# Optimal Strategies in Unionized Oligopoly and Inward FDI

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## Abstract

*In a union-oligopoly context, we interpret the optimal equilibria may arise from the implementation of any possible policies of a benevolent social planner in the labour market. The applied policies may contradict or correspond with unions' and firms' objectives, while in other cases institutional arrangements of labour market appear to be inefficient to induce or deter FDI and thus social planner must search for alternative strategic devices. Given the complexity of the model, which must be solved computationally to obtain results, there are several outcomes depending on the values of the parameters.*

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## Introduction

Foreign direct investments (FDI) and unionization in the labour market, separately, is a multi-dimensional field of research in economics. The interaction between them is more complicated, yet quite promising for generating findings furnishing interesting policy implications.

Focusing on the economic analysis of FDI, it appears that there are three different types of models which have been widely used to explain the nature and impact of (inward-outward) foreign direct investments: (a) real capital arbitrage models (b) market power / industrial organization models and (c) firm-theoretic models. Hymer (1960) has been the first to argue that real capital arbitrage models have basic shortages, and that a multinational company should rather possess a competitive advantage (e.g. higher productivity than local firms) in order to serve a foreign market. Regarding market structure, on the other hand, though earlier contributions have been mainly dealing with international monopolistic markets, most contemporary researchers focus their analysis on oligopolistic markets. Whilst, based on the works of Coase (1937), Arrow (1964) and Williamson (1975), and infused with ideas and surveys of internalization and endogenous approach, a multinational firm-theoretic paradigm has already been established.

As in particular regards the impact of FDI on labour market(s), and vice versa, Gaston and Nelson (2001) argue that FDI have negative effects on immigration, while the same authors (2000) claim that the most reasonable conclusion to draw is that the actual impact of FDI on the developed countries' labour markets is negligible. Furthermore, there is a growing interest on the unionization and/or the wage bargaining structure as important factors for firms, and social planners, regarding FDI decisions, and relevant policies, respectively [see e.g., Brander and Spencer (1988), Mezzetti and Dinopoulos (1991), Ishiguro and Shirai (1998)].

One of the most interesting folds of the latter issue is the manipulation of the labour market institutional set-up in order to induce or deter FDI. Contributions to this framework mainly come from Naylor and Santoni (2003), who proposed that the

greater unions' bargaining power is, the less likely FDI is to emerge. Moreover, Vlassis (2009) stressed out that if the FDI-associated unit costs are not high enough, then employment-neutral inward FDI will emerge if the domestic wage setting is credibly centralized (so that the foreign and the domestic firms to pay equal wages) and the unemployment benefit is sufficiently high.

Along similar lines of research, in the present analysis we consider two firms (home and abroad) which compete a la Cournot in a host country. The foreign firm has two options, either to build a plant abroad and serve the host country via exports or to invest in the host country and thus serve the local market via FDI. Each choice is considered to be credible due to the sunk cost of building a plant for serving the host market. Following Hymer (1960), we consider that the foreign firm possesses higher productivity than the home firm. Given the possibility of FDI, as above, two different unionization structures, centralized and decentralized, may then arise in the host country, giving rise to centralized or decentralized wage bargaining, respectively, as follows: Under the centralized union structure/wage bargaining, the home union bargains with both the home and the foreign firm about firm-specific wages considering that, in the event of a failure in any of those firm-specific negotiations, all union members will be employed only by the other firm (which will then become a monopolist). On the other hand, under the decentralized union structure/wage bargaining, on the other hand, the home union splits in two different firm-specific unions which, independently and separately, bargain with the home and the foreign firm over firm-specific wages.

In the above context, the sequence of events has as follows:

*Stage 1:* A benevolent social planner – if needed – establishes and legally enforces the unionization structure in the home country.

*Stage 2:* The foreign firm chooses to serve the local market either via exports or FDI.

*Stage 3:* The labour unions chose to bargain the wages either decentralized or centralized (unions' coordination)

*Stage 4:* Depending on the outcome of the previous events, the foreign firm's as well as the home firm's employees' wages are determined via centralized or decentralized firm-union wage bargains.

*Stage 5:* The foreign firm and the home firm compete in the home market by adjusting their quantities.

Our analysis illustrates the conflicts arising among the agents' optimal strategies and shows that inward FDI are not axiomatically desirable by all agents. Our findings suggest that, under certain circumstances, the unionization structure is an effective policy tool to induce or deter FDI. Otherwise, it is useless, since it cannot affect the (FDI inducing vs. FDI deterring) state of the equilibrium. Last but not least, in some cases the unionization structure must be used as a policy tool, to maximize social welfare, within an option of two different equilibrium states.

## 1. The Model

Consider a homogeneous good sector in a host country, where one home (h) firm and one foreign (f) firm compete by adjusting their quantities. The h-firm always produces and sells exclusively domestically. The f-firm, nonetheless, may alternatively

- produce abroad and sell its output in the host country (exports case), facing a unit cost $x$[1], plus a sunk cost $F_x$, made up of building a plant in its own country to produce the quantity exported in the host market or

- produce and sell in the host country, with an FDI-associated unit cost $c$[2], plus a sunk cost $F_d$, made up of building a plant in the host country to produce the quantity sold in the host market.

In the present research we focus on the role of the labour market's setup along with the associated variable costs, and given that the sunk costs in each case

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[1] It represents - constant per unit of sales - export-marketing costs, made up of transport, packaging, insurance, tariffs, etc.

[2] Following Hirsch (1976), in the above setting, the parameter c formally represents coordination and control costs - assumed to be constant per unit of production - which are incurred when the f-firm runs its production in the host market. These costs arise from cross-border differences in legislation, taxation, language, work ethics, personnel procedures, etc.

affect only the type of the equilibrium, $F_d$ and $F_x$ are assumed to be symmetric and, for simplicity, are normalized to zero.

Production, wherever, exhibits constant returns to scale and requires only labour input to produce the good. Moreover, each firm possesses a Leontief technology, so the capital stock is always sufficient to produce the good. Nevertheless, let the f-firm enjoy a technological advantage over its rival h-firm. Therefore, the production function of the h-firm (f-firm) can be defined as $Q_h = L_h$ $\left( Q_f = k \cdot L_f \; ; \; k > 1 \right)$, where Q (L) denotes output (employment), and the productivity of labour is normalized to unity. Moreover, let the inverse demand function specified of the simple normalized linear form, P(Q) = 1 - Q, where Q is the aggregate output: $Q = Q_h + Q_f$.

The labour market is unionized at home and abroad, while the union structure is centralized in any separate labour market[3]. Hence, we assume that there is one union abroad and one union in the host country (home and foreign union). Given risk-neutral fixed membership and immobile labour, according to the utilitarian hypothesis [4], unions are assumed to maximize rents, $U(w_i, L_i) = (w_i - w_0) \cdot L_i$, where $w_i$ and $L_i$ are the wage and employment arguments, i stands for home or abroad firm, and $w_0$ stands for the local reservation wage - unemployment benefit ($w_{0h}$ for the domestic market, $w_{0f}$ for abroad). Unions (firms), wherever located, are moreover assumed to possess a bargaining power of b (1-b) during labour-management negotiations.

As regards to the wage-setting structure, if the f-firm produces abroad, then the wage setting is de facto decentralized across firms. However, if the f-firm locates production in the host country, the wage setting can be decentralized, or centralized, across firms, depending on the host labour market's institutional framework:

- If the latter imposes wage bargaining centralization (CB), there will be coordination between the two unions during the bargaining process with each firm separately. The unions will maximize both utilities, having in mind

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[3] In this case, we follow Dhillon and Petrakis (2002).
[4] See Oswald, 1982; Booth, 1995.

that if the negotiations with one firm fail, then there will be a reservation utility derived from the fact that all workers will be occupied at the other firm.

- Otherwise, if the wage-bargaining structure in the host country is decentralized bargaining (DB), then each union will negotiate the wage (and thus the employment level) with the relevant firm, considering the maximization of its own utility.

One of the major matters that we investigate is what labour market's setup leads to a time-consistent equilibrium, deterring or inducing FDI. The policy maker will, in any case, make those arrangements, that will maximize the social welfare. For the needs of the present analysis, social welfare is defined as the sum of home unions' utilities, the profits of the home firm and the consumer surplus (SW = $U_h$ + $U_f$ + $\Pi_h$ + CS). In case of equivalent outcome, and since knowledge, know-how and technology can be better diffused with FDI rather than international trade, FDI comprises a preference to the policy maker's goals.

Arising from the above, a five-stage game can be formally addressed as follows:

- Stage 1: Policy Maker's Decision.
  The policy maker settles or reforms labour market institutional arrangements in the host country, so that the Social Welfare will maximise. Labour's market institutional arrangements include the wage-bargaining structure (DB or CB), the level of the unemployment benefit and taxes or/and penalties to the labour market agents.

- Stage 2: F Firm's Decision.
  Given the labour market institutional resolutions in the host country, the f-firm decides to serve the home market via either exports or FDI. As already stated, at this entry stage, the sunk costs of either option are assumed to be symmetric and for convenience are normalized to zero. Though, we consider that f firm will be consistent with its decision, due to the sunk cost.

- Stage 3: Unions' Decision.

Considering the payoffs of each case, unions decide to act coordinated or not. Prerequisite for unions to coordinate is that both utilities (strictly) should increase. If the utility of at least one union decreases (comparing to the decentralized bargaining), then it will be motivated to decline from the coordination, so the equilibrium will be time-inconsistent.

- Stage 4: Wage Determination.

Given the final labour market institutional set-up in the host country (delivered from the above stages), optimal wages (home firm / foreign firm) are in all candidate cases defined as follows:

- *Export case:*

$$w_{he} = \arg\max \left( \left( w_{he} - w_{0h} \right) \cdot q_{he} \right)^b \cdot \Pi_{he}^{(1-b)} \tag{1}$$

$$w_{fe} = \arg\max \left( \left( w_{fe} - w_{0f} \right) \cdot \left( \frac{q_{fe}}{k} \right) \right)^b \cdot \Pi_{fe}^{(1-b)} \tag{2}$$

- *FDI under DB case:*

$$w_{hdb} = \arg\max \left( \left( w_{hdb} - w_{0h} \right) \cdot q_{hdb} \right)^b \cdot \Pi_{hdb}^{(1-b)} \tag{3}$$

$$w_{fdb} = \arg\max \left( \left( w_{fdb} - w_{0h} \right) \cdot \left( \frac{q_{fdb}}{k} \right) \right)^b \cdot \Pi_{fdb}^{(1-b)} \tag{4}$$

- *FDI under CB case:*

$$w_{hcb} = \arg\max \left( \left( w_{hcb} - w_{0h} \right) \cdot q_{hcb} + \left( w_{fcb} - w_{0h} \right) \cdot \left( \frac{q_{fcb}}{k} \right) - \overline{U}_2 \right)^b \cdot \Pi_{hcb}^{(1-b)} \tag{5}$$

$$w_{fcb} = \arg\max \left( \left( w_{hcb} - w_{0h} \right) \cdot q_{hcb} + \left( w_{fcb} - w_{0h} \right) \cdot \left( \frac{q_{fcb}}{k} \right) - \overline{U}_1 \right)^b \cdot \Pi_{fcb}^{(1-b)} \tag{6}$$

Where:
- $w_{ij}$ : the wage paid in each i firm (i: h=home firm, f=foreign firm), under each j case (j: e=exports case, db=decentralized bargaining, cb=centralized bargaining).

- $q_{ij}$ : the Cournot quantity of each i firm and under each j case. Note here, from the production functions of the firms we resume: for the home firm q=L, for the foreign firm $q=k \cdot L \Rightarrow L = \dfrac{q}{k}$.

- $\Pi_{ij}$ : the Cournot profits of each i firm and under each j case.

- $w_{0h}, w_{0f}$ : the reservation wage paid in host country and abroad, respectively.

- b : stands for the bargaining power that unions have, while (1-b) is the bargaining power of the firms.

- $U_{1(2)}$ : is the reservation utility that the unions will have, if the negotiations with the foreign (home) firm fail, knowing that, in that case, home (foreign) firm will act as a monopolist and will sell monopoly's quantity.

- Stage 5: Cournot Competition.

  Given any output level of its rival firm, each firm adjusts its output in order to maximize its profits.

  In the exports case, profit is given by:

  $\Pi_h = (p - w_h)\, q_h,$              (7)

  for the h firm, though for the f firm is given by:

  $$\Pi_f = \left( p - \left( \frac{w_f}{k} \right) - x \right) \cdot q_f \tag{8}$$

  In the FDI case, profit is given by:

  $\Pi_h = (p - w_h)\, q_h,$              (9)

  for the h firm, though for the f firm is given by:

  $$\Pi_f = \left( p - \left( \frac{w_f}{k} \right) - c \right) \cdot q_f \tag{10}$$
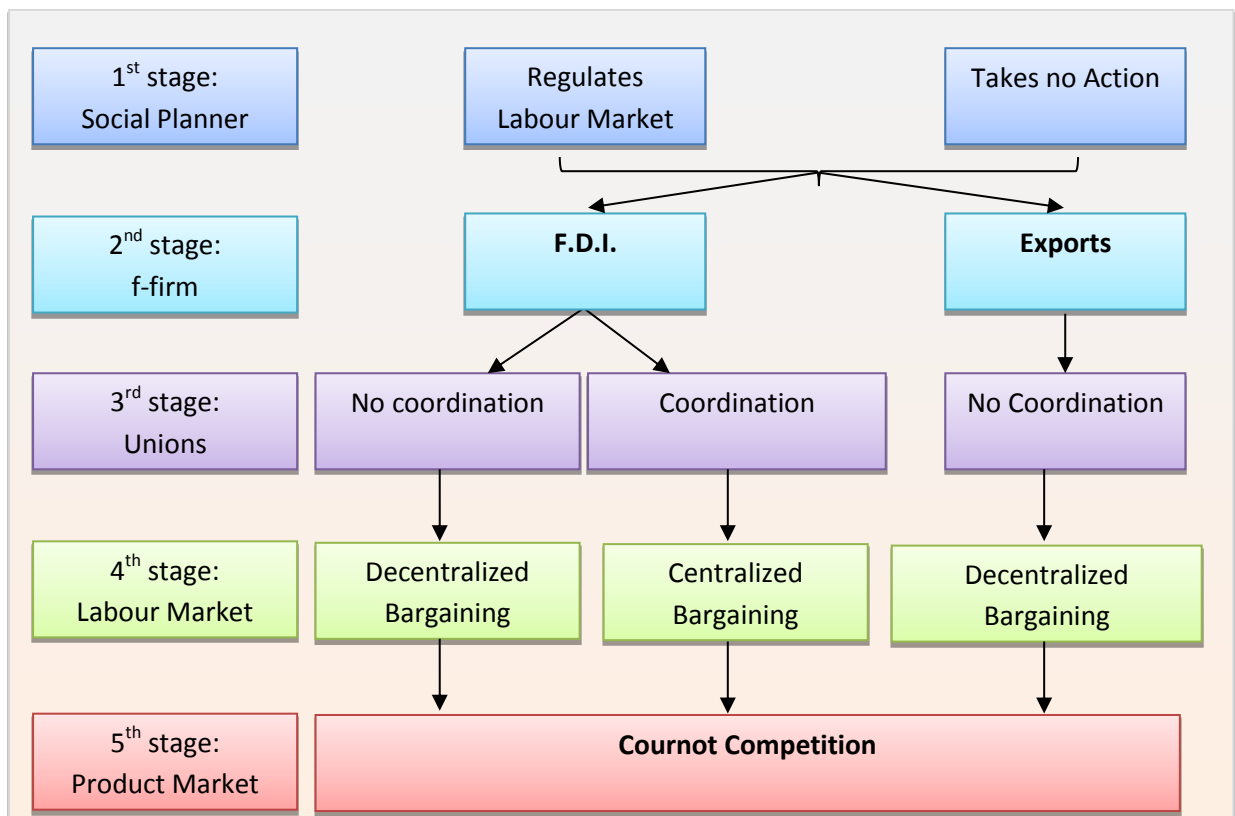
## 2. Theoretical Approach

Economic theory on F.D.I. assumes that there must be a condition in order F.D.I. to take place. Assuming that this condition is the productivity advantage of the f firm, denoted as *k*, the structure of the game has as follows:

The f-firm decides to accommodate the host market via exports (ex-ante situation) or F.D.I. depending on which case its profits is greater, calculating and quantifying all the effects derived from the choices of unions and social planner.

Labour Unions decide to coordinate or not depending on their utility. Both unions' utility must strictly increase to coordinate - or even better defined, any of them should not decrease - or else there will be a motive to decline from the coordination. At this point, we should stress out that unions will take into account all the changes of the market's setup, which will be caused by their choice. For example, the unions' decision to coordinate will affect firms' profit as well as social welfare. Social planner will act proportionally.

According to the above, the following diagram-tree arises including all 5 steps.

| 1st stage: Social Planner | Regulates Labour Market | | Takes no Action |
|---|---|---|---|
| 2nd stage: f-firm | F.D.I. | | Exports |
| 3rd stage: Unions | No coordination | Coordination | No Coordination |
| 4th stage: Labour Market | Decentralized Bargaining | Centralized Bargaining | Decentralized Bargaining |
| 5th stage: Product Market | Cournot Competition | | |

The game seems more than simple. However, the complexity of the model emerges if we try to illustrate the strategies of each agent combined with each other. Using the unionization of the labour market as a strategic tool, we can eventually say that
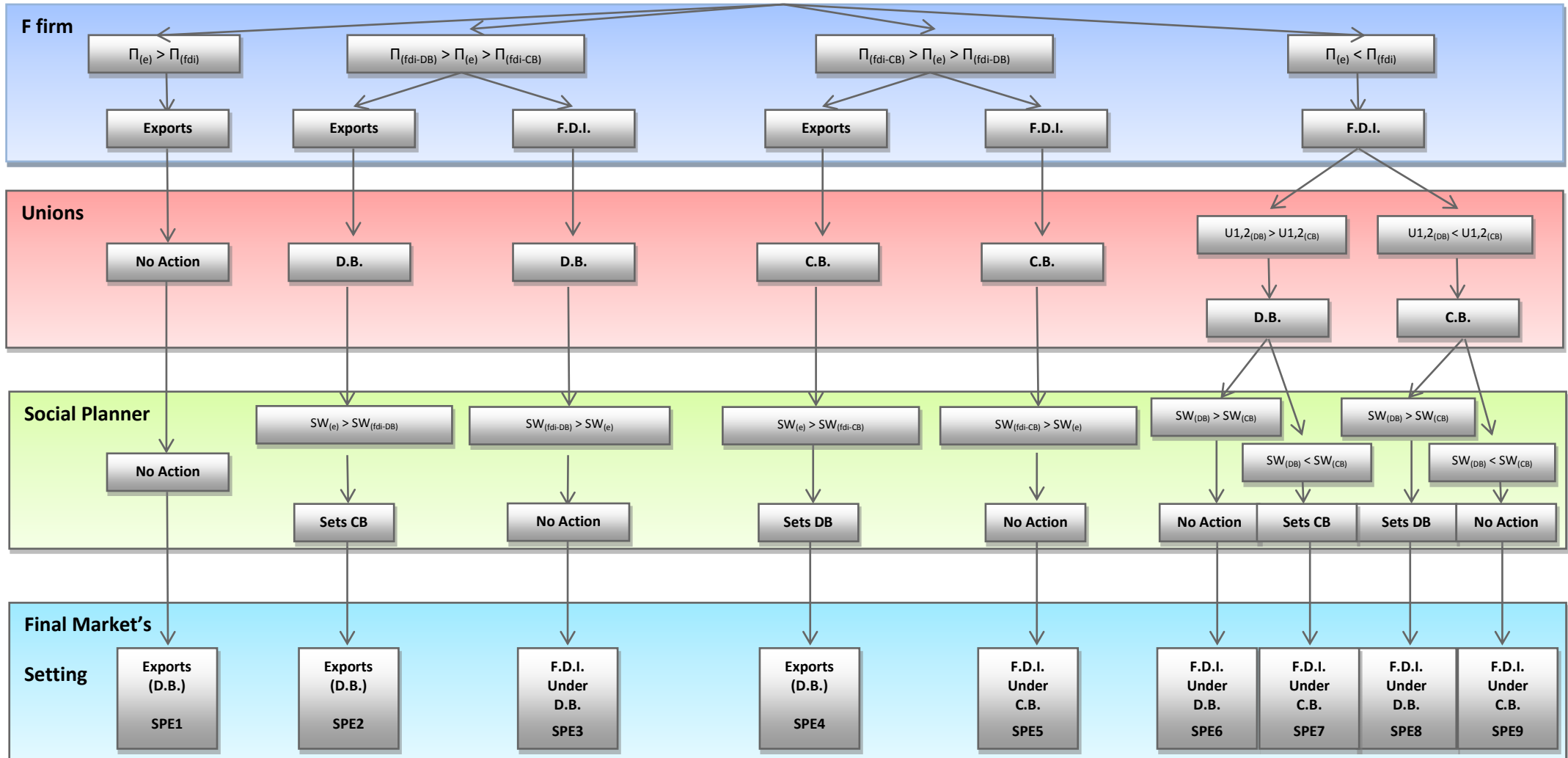
- in some cases, there will be no intervention from the social planner, as the market auto-regulates, maximizing thereby social welfare
- in some cases, the policy maker legislates certain wage bargaining structure, possibly contrasting to the goals of the unions, in order to ensure the social optimum and finally
- in some cases, the policy maker simply won't be able to affect the market by regulating labour market and consequently he will have to find other policies to induce or deter FDI.

We can show all possible results – SPE – in the following diagram - tree[5].

As it is shown, not surprisingly given the complexity of the model, a variety of outcomes are possible under variant values of parameters.

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[5] Although the policy maker makes his decisions on the first stage of the game, the diagram is better understood if we illustrate that stage after f-firm's & unions' choice (policy maker applies his policy considering both f-firm's and unions' afterwards behavior), as social planner takes into consideration their decisions in order to modulate his policy.

# Possible Nash Equilibrium (SPE)

**F firm**

| $\Pi_{(e)} > \Pi_{(fdi)}$ | $\Pi_{(fdi\text{-}DB)} > \Pi_{(e)} > \Pi_{(fdi\text{-}CB)}$ | $\Pi_{(fdi\text{-}CB)} > \Pi_{(e)} > \Pi_{(fdi\text{-}DB)}$ | $\Pi_{(e)} < \Pi_{(fdi)}$ |

- Exports
- Exports
- F.D.I.
- Exports
- F.D.I.
- F.D.I.

**Unions**

- No Action
- D.B.
- D.B.
- C.B.
- C.B.
- $U1,2_{(DB)} > U1,2_{(CB)}$
- $U1,2_{(DB)} < U1,2_{(CB)}$
- D.B.
- C.B.

**Social Planner**

- No Action
- $SW_{(e)} > SW_{(fdi\text{-}DB)}$
- $SW_{(fdi\text{-}DB)} > SW_{(e)}$
- $SW_{(e)} > SW_{(fdi\text{-}CB)}$
- $SW_{(fdi\text{-}CB)} > SW_{(e)}$
- $SW_{(DB)} > SW_{(CB)}$
- $SW_{(DB)} > SW_{(CB)}$
- $SW_{(DB)} < SW_{(CB)}$
- $SW_{(DB)} < SW_{(CB)}$

- No Action
- Sets CB
- No Action
- Sets DB
- No Action
- No Action
- Sets CB
- Sets DB
- No Action

**Final Market's Setting**

| Exports (D.B.) SPE1 | Exports (D.B.) SPE2 | F.D.I. Under D.B. SPE3 | Exports (D.B.) SPE4 | F.D.I. Under C.B. SPE5 | F.D.I. Under D.B. SPE6 | F.D.I. Under C.B. SPE7 | F.D.I. Under D.B. SPE8 | F.D.I. Under C.B. SPE9 |

There are three different cases in our analysis:

1. **Definite Emerge of Exports.**

If f-firm's profit under export's case is greater than the profit under any FDI case (either under decentralised or centralised bargaining), the f-firm will prefer to accommodate the market via exports. In this case, neither unions nor the social planner can use the unionisation setup as a policy tool in order to induce FDI (SPE1). In this case, social planner should apply different policies (e.g. lowering $w_0$ of the host country) to achieve his objectives.

2. **Definite Emerge of F.D.I.**

On the other hand, if f-firm's profit in any case of FDI (either under DB or CB) is greater than the profit in exports case, f-firm will choose to settle its production in the host country and accommodate the local market via FDI (SPE6-9). In this case, unions will coordinate only if both utilities (home firm's and foreign firm's union) remain the same or become even greater compared to the corresponding ones in the decentralized unionization case. The social planner will regulate labour market, aiming to social welfare's maximization, either by changing the bargaining status from decentralized to centralized bargaining (and conversely) or by letting the market auto-regulate itself. Essentially, since the emergence of FDI is definite, the mode of unionization will maximize social welfare within the FDI frame.

3. **Undefined Outcome.**

Game's strategic becomes even more interesting when f-firm's profit under exports is greater than the one mode of bargaining, but less than the other mode of bargaining under FDI. If, for example, stands $\Pi_{(fdi-DB)} > \Pi_{(e)} > \Pi_{(fdi-CB)}$ (SPE2-3), we assume that FDI will emerge only under decentralized bargaining status. Facing this situation, unions will not coordinate, as the f-firm's union will not exist under centralized bargaining (and therefore that union has a strong incentive to decline from that collusion). So, the optimal strategy for unions will be to bargain their wages decentralized. On the other hand, social planner will make such a decision that will maximize social welfare, even if it means that no FDI will emerge but

exports. So, if social welfare in export case is greater than the respective one in FDI under decentralized mode, the social planner will impose centralized wage bargaining, in order to deter FDI. On the contrary, if social welfare in the case of FDI under decentralized wage bargaining is greater, the social planner will let the market auto-regulate and conclude to its equilibrium, as by this choice, he maximizes the social welfare.

Proportional analysis stands for the $\Pi_{(fdi-CB)} > \Pi_{(e)} > \Pi_{(fdi-DB)}$ case (SPE4-5).

## 3. Solving the Model

Proceeding with the resolution of the model, we assume that the wage-setting structure in the host country is DB and using backward induction let us consider **the fifth stage of the game** first: in the subgame perfect equilibrium (SPE) each firm independently chooses its employment/output level so as to maximize its profit, given the firm-specific wage contract resulting from Stage 4 and the f-firm's - entry - decision at Stage 2. Thus, the derived optimal **output functions** - in any instance - appear to be as follows:

*Exports case:*

$$q_{he} = \frac{k + w_{fe} - 2\,k\,w_{he} + k\,x}{3\,k}, \text{ for h firm} \tag{11}$$

$$q_{fe} = \frac{k - 2\,w_{fe} + k\,w_{he} - 2\,k\,x}{3\,k}, \text{ for f firm} \tag{12}$$

Where $w_{he}$ ($w_{fe}$) is the wage that h(f)-firm will pay in exports case

*FDI case:*

$$q_{hf} = \frac{k + c\,k + w_{ff} - 2\,k\,w_{hf}}{3\,k}, \text{ for h firm} \tag{13}$$

$$q_{ff} = \frac{k - 2\,c\,k - 2\,w_{ff} + k\,w_{hf}}{3\,k}, \text{ for f firm} \tag{14}$$

Where $w_{hf}$ ($w_{ff}$) is the wage that h (f) -firm will pay in F.D.I. case

As expected, in either FDI (under DB) or Exports case, unit costs are strategic substitutes from the rival firms' point of view. Moreover, note that the partial derivative of $q_{he}$ (the same result applies also for the FDI case) with respect to k, is

$$\frac{\partial q_{he}}{\partial k} = \frac{1 - 2\,w_{he} + x}{3\,k} - \frac{k + w_{fe} - 2\,k\,w_{he} + k\,x}{3\,k^2}. \text{ For } w_{he}, w_{fe}, x \in (0,1) \text{ and } k > 1, \text{ it}$$

applies that $\dfrac{\partial q_{he}}{\partial k} < 0$, meaning that (as expected) as the productivity of the f firm increases, the output of the h-firm decreases (and so its profit).

Respectively, the partial derivative of $q_{fe}$ (the same result applies also for the FDI case) with respect to k, is $\dfrac{\partial q_{fe}}{\partial k} = \dfrac{1 + w_{he} - 2\,x}{3\,k} - \dfrac{k - 2\,w_{fe} + k\,w_{he} - 2\,k\,x}{3\,k^2}$. For $w_{he}, w_{fe}, x \in (0,1)$ and $k > 1$, it applies that $\dfrac{\partial q_{fe}}{\partial k} > 0$, meaning that (as expected) as the productivity of the f firm increases, the output of the f-firm increases too (and so its profit).

It follows that the f-firm's relative technological advantage (k) over the h-firm can render the f-firm dominant in the home market despite the fact that f-firm always faces extra costs (c or x) to serve this market. On the other hand, nonetheless, it, in either instance, depends on the wage contract whether the f-firm's cost per efficient unit of labour would be low enough so as to make F.D.I. the f-firm's optimal strategy.

The **price** that will be set in the market in the exports (FDI) case is:

$$p_e = \frac{w_{fe} + k\left(1 + w_{he} + x\right)}{3\,k} \quad \left(p_f = \frac{w_{ff} + k\left(1 + c + w_{hf}\right)}{3\,k}\right).$$

The partial derivative of the price relative to k, is

$$\frac{\partial p_e}{\partial k} = \frac{1 + w_{he} + x}{3\,k} - \frac{w_{fe} + k\left(1 + w_{he} + x\right)}{3\,k^2} \quad \left(\frac{\partial p_f}{\partial k} = \frac{1 + c + w_{hf}}{3\,k} - \frac{w_{ff} + k\left(1 + c + w_{hf}\right)}{3\,k^2}\right).$$

Both partial derivatives of the price relative to k are negative for $w_h, w_f, x, c \in (0,1)$ and $k > 1$, meaning that as the productivity of the f firm increases, the price in the market decreases in any case (exports or FDI).

Let us therefore proceed to **Stage 4 of the game**. By virtue of the previous stage and the maximization of the arguments [1]-[6], the following wages are specified:

*For the exports case:*

$$w_{he} = \frac{-16kw_{0h} - 4\, b\left(w_{0f} + k\left(1 - 2w_{0h} + x\right)\right) + b^2\left(2w_{0f} + k\left(-1 + 2x\right)\right)}{(-16 + b^2)k} \tag{15}$$

$$w_{fe} = \frac{-16w_{0f} + b\left(8\, w_{0f} + k\left(-4\left(1 + w_{0h} - 2x\right) + b\left(-1 + 2w_{0h} - x\right)\right)\right)}{-16 + b^2} \tag{16}$$

*For the FDI case, under DB:*

$$w_{hdb} = \frac{b\left(-4 - b + 2\left(-2 + b\right)c\right)k + 2\left(-2 + b\right)\left(b + 4\,k\right)w_{0h}}{\left(-16 + b^2\right)k} \tag{17}$$

$$w_{fdb} = \frac{-b\left(4 + b + \left(-8 + b\right)c\right)k + 2\left(-2 + b\right)\left(4 + b\,k\right)w_{0h}}{(-16 + b^2)} \tag{18}$$

*For the FDI case, under CB:*

$$w_{hcb} = \frac{b + 2\,w_{0h} - b\,w_{0h}}{2} \tag{19}$$

$$w_{fcb} = \frac{2\,w_{0h} - b\left(\left(-1 + c\right)k + w_{0h}\right)}{2} \tag{20}$$

Replacing [15]-[20] into [11]-[14] and solving the game, we have the following final output:

**The Exports Case:**

$$p_e = \frac{2\left(-2 + b\right)w_{0f} + k\left(-4\left(1 + w_{0h} + x\right) + b\left(-1 + 2w_{0h} + 2x\right)\right)}{3k\left(-4 + b\right)} \tag{21}$$

$$q_{he} = \frac{2\left(-2 + b\right)\left(-2\left(-2 + b\right)w_{0f} + k\left(4 - 8w_{0h} + b\left(1 + w_{0h} - 2x\right) + 4x\right)\right)}{3\,k\left(-16 + b^2\right)} \tag{22}$$

$$q_{fe} = \frac{2\left(-2 + b\right)\left(\left(-8 + b\right)w_{0f} + k\left(4 + b + 4w_{0h} - 2bw_{0h} + \left(-8 + b\right)x\right)\right)}{3k\left(-16 + b^2\right)} \tag{23}$$

$$\Pi_{he} = \frac{4(-2+b)^2 \left(-2(-2+b)w_{0f} + k\left(4-8w_{0h} + b(1+w_{0h}-2x)+4x\right)\right)^2}{9\,k^2\,(-16+b^2)^2} \qquad (24)$$

$$\Pi_{fe} = \frac{4(-2+b)^2 \left((-8+b)w_{0f} + k\left(4+b+4w_{0h}-2bw_{0h}+(-8+b)x\right)\right)^2}{9\,k^2\,(-16+b^2)^2} \qquad (25)$$

$$U_{he} = \frac{2b(2-b)\left(-2(-2+b)w_{0f} + k\left(4-8w_{0h}+b(1+w_{0h}-2x)+4x\right)\right)^2}{3\,(-16+b^2)^2\,k^2} \qquad (26)$$

$$U_{fe} = \frac{2b(2-b)\left((-8+b)w_{0f} + k\left(4+b+4w_{0h}-2bw_{0h}+(-8+b)x\right)\right)^2}{3(-16+b^2)^2\,k^2} \qquad (27)$$

Where

$p_e$ the price,

$q_{he}$, $q_{fe}$ the output (quantity) of h-firm and f-firm respectively,

$Pr_{he}$, $Pr_{fe}$ the profits of h-firm and f-firm respectively,

$U_{he}$, $U_{fe}$ the utility of home / foreign union

at the export case.

**The F.D.I. case under decentralized wage bargaining:**

$$p_{db} = \frac{\left(-4-b+2(-2+b)c\right)k + 2(-2+b)(1+k)w_{0h}}{3k\,(-4+b)} \qquad (28)$$

$$q_{hdb} = \frac{2(-2+b)\left(-2(-2+b)w_{0h}+k\left(4+b+4c-2bc+(-8+b)w_{0h}\right)\right)}{3k\,(-16+b^2)} \qquad (29)$$

$$q_{fdb} = \frac{2(-2+b)\left((4+b+(-8+b)c)k + (-8+b+4k-2bk)w_{0h}\right)}{3k\,(-16+b^2)} \qquad (30)$$

$$\Pi_{hdb} = \frac{4(-2+b)^2 \left(k\left(-4(1+c-2w_{0h})+b(-1+2c-w_{0h})\right)+2(-2+b)w_{0h}\right)^2}{9k^2\,(-16+b^2)^2} \qquad (31)$$

$$\Pi_{fdb} = \frac{4(-2+b)^2 \left((4+b+(-8+b)c)k+(-8+b+4k-2bk)w_{0h}\right)^2}{9k^2\,(-16+b^2)^2} \qquad (32)$$

$$U_{hdb} = \frac{2b(2\text{-}b)\left(-2(-2+b)\,w_{0h}+k\left(4+b+4c-2bc+(-8+b)\,w_{0h}\right)\right)^2}{3\left(-16+b^2\right)^2\,k^2} \quad (33)$$

$$U_{fdb} = \frac{2b(2\text{-}b)\left(-2(-2+b)\,w_{0h}+k\left(4+b+4c-2bc+(-8+b)\,w_{0h}\right)\right)^2}{3\left(-16+b^2\right)^2\,k^2} \quad (34)$$

*Where*

$p_{fdb}$ *the price,*

$q_{hdb}$, $q_{fdb}$ *the output (quantity) of h-firm and f-firm respectively,*

$Pr_{hdb}$, $Pr_{fdb}$ *the profits of h-firm and f-firm respectively,*

$U_{hdb}$, $U_{fdb}$ *the utility of home / foreign union*

*at the F.D.I. under decentralized wage bargaining case.*


**The F.D.I. case under centralized wage bargaining:**

$$p_{cb} = \frac{(2\text{-}b)\,w_{0h}+k\left(-b(-2+c+w_{0h})+2(1+c+w_{0h})\right)}{6\,k} \quad (35)$$

$$q_{hcb} = \frac{(2\text{-}b)\left(k(1+c-2\,w_{0h})+w_{0h}\right)}{6\,k} \quad (36)$$

$$q_{fcb} = \frac{(-2+b)\left(k(-1+2c-w_{0h})+2w_{0h}\right)}{6\,k} \quad (37)$$

$$\Pi_{hcb} = \frac{(-2+b)^2\left(k(1+c-2w_{0h})+w_{0h}\right)^2}{36\,k^2} \quad (38)$$

$$\Pi_{fcb} = \frac{(-2+b)^2\left(-2w_{0h}+k(1-2c+w_{0h})\right)^2}{36\,k^2} \quad (39)$$

$$U_{hcb} = \frac{b(-2+b)(-1+w_{0h})\left(k(1+c-2\,w_{0h})+w_{0h}\right)}{12\,k} \quad (40)$$

$$U_{fcb} = \frac{b(2\text{-}b)\left((-1+c)k+w_{0h}\right)\left(k(-1+2c-w_{0h})+2w_{0h}\right)}{12\,k^2} \quad (41)$$

*Where*

$p_{fcb}$ *the price,*

$q_{hcb}$, $q_{fcb}$ *the output (quantity) of h-firm and f-firm respectively,*

$Pr_{hcb}$, $Pr_{fcb}$ *the profits of h-firm and f-firm respectively,*

$U_{hcb}$, $U_{fcb}$ *the utility of home / foreign union*

*at the F.D.I. under centralized wage bargaining case.*

**Stages 3 & 2** do not have any new outputs, other than the ones from the last two stages. Let us therefore proceed to **stage 1 of the game**. The social welfare results from the aggregation of the utility of the home union, the utility of the foreign union (only in the F.D.I. case) the profits of the h-firm and the consumer surplus. Thus, the derived social welfare - in any instance - appears to be as follows:

$$SW_e = \frac{2(-2+b)\left(\begin{array}{l} -(-2+b)w_{0f}^2 + 2(-2+b)kw_{0f}(w_{0h}-x) + \\ k^2\left(4+b-8w_{0h}-2bw_{0h}+6w_{0h}^2+2(-2+b)w_{0h}x-(-2+b)x^2\right) \end{array}\right)}{3k^2\left(-16+b^2\right)} \quad (42)$$

$$SW_{db} = \frac{4(-2+b)\left(\begin{array}{l} -\left(2(4+b)^2+(-8+b)b(4+b)c+\left(16+b(24+(-9+b)b)\right)c^2\right)k^2 \\ +\left(\begin{array}{l} b^2(4+c(18-22k))+16b(2+c(-3+k))+32c(-1+k)+64k+ \\ b^3(-1+k+c(-2+3k)) \end{array}\right)w_{0h}k \\ -\left(\begin{array}{l} b^3(-1+k)(-1+2k)+b^2(-9-11(-2+k)k)+8b(3+(-2+k)k)+ \\ 16(1+k(-2+3k)) \end{array}\right)w_{0h}^2 \end{array}\right)}{3k^2\left(-16+b^2\right)^2} \quad (43)$$

$$SW_{cb} = \frac{(2-b)\left(\begin{array}{l} \left(4+2c^2+b(2+c(-4+3c))\right)k^2-2k\left(b(2+c(-3+k))+2c(-1+k)+4k\right)w_{0h} \\ +\left(2+3b-2(2+b)k+(6+b)k^2\right)w_{0h}^2 \end{array}\right)}{24\,k^2} \quad (44)$$

*Where:*

*SWe the social welfare in the exports case*

*SWdb the social welfare in the F.D.I. under decentralized wage bargaining*

*SWcb the social welfare in the F.D.I. under centralized wage bargaining*

## 4. Solvability conditions of the model.

At this point, we check under which conditions the model has internal solutions. Due to the mentioned normalizations as well as model's assumptions, the parameters range as follows:

$$w_{0h} \in (0,1),\ w_{0f} \in (0,1),\ b \in (0,1),\ c \in (0,1),\ x \in (0,1),\ k > 1$$

Additionally, the quantities and the wages must be greater than zero - in any instance. After the proper calculations, we conclude to the following restrictions:

$$\mathrm{Max}\begin{cases} 0 \\[4pt] \dfrac{(8-b)\,w_{0f} - k\left(4+b+(-8+b)\,x\right)}{(4-2b)\,k} \\[8pt] \dfrac{b\left(-2(-2+b)\,w0f + k\,(4+b+4x-2bx)\right)}{(b-2)\,8k} \\[8pt] \dfrac{\left(-4-b+2(-2+b)\,c\right)b\,k}{2(2-b)(b+4k)} \\[8pt] \dfrac{16\,w_{0f}+b\left(-8\,w_{0f}+k\,(4+b+(-8+b)x)\right)}{(b-2)\,2bk} \\[8pt] \dfrac{b\left(4+b+(-8+b)\,c\right)k}{2(-2+b)(4+bk)} \end{cases} < w_{0h} <\ \mathrm{Min}\begin{cases} 1 \\[4pt] \dfrac{-(4+b)\,k+2(-2+b)\,w_{0f}+2(-2+b)\,k\,x}{(-8+b)\,k} \\[8pt] \dfrac{-k\,(4+b+4c-2bc)}{4+b(-2+k)-8k} \\[8pt] \dfrac{k\,(1+c)}{2k-1} \\[8pt] \dfrac{-\left(4+b+(-8+b)\,c\right)k}{-8+4k+(1-2k)\,b} \\[8pt] \dfrac{k\,(1-2c)}{2-k} \end{cases}$$

$$\mathrm{Max}\begin{cases} 0 \\[4pt] \dfrac{\left(4+b(1-2x)+4x\right)k}{2(b-2)} \\[8pt] \dfrac{\left(16+(-4+b)\,b\right)k}{2b(-2+b)} - kx \\[8pt] \dfrac{-(-8+b)\,(-1+x)\,b\,k}{8(2-b)} \end{cases} < w_{0f} <\ \mathrm{Min}\begin{cases} 1 \\[6pt] (1-x)\,k \end{cases}$$

$$0 \quad\quad\quad < b <\quad \mathrm{Min}\begin{cases} 1 \\[6pt] -4\,\dfrac{1+k(1+x)}{(1-2x)\,k-2} \end{cases}$$

The model must be solved computationally to obtain results, due to its complexity. However, for a certain range of values, the following analysis sustains. For the purposes of this analysis, we assume the following restrictions: $0 < x < \dfrac{1}{2}$ , $0 < c < \dfrac{1}{2}$ , $1 < k < \dfrac{2}{1-2x}$. And finally, since $x \in \left(0,\dfrac{1}{2}\right) \Rightarrow \dfrac{2}{1-2x} \in (2,+\infty)$, we can reasonably accept (assuming no great productivity differences between the two firms) that: $1 < k < 2$.

## 5. Optimal Strategies

In this section, we examine the formulated optimal strategic choices of each agent under alternative wage-bargaining structures in the host country. If it proves that, the f-firm, unions and the social planner, have no incentive to deviate from the suggested market's setup, its institutional component (e.g. DB or CB) can be characterized as part of the Nash equilibrium, and it is only then that inward FDI would emerge in equilibrium. Otherwise, exports would be accommodated in the host country in the equilibrium.

Starting with **f-firm's choices**, let us first assume that the wage-bargaining structure in the host country is DB and, by backward induction, the derived optimal output functions appear as above (section 1.2.4). Since $\Pi = q^2$ in Cournot competition - and under the constraint in §1.2.5. - the f-firm will choose either F.D.I. (under DB) or Exports, depending on where its output is greater. Subtracting $q_{fdb}$ (30) from $q_{fe}$ (23) and simplifying, we conclude to the following:

- if $w_{0h} > cr_I = w_{0f} + (x - c)\,k \Rightarrow q_{fe} > q_{fdb}$

- if $w_{0h} < cr_I = w_{0f} + (x - c)\,k \Rightarrow q_{fe} < q_{fdb}$

Interpreting this conclusion, we conclude to:

$$q_{fe} > q_{fdb} \implies w_{0h} - w_{0f} > (x - c)\,k \implies c + \frac{w_{0h}}{k} > x + \frac{w_{0f}}{k} \quad \text{and}$$

$$q_{fe} < q_{fdb} \implies w_{0h} - w_{0f} < (x - c)\,k \implies c + \frac{w_{0h}}{k} < x + \frac{w_{0f}}{k}$$

If the sum of the FDI's associated unit cost plus the unemployment benefit in home country under effective labour is less than the sum of the Exports' associated unit cost plus the unemployment benefit in foreign country under effective labour, then the institutionalization of Decentralized Wage Bargaining in home Labour Market will induce FDI.

The previous statement nominates decentralized bargaining regime as an institutional formation that can – under circumstances – effectively induce FDI.

However, we must stress out here that the above condition although necessary, yet is not sufficient, due to the strategic choices of the other agents in the game.

Interpreting the above conclusion, f-firm will face

- unit cost $c$ and unemployment benefit $w_{0h}$ for the FDI case
- unit cost $x$ and unemployment benefit $w_{0f}$ for the Exports case,

counting in its productivity $k$ as well. As it is proven, f-firm will examine only the associated costs (unit cost and the unemployment benefit under effective labour) in each case, in order to serve the home market via FDI or via Exports.

Thereafter, we continue comparing exports case to FDI under centralized bargaining regime. Subtracting $q_{fcb}$ (37) from $q_{fe}$ (23) and simplifying, it proves that:

- $q_{fe} > q_{fcb} \Rightarrow w_{0h} > cr_2 = \dfrac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}$

- $q_{fe} < q_{fcb} \Rightarrow w_{0h} < cr_2 = \dfrac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}$

Meaning that, if $w_{0h}$ is less than a critical value $cr_2 = \dfrac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}$, then f-firm will choose to serve home market via FDI under centralized bargaining regime over exports and conversely.

Finally, subtracting $q_{fdb}$ (30) from $q_{fcb}$ (37) and simplifying, it proves that:

- $q_{fdb} > q_{fcb} \Rightarrow w_{0h} < cr_3 = \dfrac{4k+bk+4ck-2bck}{-4+2b+8k-bk}$

- $q_{fdb} < q_{fcb} \Rightarrow w_{0h} > cr_3 = \dfrac{4k+bk+4ck-2bck}{-4+2b+8k-bk}$

Interpreting the above lines, if $w_{0h}$ is less than a critical value $cr_3 = \dfrac{4k+bk+4ck-2bck}{-4+2b+8k-bk}$, then f-firm will enjoy greater market share, and thus profits, in FDI under decentralized bargaining regime over FDI centralized bargaining regime and conversely.

For any values of the parameters as cited in 1.2.5 section, it is proven that

$$cr_3 = \frac{4k+bk+4ck-2bck}{-4+2b+8k-bk} > cr_1 = w_{0f} + (x - c)\,k > cr_2 = \frac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}.$$

Summarizing, we sort the profits of f-firm (higher the greater, lower the less), depending on the value of $w_{0h}$ in each case to the following matrix:

| $w_{0h}$ | 0 | | $cr_2$ | | $cr_1$ | | $cr_3$ | | 0.5 |
|---|---|---|---|---|---|---|---|---|---|
| Ranking of f-firm quantities (the higher, the greater) | | $q_{fdb}$ | | $q_{fdb}$ | | $q_{fe}$ | | $q_{fe}$ | |
| | | $q_{fcb}$ | | $q_{fe}$ | | $q_{fdb}$ | | $q_{fcb}$ | |
| | | $q_{fe}$ | | $q_{fcb}$ | | $q_{fcb}$ | | $q_{fdb}$ | |

From the examination of the matrix above, we come to the following conclusions:

---

**Proposition 1**

*If $w_{0h}$ is low enough (less than $cr_2 = \frac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}$), then any institutional arrangement of labour market is insufficient to deter FDI. If on the other hand $w_{0h}$ is great enough (greater than $cr_1 = w_{0f} + (x - c)\,k$), then any institutional arrangement of labour market is insufficient to induce FDI.*

---

Notice that, if $w_{0h}$ ranges from zero to $cr_2$, then f-firm's quantities in each case of FDI (either under centralized or under decentralized bargaining) are greater than the quantity in exports case. Thus, f-firm will accommodate home market via FDI, in any case. Once again, if $w_{0h}$ is greater than $cr_1$, then f-firm's quantity in exports case is greater than the respective ones in any case of FDI (either under centralized or under decentralized bargaining). Thus, f-firm will eventually choose to serve the home market via exports.

Let us now proceed with **unions' strategic decisions**. Labour unions will either stay decentralized or will coordinate and bargain their wage in a centralized regime with the firms. Obviously, centralized bargaining regime is an option only in case that FDI emerges. As mentioned above, both unions' utility must increase with

centralized bargaining (vs DB), else unions will have an incentive to decline from the coordination. In case that any unions' utility decrease after the coordination, that union will be motivated to decline and thus decentralized wage bargaining will emerge.

Regarding **home union**, we first examine its utility under exports case versus FDI under DB case. Abstracting $U_{hdb}$ (33) from $U_{he}$ (26), we conclude to the following:

- if $w_{0h} > cr_1 = w_{0f} + (x - c)\,k \Rightarrow U_{he} < U_{hdb}$

- if $w_{0h} < cr_1 = w_{0f} + (x - c)\,k \Rightarrow U_{he} > U_{hdb}$

Therefore, if $w_{0h}$ is low enough, less than $cr_1 = w_{0f} + (x - c)\,k$, we conclude that $U_{he} > U_{hdb}$. So, for home union, the FDI under decentralized wage bargaining is rather damaging in comparison to exports case, meaning that home union has incentive to prevent FDI under DB with its choices.

Note that, regarding exports versus FDI under decentralized wage bargaining case, f-firm and home union have exactly opposite behaviors; if $w_{0h}$ is less than $cr_1$, then f-firm will choose to serve home market via exports, while home union would prefer FDI under DB to emerge.

Continuing with the comparison of FDI under decentralized wage bargaining versus centralized wage bargaining regime, and abstracting $U_{hcb}$ (40) from $U_{hdb}$ (33), we obtain the following results:

$$U_{hdb} - U_{hcb} = \frac{b(b-2)\left( k\,(w_{0h}-1)\left( k\,(1+c-2w_{0h}) + w_{0h} \right) + \dfrac{\left( 8(-2(b-2)w_{0h} + k(4+b+4c-2bc+(b-8)w_{0h}))^2 \right)}{\left( -16 + b^2 \right)^2} \right)}{12\,k^2}$$

Since $12\,k^2 > 0$ , $b(b-2) < 0$ and for $w_{0h} < \dfrac{1}{2}$ ,

$$\left( k\,(w_{0h}-1)\left( k\,(1+c-2w_{0h}) + w_{0h} \right) + \frac{\left( 8(-2(b-2)w_{0h} + k(4+b+4c-2bc+(b-8)w_{0h}))^3 \right)}{\left( -16 + b^2 \right)^2} \right) > 0$$ , we conclude to

$U_{hdb} < U_{hcb}$.

Finally, let us compare home union's utility under exports and FDI (CB) case. Abstracting $U_{hcb}$ (40) from $U_{he}$ (26) and simplifying, we conclude to the following:

$$U_{he} - U_{hcb} =$$
$$-\left(b^2-16\right)^2 k\left(w_{0h}-1\right)\left(k\left(1+c-2w_{0h}\right)+w_{0h}\right)-8\left(-2\left(b-2\right)w_{0f}+k\left(4-8w_{0h}+b\left(1+w_{0h}-2x\right)+4x\right)\right)^2 < 0 \Rightarrow$$
$$U_{he} < U_{hcb}$$

---

**Proposition 2:**

*In case that FDI emerges, home union will prefer to coordinate with the other union in order to bargain their wages under a centralized regime.*

---

The analysis above reveal that centralized wage bargaining appears to be an optimal strategy for home union in each case. Summarizing the choices of home union, we sort its utilities (higher the greater, lower the less), depending on the value of $w_{0h}$ in each case to the following matrix:

| $w_{0h}$ | **0** | **$cr_1$** | **0.5** |
|---|---|---|---|
| Ranking of h-union's utilities (the higher, the greater) | $U_{hcb}$ | $U_{hcb}$ | |
| | $U_{he}$ | $U_{hdb}$ | |
| | $U_{hdb}$ | $U_{he}$ | |

Regarding **f-union**, it exists only if f-firm will accommodate home market via FDI. Therefore, we check if foreign union has an incentive to coordinate with the home union. Abstracting $U_{fcb}$ (41) from $U_{fdb}$ (34), we conclude to the following:

$$U_{fdb} - U_{fcb}$$
$$= \frac{(-2+b)b(((-1+c)k+w0h)(k(-1+2c-w0h)+2w0h) - \frac{8((4+b+(-8+b)c)k+(-8+b+4k-2bk)w0h)^2}{(-16+b^2)^2})}{12k^2}$$

Given the complexity of the model, no solid strategy can be revealed, as the model must be solved computationally to obtain solutions [6]. Nevertheless, constraining $c \in (0, 0.25)$ [7], we observe that applies $U_{fdb} < U_{fcb}$.

Finally, in order to rationalize social planner's choices, let us examine how **social welfare** formulates in each case. Dividing $SW_e$ (42) by $SW_{db}$ (43), it can be proven that $\frac{SW_e}{SW_{db}} < 1 \rightarrow SW_e < SW_{db}$. In the same way (abstracting $SW_{cb}$ (44) from $SW_e$ (42) and $SW_{cb}$ (44) from $SW_{db}$ (43)) it proves that it also applies $SW_e < SW_{cb}$, while $SW_{db} < SW_{cb}$. Proposition 3 summarizes.

---

**Proposition 3:**

*FDI proves to be social optimal frame rather than exports regime. Within FDI frame, centralized wage bargaining regime will yield greater social welfare rather than decentralized wage bargaining setup.*

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## 6. Subgame perfect equilibrium (S.P.E.)

Summarizing all the above, we can illustrate all strategies in the following matrix:



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[6] Simplifying the above expression,

- if $k \in (1, \frac{256 - 320b + 64b^2 - b^4 - (-16 + b^2)\sqrt{256 - 384b + 160b^2 + b^4}}{2(128 - 128b + 32b^2)})$, and considering as $x_1$ and $x_2$ the roots of the formulated trinomial, then
  - for $0 < w_{0h} < x_1$ & $x_2 < w_{0h} < 0.5 \rightarrow U_{fdb} < U_{fcb}$
  - for $x_1 < w_{0h} < x_2 \rightarrow U_{fdb} > U_{fcb}$
- if $k \in (\frac{256 - 320b + 64b^2 - b^4 - (-16 + b^2)\sqrt{256 - 384b + 160b^2 + b^4}}{2(128 - 128b + 32b^2)}, 2)$, and considering as $x_1$ and $x_2$ the roots of the formulated trinomial, then
  - for $0 < w_{0h} < x_1$ & $x_2 < w_{0h} < 0.5 \rightarrow U_{fdb} > U_{fcb}$
  - for $x_1 < w_{0h} < x_2 \rightarrow U_{fdb} < U_{fcb}$

[7] The restriction is made for the analysis purposes and for better understanding of the game flow.

| | | | | |
|---|---|---|---|---|
| Ranking of social welfare (the higher, the greater) | $SW_{cb}$ | $SW_{cb}$ | $SW_{cb}$ | $SW_{cb}$ |
| | $SW_{db}$ | $SW_{db}$ | $SW_{db}$ | $SW_{db}$ |
| | $SW_{e}$ | $SW_{e}$ | $SW_{e}$ | $SW_{e}$ |
| Ranking of f-firm quantities (the higher, the greater) | $q_{fdb}$ | $q_{fdb}$ | $q_{fe}$ | $q_{fe}$ |
| | $q_{fcb}$ | $q_{fe}$ | $q_{fdb}$ | $q_{fcb}$ |
| | $q_{fe}$ | $q_{fcb}$ | $q_{fcb}$ | $q_{fdb}$ |
| Ranking of h-union's utilities (the higher, the greater) | $U_{hcb}$ | $U_{hcb}$ | $U_{hcb}$ | $U_{hcb}$ |
| | $U_{he}$ | $U_{he}$ | $U_{hdb}$ | $U_{hdb}$ |
| | $U_{hdb}$ | $U_{hdb}$ | $U_{he}$ | $U_{he}$ |
| Ranking of f-union's utilities (the higher, the greater) | $U_{fcb}$ | $U_{fcb}$ | $U_{fcb}$ | $U_{fcb}$ |
| | $U_{fdb}$ | $U_{fdb}$ | $U_{fdb}$ | $U_{fdb}$ |

Given the complexity of the model and the restrictions mentioned, we proceed with the examination of the Subgame Perfect Equilibria (SPE).

---

**Proposition 4: SPE 1**

*If $w_{0h} \in \left( 0, cr_2 = \frac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk} \right)$ , then f-firm will accommodate home market via FDI. The labour market will auto-regulate to centralized wage bargaining regime, maximizing that way the social welfare.*

---

Analyzing the optimal strategies of each agent comparatively, let us first approach f-firm's alternatives. As mentioned above, since *w₀ₕ* is low enough, f-firm's profits under FDI is greater than profits under exports in either case (either decentralized or centralized bargaining regime). Therefore, the optimal choice of f-firm is to serve the home market via FDI. Even if centralized wage bargaining regime finally emerges in home's labour market, f-firm will still enjoy greater



profits versus the exports case. Unions will coordinate and bargain their wages under centralized regime, since they both enjoy greater utility in this case, rather than decentralized bargaining. Social planner will let labour market to auto-regulate, as

this proposed equilibrium maximizes social welfare. Since no agent has any incentive to decline, the proposed equilibria consists a Nash subgame perfect equilibria.

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**Proposition 5: SPE 2**

*If $w_{0h} \in \left( cr_2 = \dfrac{b^2(k-2ck)-32w_{0f}+32k(c-x)+4b(k+w_{0f}+kx)}{-b^2k+2b^2-32+8bk}, \; cr_1 = w_{0f} + (x - c)\,k \right)$, then FDI will finally emerge. Social planner will legislate (impose) decentralized wage bargaining regime – in contrast to unions' interests – in order to ensure the maximization of social welfare.*

---

Interpreting the lines above, f-firm will serve the home market via FDI only in the case that home's labour market is adjusted to decentralized wage bargaining regime; otherwise, f-firm's second best choice is exports. Since FDI under CB is a non-feasible option, home union will choose centralized bargaining aiming to a dual purpose; first to deter FDI and second to enjoy second-best utility (the one under exports case). However, the social planner is

| | $cr_2$ | $cr_1$ |
|---|---|---|
| Ranking of social welfare (the higher, the greater) | $SW_{cb}$ | |
| | $SW_{db}$ | |
| | $SW_e$ | |
| Ranking of f-firm quantities (the higher, the greater) | $q_{fdb}$ | |
| | $q_{fe}$ | |
| | $q_{fcb}$ | |
| Ranking of h-union's utilities (the higher, the greater) | $U_{hcb}$ | |
| | $U_{he}$ | |
| | $U_{hdb}$ | |
| Ranking of f-union's utilities (the higher, the greater) | $U_{fcb}$ | |
| | $U_{fdb}$ | |

obliged to interfere and impose DB, to ensure the second-best social welfare. Thus, in this case, FDI under decentralized wage bargaining regime consists a Nash Subgame Perfect Equilibria.

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**Proposition 6: SPE 3**

*If $w_{0h} > cr_1 = w_{0f} + (x - c)\,k$, then f-firm will serve home market via exports. As mentioned in Proposition 2, in this case, any institutional arrangement of labour market is insufficient to induce FDI and thus social planner must seek for an alternative institutional tool to induce FDI.*

| | | $cr_1$ | $cr_3$ | 0.5 |
|---|---|---|---|---|
| $w_{0h}$ | | | | |
| Ranking of social welfare (the higher, the greater) | | $SW_{cb}$ | $SW_{cb}$ | |
| | | $SW_{db}$ | $SW_{db}$ | |
| | | $SW_e$ | $SW_e$ | |
| Ranking of f-firm quantities (the higher, the greater) | | $q_{fe}$ | $q_{fe}$ | |
| | | $q_{fdb}$ | $q_{fcb}$ | |
| | | $q_{fcb}$ | $q_{fdb}$ | |
| Ranking of h-union's utilities (the higher, the greater) | | $U_{hcb}$ | $U_{hcb}$ | |
| | | $U_{hdb}$ | $U_{hdb}$ | |
| | | $U_{he}$ | $U_{he}$ | |
| Ranking of f-union's utilities (the higher, the greater) | | $U_{fcb}$ | $U_{fcb}$ | |
| | | $U_{fdb}$ | $U_{fdb}$ | |

In this last proposed equilibria, FDI appears as a less profitable choice for f-firm. F-firm will serve the home market via exports in any instance, maximizing its profits. The institutional arrangement of labour market in this case is insufficient to induce FDI, and thus union's utility and social welfare will adjust to their minimum values. In order FDI to emerge, the social planner has to find an alternative institutional tool.


## 7. Conclusions

In this section, we have examined whether enforcing a particular unionization structure in a host labour market is an effective policy tool in order to induce or deter inward FDI. Our analysis diverts from previous works [see, e.g., Vlassis (2009) and the references therein] in two major aspects. **First**, we have considered the home union's choice about the domestic unionization structure as a strategy to deter or accommodate inward FDI at the union's best interest. **Second**, we have inbuilt to our model the concept of the home union's reservation utility under the centralized unionization structure and the ensuing wage bargaining regime.

We focused in a union-oligopoly context interpreting the optimal equilibria may arise from any possible policies of a benevolent social planner. Furthermore, we investigated the circumstances under which the institutional arrangements of labour market (decentralized versus centralized wage bargaining) consist effective policy tools to induce or deter FDI.

Given the complexity of the model, we applied extended restrictions for the values of the parameters, and consequently the results - although applied - are not widely applicable.

Through our analysis, we provided a consistent model as an analytical tool, which combines the strategies and the goals of all agents (f-firm, unions, social planner) and analyze all possible equilibria.

Our findings suggest that the institutional arrangement of labour market may be insufficient to induce (if $w_{0h} > cr_1$) or to deter (if $w_{0h} < cr_2$) FDI. In other cases ($w_{0h} \in (cr_2, cr_1)$), institutional arrangement of labour market proves to be an efficient

policy device to induce FDI and maximize social welfare, even in contrast to unions' objectives. While in other cases ($w_{0h} < cr_2$), the social planner should let the labour market to auto-regulate itself, gaining the maximum social welfare.

Furthermore, FDI appears to be social welfare maximizing rather than exports regime. We should also stress out that centralized wage bargaining regime maximizes not only unions' utility, but social welfare as well.

Notwithstanding, it is most possible that we revealed only some of the possible SPE, due to the complexity of the model and the extended restrictions we assumed in our effort to illustrate the flow of the game.

## Appendix

### 1. Solving the Model

Using backward induction, we first begin from **the last – 5$^{th}$ – stage** of the game, Cournot competition.

For the **exports case**, the definition of the functions:

- $pe = 1 - (qhe + qfe)$
- $prhe = (pe - whe)qhe$
- $prfe = (pe - (wfe/k) - x)qfe$

From the expressions above, we extract the reaction functions:

- $qhe \rightarrow \frac{1}{2}(1 - qfe - whe)$
- $qfe \rightarrow \frac{k - kqhe - wfe - kx}{2k}$

Solving the system of reaction functions, we obtain the results for the last stage of the game:

- $qhe = \frac{k + wfe - 2kwhe + kx}{3k}$
- $qfe = \frac{k - 2wfe + kwhe - 2kx}{3k}$
- $prhe = \frac{(wfe + k(1 - 2whe + x))^2}{9k^2}$
- $prfe = \frac{(-2wfe + k(1 + whe - 2x))^2}{9k^2}$
- $pe = \frac{wfe + k(1 + whe + x)}{3k}$

Proportionally, for the **FDI case**:

- $pf = 1 - (qhf + qff)$
- $prhf = (pf - whf)qhf$
- $prff = (pf - (wff/k) - c)qff$

Reaction functions:

- $qhf \to \frac{1}{2}(1 - qff - whf)$

- $qff \to \frac{k-ck-kqhf-wff}{2k}$

Solving the equation system above:

- $qhf = -\frac{-k-ck-wff+2kwhf}{3k}$

- $qff = -\frac{-k+2ck+2wff-kwhf}{3k}$

- $prhf = \frac{(wff+k(1+c-2whf))^2}{9k^2}$

- $prff = \frac{(-2wff+k(1-2c+whf))^2}{9k^2}$

- $pf = \frac{wff+k(1+c+whf)}{3k}$

Continuing to the **4$^{th}$ stage** of the game, we determine the wages in each instance.

For the exports case, the wage bargaining is expressed by the following expressions:

- $B_{he} = \left((whe - w0h)qhe\right)^b \cdot prhe^{(1-b)}$

- $B_{fe} = \left((wfe - w0f)(qfe/k)\right)^b \cdot prfe^{(1-b)}$

Taking first order conditions and solving the equation system, we obtain the wages:

- $whe = \frac{-16kw0h-4b(w0f+k(1-2w0h+x))+b^2(2w0f+k(-1+2x))}{(-16+b^2)k}$

- $wfe = \frac{-16w0f+b(8w0f+k(-4(1+w0h-2x)+b(-1+2w0h-x)))}{-16+b^2}$

Substituting the wages:

- $qhe = \frac{2(-2+b)(-2(-2+b)w0f+k(4-8w0h+b(1+w0h-2x)+4x))}{3(-16+b^2)k}$

- $qfe = \frac{2(-2+b)((-8+b)w0f+k(4+b+4w0h-2bw0h+(-8+b)x))}{3(-16+b^2)k}$

- $prhe = \frac{4(-2+b)^2(-2(-2+b)w0f+k(4-8w0h+b(1+w0h-2x)+4x))^2}{9(-16+b^2)^2k^2}$

- $prfe = \frac{4(-2+b)^2((-8+b)w0f+k(4+b+4w0h-2bw0h+(-8+b)x))^2}{9(-16+b^2)^2k^2}$

- $pe = \dfrac{2(-2+b)w0f+k(-4(1+w0h+x)+b(-1+2w0h+2x))}{3(-4+b)k}$

For the FDI under decentralized wage bargaining, the wage bargaining is expressed by the following expressions:

- $B_{hdb} = \left((whf - w0h)qhf\right)^{b} \cdot prhf^{(1-b)}$

- $B_{fdb} = \left((wff - w0h)(qff/k)\right)^{b} \cdot prff^{(1-b)}$

Taking first order conditions and solving the equation system, we obtain the wages:

- $whf \rightarrow \dfrac{4kw0h+b(k(1+c-2w0h)+wff)}{4k}$

- $wff \rightarrow \dfrac{1}{4}(4w0h + b(-2w0h + k(1 - 2c + whf)))$

Substituting the wages:

- $qhdb = \dfrac{2(-2+b)(-2(-2+b)w0h+k(4+b+4c-2bc+(-8+b)w0h))}{3(-16+b^2)k}$

- $qfdb = \dfrac{2(-2+b)((4+b+(-8+b)c)k+(-8+b+4k-2bk)w0h)}{3(-16+b^2)k}$

- $prhdb = \dfrac{4(-2+b)^2(k(-4(1+c-2w0h)+b(-1+2c-w0h))+2(-2+b)w0h)^2}{9(-16+b^2)^2k^2}$

- $prfdb = \dfrac{4(-2+b)^2((4+b+(-8+b)c)k+(-8+b+4k-2bk)w0h)^2}{9(-16+b^2)^2k^2}$

- $pdb = \dfrac{(-4-b+2(-2+b)c)k+2(-2+b)(1+k)w0h}{3(-4+b)k}$

For the FDI under centralized wage bargaining, the wage bargaining is expressed by the following expressions:

- $B_{hcb} = (Uhc + Ufcb + \overline{U_2})^b \cdot prhf^{(1-b)} = \Big(\big((whf - w0h) \cdot qhf\big) + \big((wff - w0h)(qff/k)\big) -$

  $\left((wff - w0h)\left(\dfrac{1-c-(wff/k)}{2k}\right)\right)\Big)^{b} \cdot prhf^{(1-b)}$

- $B_{fcb} = (Uhc + Ufcb + \overline{U_1})^b \cdot prff^{(1-b)} = \left( \big((whf - w0h) \cdot qhf\big) + \big((wff - w0h)(qff/k)\big) - \left((whf - w0h)(\frac{1-whf}{2})\right)\right)^b \cdot prff^{(1-b)}$

Taking first order conditions and solving the equation system, we obtain the wages:

- $whcb = \frac{1}{2}(b + 2w0h - b\,w0h)$

- $wfcb = \frac{1}{2}(bk - bck + 2w0h - bw0h)$

Substituting the wages:

- $qhcb = -\frac{(-2+b)(k(1+c-2w0h)+w0h)}{6k}$

- $qfcb = \frac{(-2+b)(k(-1+2c-w0h)+2w0h)}{6k}$

- $prhcb = \frac{(-2+b)^2(k(1+c-2w0h)+w0h)^2}{36k^2}$

- $prfcb = \frac{(-2+b)^2(-2w0h+k(1-2c+w0h))^2}{36k^2}$

- $pcb = \frac{-(-2+b)w0h+k(-b(-2+c+w0h)+2(1+c+w0h))}{6k}$

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