f$:
 $u^w(s_{wf}(t^*)) \geq u^w(\sigma_{wf})$

Case 1. $f \in \mathcal{F}$

By Step 1 and Step 4 of the firm-proposing salary adjustment process, $s_{wf}(t^*) \geq \sigma_{wf}$. Since u is strictly increasing, we have $u^w(s_{wf}(t^*)) \geq u^w(\sigma_{wf})$

Case 2. $f = \emptyset$

Since the worker is unemployed, then his salary will be zero. Formally, $s_{wf}(t^*) = 0$. Thus, $u^w(s_{wf}(t^*)) = u^w(0) = u^w(\sigma_{wf})$ which is the lowest utility which the worker w would ever consider for working for firm f

Claim. For any $f \in \mathcal{F}$: $\pi^f(W_\mu^f, s^f(t^*)) \geq 0$

Since no free lunch assumption implies $\pi^f(\emptyset, s^f(t^*)) = y^f(\emptyset) = 0$, the claim is the immediate result of Step 1 of the firm-proposing salary adjustment process and the fact that the firm is not required to hire any workers.

□

Lemma 3. *The firm-proposing salary adjustment process converges to a stable matching.*

Proof. By Lemma 1, the process converges to a matching. For any $f \in \mathcal{F}$ and for any $w \in \mathcal{W}$, let $\mu^{-1}(f)$ be the set of workers assigned to firm f by μ and $s_{w\mu(w)}$ be the salary of w . By marginal productivity, if it hires less workers, it does not maximize its profits. Hence, the firm will hire exactly v_f -workers.

Assume that the matching is not stable. By Lemma 2, it is individual rational. Thus, there must exist a firm-set of workers pair (f, W) satisfying $|W| \leq v_f$ and salaries r^f such that

- (1) $\forall w \in W: u^w(r_{wf}) > u^w(s_{w\mu(w)})$
- (2) $\pi^f(W, r^f) > \pi^f(\mu^{-1}(f), s^f)$

Consider the case $\mu(w) \in \mathcal{F}$. By (1) and Step 3 of the worker proposing salary adjustment process, worker w must never have received an offer from firm f at a salary r_{wf} or greater. Since permitted salaries never fall, the salaries s^f must satisfy: $\forall w \in W$ such that $\mu(w) \in \mathcal{F}$, $s_{wf} \leq r_{wf}$.

On the other hand consider the case $\mu(w) = \emptyset$. Then, since the worker w never have received an offer, $s_{wf} = \sigma_{wf}$. By (1), $s_{wf} \leq r_{wf}$.

Hence, for any $w \in W$, $s_{w\mu(w)} \leq r_{wf}$. Then,

$$\begin{aligned}\pi^f(W, s^f) &= y^f(W) - \sum_{w \in W} s_{wf} \\ &\geq y^f(W) - \sum_{w \in W} r_{wf} \\ &> \pi^f(\mu^{-1}(f), s^f)\end{aligned}$$

by (2) which is a contradiction. This completes the proof of our theorem. $\square$

4.2 The Worker-proposing Salary Adjustment Process

This section describes the rules of worker-proposing salary adjustment process and documents the characteristics of the process. Capacity constraint of firms remains in force.

Step 1. In the very first step, each worker w specifies the highest salary for each firm by solving the following maximization problem

$$\delta_{wf} = \max_{W \in \mathcal{W} - \{w\}} y^f(W \cup w) - y^f(W).$$

Permitted salaries at step t are given by $s_{wf}(t)$.

Step 2. In each step, each worker w makes offer to one of the firms that maximize his utility. Note that, the utility of a worker depends only on the salary and it is an increasing function. Let A^f denote the set of workers who make offer to the firm f .

Step 3. Each firm f accepts the offers of the workers that are in the profit-maximizing set. Formally, firm f accepts the offers of the workers of $W^f[s^f(t)]$ where $W^f[s^f(t)]$ maximizes $\pi^f(W, s^f(t))$ subject to $|W| \leq v_f$ and $W \in A^f$.

Step 4. If the worker w 's offer is rejected by firm f in step $t - 1$, $s_{wf}(t) = s_{wf}(t - 1) - 1$; otherwise $s_{wf}(t) = s_{wf}(t - 1)$. Each worker keeps on making offers to one of its utility maximizing firm and he can decrease his offer only

to σ_{wf} (the lowest salary that w would ever consider to work for firm f).

Step 5. The process stops when there is no rejection.

The worker-proposing salary adjustment process converges to an individually rational matching but it may not be stable. The example that illustrates this case will be given at the end of the section.

Lemma 4. *After a finite number of steps, the worker-proposing salary adjustment process stops.*

Proof. By Step 3 of the worker-salary adjustment process, each firm f will accept the offers of the workers that are in the profit maximizing subset of A^f and reject the other offers. The permitted salaries of the rejected workers will fall by one. Since for all $w \in \mathcal{W}$ the lowest salary exists, the firm eventually loses his offer. Thus, in some step there will be no rejection. $\square$

Lemma 5. *The worker-proposing salary adjustment process converges to an individually rational matching.*

Proof. Let t^* be the step at which the process stops and let μ be the matching that it converges. Denote the set of workers that are assigned to firm f by $\mu^{-1}(f)$

Claim. For any $f \in \mathcal{F} \cup \{\emptyset\}$ and for any $w \in \mathcal{W}$ with $\mu(w) = f$:
 $u^w(s_{wf}(t^*)) \geq u^w(\sigma_{wf})$

Case 1. $f \in \mathcal{F}$

By Step 1 and Step 4 of the worker-proposing salary adjustment process, $s_{wf}(t^*) \geq \sigma_{wf}$. Since u^w is strictly increasing, we have $u^w(s_{wf}(t^*)) \geq u^w(\sigma_{wf})$.

Case 2. $f = \emptyset$

Since the worker is unemployed, then he has zero salary, $s_{wf}(t^*) = 0$

$u^w(s_{wf}(t^*)) = u^w(0) = u^w(\sigma_{wf})$ which is the lowest utility.

Claim. For any $f \in \mathcal{F}$: $\pi^f(W_\mu^f, s^f(t^*)) \geq 0$

By no free lunch assumption, $\pi^f(\emptyset, s^f(t^*)) = y^f(\emptyset) = 0$. The claim is the immediate result of Step 3 of worker-proposing salary adjustment process and

the fact that the firm is not required to hire any workers. $\square$

Here is the example in which the worker-proposing salary adjustment process does not converge to a stable matching.

Example 1. $\mathcal{W} = \{1, 2, 3\}$ $\mathcal{F} = \{F, D\}$

$$y^D(1) = 3 \quad y^D(2) = 3 \quad y^D(3) = 1$$

$$y^D(12) = 10 \quad y^D(13) = 8 \quad y^D(23) = 8 \quad y^D(123) = 12$$

$$y^F(1) = 4 \quad y^F(2) = 5 \quad y^F(3) = 6$$

$$y^F(12) = 10 \quad y^F(13) = 13 \quad y^F(23) = 15 \quad y^F(123) = 18$$

$$v_D = 2, v_F = 1$$

$$\forall f \in \mathcal{F}, \sigma_{wf} = 0$$

$$\delta_{1D} = 7, \delta_{2D} = 7, \delta_{3D} = 5$$

$$\delta_{1F} = 7, \delta_{1F} = 9, \delta_{1F} = 10$$

The matching that the process converges is given by μ .

$$\begin{array}{ccc} 1 (s_{1\mu(1)}) & 2 (s_{2\mu(2)}) & 3(s_{3\mu(3)}) \\ \mu : D (2) & F (3) & D (5) \end{array}$$

The profits of firms: $\pi^D(\{1, 3\}, (2, 3, 5)) = 1$, $\pi^F(2, (2, 3, 4)) = 2$

Now, consider the firm-set of workers pair $(D, \{1, 2\})$ and the salary vector $(3, 4, 5)$. Suppose that domestic firm hires worker 1 and worker 2 with salaries 3 and 4, respectively. Clearly, there is a rise in the utilities of workers 1 and 2. The new profit of domestic firm, $\pi^D(\{1, 2\}, (3, 4, 5)) = 10 - 7 = 3$, which means there is also a rise in the profit of domestic firm. Thus, $(D, \{1, 2\})$ blocks μ . μ is not stable.

CHAPTER 5

THE IMPLICATIONS OF FOREIGN DIRECT INVESTMENT

One of the main goal of this study is how the wages of workers and the profits of firms evolve upon increasing foreign firm activities which is captured by rising the number of foreign firm vacancy by one. The cause of this increase may be legal changes, having new technology etc. Then, the implications of the increasing foreign activities on wages and on profits will be discussed by looking into the differences between the matching that the firm-proposing salary adjustment process converges and the matching that the firm-proposing salary adjustment process converges after increase. A restriction on production function is needed to have certain results.

Assumption E. For any $f \in \mathcal{F}$ and for any $W, W' \subseteq \mathcal{W}$ and for any $w \in \mathcal{W} - (W \cup W')$:

$$y^f(W) \geq y^f(W') \Rightarrow y^f(W \cup w) \geq y^f(W' \cup w)$$

Adding same worker to both sets of worker does not change the ranking of production between these two sets.

Proposition 1. *Suppose that Assumption E is satisfied. Then, if the foreign firm increases the number of vacancies, each worker's salary increases or does not change.*

Proof. Let the first vacancy of foreign firms equals to the v_F . Let μ be the matching that the firm-proposing salary adjustment process converges and $\mu^{-1}(F) = W_F$, $\mu^{-1}(D) = W_D$ and unemployed workers $U = \mathcal{W} - (W_F \cup W_D)$. Denote the salary schedules with s^F and s^D . Now, suppose the foreign firm increases the number of vacancies, i.e. $v_F + 1$. Assume that the new matching is μ' and $\mu'^{-1}(F) = W'_F$, $\mu'^{-1}(D) = W'_D$. New salary schedules are given by r^F and r^D . Since the number of vacancies increases, $W'_F - W_F \neq \emptyset$. Take any $w \in W'_F - W_F$.

Case 1. $\mu(w) = \emptyset$

If in the first step, F makes an offer to w , then for all $w' \in \mathcal{W} - \{w\}$, $\mu'(w') = \mu(w')$, $r_{w'\mu'(w')} = s_{w'\mu(w')}$ and $r_{w\mu'(w)} \geq 0$.

If F makes an offer to the worker of a domestic firm, w' , not to an unemployed worker. There are two possibilities:

(1) w' rejects the offer. It means that w' accepts the offer of the domestic firm. If in any period w' accepts the offer of F , since w' is assigned to D at the end, $s_{w'D} \leq r_{w'D}$. We mean the rejection of the domestic firm's offer increases the salary. Otherwise, $s_{w'D} = r_{w'D}$.

(2) w' accepts the offer. It means that w' rejects the offer of domestic firm. Since w' is assigned to D at the end, in any period w' accepts the offer of D . So, $s_{w'D} \leq r_{w'D}$.

Case 2. $\mu(w) = D$

If F does not make any offer to w in previous matching, the first step offer of F is greater than the first step offer of D . In the end, $s_{wD} \leq r_{wF}$.

If F makes an offer to w in the previous matching, in any period both F and D make an offer to w . Let t be the last period in which w rejects the offer of F , i.e. $s_{wF}(t) \leq s_{wD}(t)$. In this new matching, the same point is reached. Again, w accepts D but in this time, F able to increase the salary. So, $s_{wD} \leq r_{wF}$. Therefore D starts to look for a new worker. There are two possibilities:

(1) D makes an offer to the worker that also takes an offer from F . If the offer of D is accepted, it means the salary increases. If the offer of F is accepted, it means the salary doesn't change.

(2) D makes an offer to an unemployed worker, so the salary of the worker will increase.

In conclusion, an unemployed worker is assigned to a firm. Thus, his salary will be higher and the salaries of other workers will not be lower.

□

We must check the necessity of Assumption E. The following example shows that in the absence of this assumption, there exists a worker whose wage decreases in the case of an increase in the vacancy of foreign firm.

Example 2. We have three workers and two firms: foreign firm (F) and domestic firm (D). The lowest salary that any worker would ever consider working for any firm is equal to one for all firms and workers. First, foreign firm hires one worker. For the second matching, it hires two workers.

$$W = \{1, 2, 3\}$$

$$\begin{aligned} y^D(1) &= 2 & y^D(2) &= 3 & y^D(3) &= 4 \\ y^D(12) &= 7 & y^D(13) &= 5 & y^D(23) &= 6 & y^D(123) &= 8 \\ y^F(1) &= 3 & y^F(2) &= 4 & y^F(3) &= 5 \\ y^F(12) &= 8 & y^F(13) &= 6 & y^F(23) &= 7 & y^F(123) &= 9 \\ \sigma_{if} &= 1, v_F^1 = v_D^1 = 1, v_F^2 = 2, v_D^2 = 1 \end{aligned}$$

We denote the first and second matching with μ_1 and μ_2 , respectively. The matchings that the firm-proposing salary adjustment process converges:

$$\begin{array}{ccccc} & 1 & 2 & 3 & \\ \mu_1 : & \emptyset & D(1) & F(2) & \\ \mu_2 : & F(1) & F(1) & D(1) & \end{array}$$

We write the wages of the each worker in brackets. As we can see above, the third worker is assigned to foreign firm with the wage 2 in the first matching. However, in the second matching he is assigned to domestic firm with

the wage 1. The wage of the third worker decreases. So, we need Assumption E to reach Proposition 1.

Proposition 2. *Suppose that Assumption E is satisfied. If the number of foreign firm vacancies increases, then the profit of the foreign firm increases but the profit of the domestic firm decreases.*

Proof. Let the first vacancy of foreign firms equals to the v_F . Let μ be the matching that the firm-proposing salary adjustment process converges and $\mu^{-1}(F) = W_F$, $\mu^{-1}(D) = W_D$. Now, suppose the foreign firm increases the number of vacancies, i.e. $v_F + 1$. Assume that the new matching is μ' and $\mu'^{-1}(F) = W'_F$, $\mu'^{-1}(D) = W'_D$.

In the new matching, the foreign firm tries to hire the worker, $w \in \mathcal{W} - W_F$ which maximizes

$$y^F(W_F \cup \{w'\}) - y^F(W_F) - \sigma_{w'F}$$

with respect to w' .

Case 1. $\mu(w) = \emptyset$

In this case, there will be no change in the profit of the domestic firm.

Case 2. $\mu(w) = D$

In this case, D starts to look for a new worker. By Step 2 of the firm-proposing salary adjustment process, the new set of workers give less profit than the previous one.

In both situations, note that by the second step of the firm-proposing salary adjustment process foreign firm solves its profit maximization problem. Then any set of workers that has less than $v_F + 1$ workers can never give higher profit than W'_F . So, $\pi^F(W'_F) \geq \pi^F(W_F)$. The profit of the foreign firm increases. $\square$

Considering Proposition 2, an increase in the vacancy of foreign firm makes the cake bigger. However, the slice of the domestic firm becomes smaller.

CHAPTER 6

CONCLUSION

6.1 Conclusion

This study explores the relation between increasing foreign firm activities and the wages of workers and the profits of firms in the local country. While doing this analysis, salary adjustment process of Kelso and Crawford (1982) with capacity constraint of firms is used that is different from existing papers in international economics. Furthermore, worker proposing version of salary adjustment process is built. Stability is preserved under worker-proposing salary adjustment process. However, firm-proposing salary adjustment process converges to an individually rational matching but this matching may not be stable.

In the context of theoretical framework, our analytical solutions document two conclusions which are valid in the case that adding same worker to the subsets of workers do not affect the ranking between these subsets from the standpoint of each firm. First, increasing foreign firm activities, captured by a rise in the number of foreign firm vacancies, causes an increase in the level of wages. Second, these activities increase the profits of foreign firm while reducing the profits of domestic firm.

6.2 Future Work

Fair distribution of benefits from FDI is a big concern. It is widely known and also our results show that FDI affects the wages of workers in a positive way in the local country. However, it is criticized with giving rise to wage inequality between workers. Some recent studies claim that FDI widens the gap between the wages of skilled and unskilled workers. Skilled workers are expected to benefit from FDI more than unskilled workers. Another result of recent studies is that foreign firms pay higher wages than local firms. Skill premium refers to former finding and foreign firm premium refers to the latter. Since the salary adjustment process allow us to study with heterogeneous firms and workers, we can test the previous findings with it. In order to explore the wage inequality in the local country, workers need to be categorized as skilled and unskilled workers.

Obviously, identifying the assumptions to have unique stable matching and to make worker-proposing salary adjustment process converge to a stable matching are further studies. Another future work may be whether our matching model constitutes a lattice structure or not. If it is not, under which conditions is the lattice structure found?

BIBLIOGRAPHY

- Aitken B. J., Harrison A. E. and Lipsey R. E. (1996). "Wages and Foreign Ownership: A Comparative Study of Mexico, Venezuela and United States." *Journal of International Economics* 40: 345-371.
- Barry F., Görg H. and Strobl E. (2005). "Foreign direct investment and wages in domestic firms in Ireland: Productivity spillovers versus labour market crowding out." *International Journal of the Economics of Business* 12: 67-84.
- Blomström, M. and Sjöholm, F. (1999). "Technology Transfer and Spillovers: Does Local Participation With Multinational Matter?" *European Economic Review* 43: 915-923.
- Borensztein E., De Gregorio J. and Lee J. W. (1998). "How does foreign direct investment affect economic growth?" *Journal of International Economics* 45: 115-135.
- Crawford V. P., Kelso A. S. (1982). "Job Matching, Coalition Formation, and Gross Substitutes." *Econometrica* 50(6): 1483-1504.
- Crawford V. P., Knoer M. P. (1981). "Job Matching with Heterogeneous Firms and Workers." *Econometrica* 49: 437-450.
- Driffield N. G., Girma S. (2003). "Regional Foreign Direct Investment and Wage Spillovers: Plant Level Evidence from the UK Electronics Industry." *Oxford Bulletin of Economics and Statistics* 65: 453-474.
- Gale D., Shapley L. S. (1962). "College Admission and Stability of Marriage." *American Mathematical Monthly* 69(1): 9-15.
- Glass A. J., Saggi K. (2002). "Multinational Firms and Technology Transfer." *The Scandinavian Journal of Economics* 104: 495-513.
- Nelson, R., Phelps, E. (1966). "Investment in humans, technological diffusion, and economic growth." *American Economic Review: Papers and Proceedings* 51(2): 69-75.
- Saglam B., Sayek S. (2011). "Skill and Foreign Firm Premium: Labour Market Effects of Multinational Enterprises" *working paper*.
- Shapley L., Shubik M. (1972). "The Assignment Game 1: The Core." *International Journal of Game Theory* 1: 111-130.