Differentiation, Labor Market and Globalization

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Abstract

We consider two countries with initially one firm in each country having the possibility to invest in the other country or commercialize its products, and for workers to immigrate (Migration). Interestingly, when firms compete on the product market with no competition on the labor market (Goods’ Mobility), they do not differentiate their qualities. However, when competition is introduced in both markets (Foreign Investment) firms differentiate their products. We also prove that the three globalization scenarios considered improve the global social welfare relative to autarky and that a cooperative choice by countries of a globalization scenario would lead to Goods’ Mobility.

Keywords: Vertical differentiation, labor market, globalization, foreign investment, migration, goods’ mobility.

JEL Classification: F2, F12, J4, L13.
1 Introduction

Most studies which deal with globalization distinguish three main forms of mobility between countries: goods’ mobility, workers’ mobility (migration) and capital mobility (foreign investment). Traditional trade theory considers that in the long term these three dimensions of globalization are substitutes (Xengiani, 2006; Ranis, 2007). However in practice, according to Ranis (2007) governments tend to encourage export and foreign investment but they implement barriers to migration using for example residence permits, work permits or visas. This strong political resistance to migration is explained by the fact that governments tend to protect domestic workers from immigrants (Ranis, 2007). The question is whether this preference is theoretically founded. Most of theoretical studies analyzing the impact of globalization on social welfare focused on goods’ mobility, ignoring workers’ mobility and foreign investment (Gabszewicz et al., 1981; Brander and Spencer, 1988; Lambertini, 1997; Cabrales and Motta, 2001; Fajgelbaum, 2011). Moreover addressing this question jointly with vertical differentiation and labor market is still largely under-explored in the literature.

Our paper fills a gap by considering these issues through a simple model analyzing jointly vertical differentiation, labor market and globalization, in terms of goods’ mobility, workers’ mobility and capital mobility. Starting from the benchmark of two countries in autarky with a monopoly in each country, we introduce globalization considering respectively three situations: Goods’ Mobility, Migration (workers’ mobility) and Foreign Investment (capital mobility). We characterize equilibrium in these cases and compare them from the viewpoint of workers, consumers, producers and the social planner.

Depending on the considered globalization scenario, there is either competition on the product market (Goods’ Mobility) or on the labor market (Migration) or on both markets (Foreign Investment). On the one hand, competition on the product market results in two effects: a direct effect on prices (decreasing) and on demands (increasing) and an indirect increasing effect on salaries and employment (resulting from higher demands). On the other hand, competition on the labor market leads as well to two effects: a direct increasing effect on salaries
and employment and an indirect effect on demands (increasing) and prices (decreasing).

We prove that, when there is competition on the product market with no competition on the labor one (Goods’ Mobility scenario) the incentive for firms to vertically differentiate is not strong enough: at equilibrium they choose the same quality. However, under Foreign Investment, as competition is introduced on the labor market, firms differentiate their qualities. We also prove that globalization is always welfare improving relative to Autarky and that a cooperative choice by countries of one globalization scenario among the possible ones would lead to Goods’ Mobility.

Surprisingly, we prove that workers prefer capital mobility (Foreign Investment) and Goods’ Mobility to their own mobility. Indeed, the indirect effect on salaries when we introduce competition on the product market is higher than the direct one resulting from competition on the labor market. We also prove that producers prefer workers’ mobility (Migration) to capital one (Foreign Investment) as their total surplus decreases under Foreign Investment relative to Migration due to the negative effect of product competition on prices.

**Related literature:**

Rare are articles which consider jointly the three aspects; trade, labor market and differentiation. Numerous papers consider however these aspects two by two.

In a first set of papers, several authors deal with international trade within a vertically differentiated market. Gabszewicz et al. (1981), Shaked and Sutton (1983) and more recently Cabrales and Motta (2001) analyze the effect of international trade on market equilibrium under vertical differentiation, emphasizing the ambiguous welfare effects of trade. Motta (1992) completes the analysis highlighting cost conditions under which there exist losses due to international trade. Other articles such as Flam and Helpman (1987), Chang and Kim (1989) and Kovac and Zigic (2012) study a model of trade between developed and less developed countries. More specifically, Chang and Kim (1989) tackle the less developed country dependence


A third set of articles deals with labor market under vertical differentiation. Authors such as Gabszewicz and Turrini (1999, 2000) consider a model in which firms determine their quality level depending on skilled workers availability. Others focus on the impact of labor market characteristics on welfare and profits. In this strand, Lutz and Turrini (1999) examine the effect of labor costs (wages) on industry profits and Bacchiega (2002) deals with wage bargaining and its welfare effects.

To the best of our knowledge, Cordella and Grilo (1998) and Bacchiega (2004) are the only papers which consider jointly labor market, vertical differentiation and globalization.

Cordella and Grilo (1998) consider two domestic firms in a vertically differentiated market hiring local workers at an exogenous local wage. The authors introduce globalization allowing
both firms to serve the local market through foreign plants (Foreign Investment). When firms choose to relocate they incur fixed relocation costs and employ foreign workers at a given foreign wage. The authors focus their analysis on the globalization cost effect (salaries and fixed relocation costs) on the firms’ relocation decision, considering quality as an exogenous variable. In our paper, we also consider Foreign Investment, but contrary to Cordella and Grilo (1998) we assume two countries with a monopoly in each and we introduce globalization allowing each firm to produce and sell in the domestic and foreign markets focusing our analysis on the globalization effects on qualities, demands, prices and salaries. In addition we explicitly analyze the equilibrium of labor market considering that wages are determined by balancing offer and demand in each country. Contrarily to Cordella and Grilo (1998) we prove that Foreign Investment is always welfare improving compared to Autarky.

Bacchiega (2004) considers a model closer to ours allowing trade between two countries. The first is characterized by skilled and unskilled workers and the second provides only unskilled workers. The high quality variant of the product is provided by skilled labor and the low quality one by either skilled or unskilled labor. The author supposes that unskilled workers are wage takers, and salaries for skilled workers are determined through a bargaining process between a union and firms. In our model, we suppose a continuum of workers in each country differing by their sensitivity to effort and salaries are determined such that the offer balances the demand on the labor market. Moreover, Bacchiega (2004) supposes that only goods can flow between countries disregarding labor mobility and foreign investment. In contrast with our results, the author proves that losses might arise from trade liberalization (comparable to Goods’ Mobility in our model). This divergence is mainly due to the decomposition of the work force into skilled and unskilled workers. Indeed, losses depend on the degree of unionization and the market expansion of the country which provides skilled labor.

The remaining of the paper is organized as follows. Section 2 describes the basic model. In Section 3, we analyze the autarkic case. In Section 4, we introduce globalization solving the game for Goods’ Mobility, Migration and Foreign Investment. In Section 5, we discuss our
results and compare the three globalization scenarii. Section 6 concludes the paper.

2 The model

We first introduce the basic model which links in an original way labor and quality in a vertical differentiated market. Then we describe formally the three considered scenarii of globalization.

2.1 The basic model

We consider a vertically differentiated market with a segment of consumers and a segment of workers.

The consumers. The quality is desirable from the viewpoint of consumers. As in Mussa and Rosen (1978), the indirect utility of a consumer buying a unit of product $q_i$ from Firm $i$ at price $p_i$, is given by:

$$V_i(\theta) = \begin{cases} 
\theta q_i - p_i & \text{if he/she buys one unit of product,} \\
0 & \text{if he/she buys nothing.}
\end{cases}$$

Consumers are uniformly distributed over the segment $[0, \bar{\theta}]$, with a density normalized to 1. Each consumer is assumed to buy a unit of the product from the firm that ensures to him/her the best utility if this utility is positive, otherwise he/she buys nothing.

The workers. In order to produce a higher quality product a worker needs to incur larger training costs and spend a larger part of his/her life to acquire skills, thus quality is not desirable from the viewpoint of workers. For simplicity sake, we assume that the worker’s effort equals the product quality.

Formally, a worker employed by Firm $i$ and perceiving the salary (and diverse advantages)
ω_i has the utility\(^1\):

\[ U_i(\alpha) = \omega_i - \alpha q_i, \]

where \( \alpha \) characterizes intrinsically the worker and is uniformly distributed over the segment \([0, \bar{\alpha}]\). A higher \( \alpha \) reflects a more sensitive worker to effort as he/she is more negatively affected by a given level of effort. Parameter \( \bar{\alpha} \) is assumed to be sufficiently high. A worker who does not work has utility: \( U_i = 0 \).

We assume that one unit of product requires one labor unit. Hence the demand for labor equals the product demand.

*The game.* Choices take place in the following game.

- In the first step, firms choose qualities (or equivalently the required efforts) \( q_i \) in some given interval \([q, \bar{q}]\).
- In the second step, firms choose their prices \( p_i \).
- Salaries adjust such that the offer balances the demand on the labor market.

### 2.2 The model with globalization

In the international version of the model, we consider two identical countries\(^2\) \((i = 1, 2)\). In each considered country, there are consumers and workers as described in the basic model.

In Autarky \((A)\), there is one firm in each country \((\text{Firm } i \text{ belongs to Country } i)\), selling locally one product and employing local workers. We consider three ways to open countries internationally.

1. **Goods’ Mobility \((GM)\):** each firm produces only in its own country and exports the

\(^1\)as de Fraja (1999)

\(^2\)This assumption could be warranted by the OECD’s report (2010) according to which intra-industry trade is likely to occur among countries having similar development levels and economic structures.
same quality at the same price to the other, but workers cannot move; i.e. there is competition on the product market but no competition on the labor market.

2. **Migration** ($M$): each firm is a monopoly in its own country on the product market, but workers have the possibility to move between countries; i.e. there is competition on the labor market but no competition on the product market.

3. **Foreign Investment** ($FI$): each firm is present in each country, producing and selling its product in each country. Both firms compete on the labor market of each country; i.e. there is competition on both labor and product markets. We assume that each firm sells the same quality at the same price in both countries.

### 3 Autarky

In each country, we consider a monopoly firm which locally produces and sells a product. Proposition 1 provides the equilibrium outcome in this case which will serve as a benchmark for the considered globalization scenarios. The proof is provided in Appendix A.

**Proposition 1** (Autarky). In autarky the monopoly chooses quality $q(A) = \bar{q}$, price $p(A) = \frac{3}{4} \bar{q}$ and salary $\omega(A) = \frac{\bar{q}}{4}$, making the profit $\pi(A) = \frac{\bar{q}^2}{8}$. The employment level is $L(A) = \frac{\bar{q}}{4}$.

Not surprisingly, we obtain the standard result in a model of vertical differentiated monopoly where the firm maximizes its quality at equilibrium.

The surpluses of different types of agents are provided in Result 5 in Appendix A.

### 4 Globalization

In this section we introduce globalization in three scenarios considering Goods’ Mobility, Migration and Foreign Investment and calculate for each the equilibrium outcome in terms of qualities, prices, salaries, profits and employment level. The surpluses in each globalization
scenario for consumers $S_C$, workers $S_L$, producers $S_P$ and social planners $SW$ are provided in Table 1 of Appendix B. All proofs are given in Appendix A.

4.1 Goods’ Mobility

In this scenario, each firm produces in its own country but commercializes its product in both countries offering the same quality at the same price in local and export markets. Workers are assumed not to move. Hence for each firm, there is a product demand in each country, but labor is offered only in its own one. Thus, demand for product (labor) is doubled for each firm but the labor supply remains the same as in Autarky. Proposition 2 provides the equilibrium outcome in this case. Corollary 1 compares Autarky and Goods’ Mobility outcomes.

**Proposition 2 (Goods’ Mobility).** At equilibrium of the Goods’ Mobility scenario (GM), Firm $i$ (from Country $i$, $i = 1, 2$) sells quality $q_i = q(GM) = \bar{q}$ in both countries at price $p_i = p(GM) = \frac{2}{3}\sqrt{\bar{q}}$ and pays in its country the wage $\omega_i = \omega(GM) = \frac{1}{3}\sqrt{\bar{q}}$, making the profit $\pi_i = \pi(GM) = \frac{1}{3}\bar{q}$.

The employment level in Country $i$ is given by: $L_i = L(GM) = \frac{1}{3}\bar{q}$.

In the Goods’ Mobility case, there is competition on the product market but no competition on the labor one. At equilibrium, firms do not differentiate their product both choosing the highest quality. This result is different from the one obtained with the standard vertical differentiation model (Anderson et al., 1992) where firms differentiate their product to soften competition.

This difference is necessarily due to the introduction of the labor market and could be explained by analyzing the effect of quality’s variation on the firms’ profits. Let us focus on the low quality firm. An increase in its quality rises on the one hand, the demand for the product (direct demand effect), but reduces on the other hand quality’s differentiation enhancing price competition. However, an increase in the demand for the product results in an increase in the labor demand which increases the salary for the considered firm (indirect cost effect) pushing upward its price level (indirect price effect). Hence, for the low quality firm, an increase in its
quality affects its profit, positively (enhancing the demand and price) and negatively (increasing the cost of production, i.e. the salary). It appears that the positive effects offset the negative ones discouraging the low quality firm from differentiating its product.

**Corollary 1.** *Comparison between Autarky and the Goods’ Mobility scenario for the global world, gives:*

- **For qualities, prices, employment and salaries:**

  \[ q(A) = q(GM), \ p(A) > p(GM), \ L(A) < L(GM), \ \omega(A) < \omega(GM). \]

- **For consumers, producers, workers and the social planner:**

  - \( S_C(A) < S_C(GM) \),
  - \( S_P(A) > S_P(GM) \),
  - \( S_L(A) < S_L(GM) \),
  - \( SW(A) < SW(GM) \).

Compared with Autarky, competition on the product market reduces prices and enhances the demand for product, thus increasing consumers’ satisfaction. As for workers, a higher demand for the product generates a higher demand for labor, hence higher salaries and employment levels. For producers, due to less competition, Autarky ensures higher profits than Goods’ Mobility. Considering all the interests, Goods’ Mobility provides a higher level of social welfare than Autarky.

This result is in line with Motta (1992) and Cabrales and Motta (2001). They prove that under country size asymmetry (in terms of population), both small and large countries gain from free trade and possible producers’ losses might be outweighed by consumers’ gains. But the authors focus on producers and consumers’ surpluses ignoring workers. Our results confirm Motta (1992) and Cabrales and Motta (2001) outcomes even if we take into account workers’ satisfaction in the total social welfare.

\[^{3}\text{Motta (1992) introducing in addition sunk costs, proves that losses may arise from liberalization.}\]
Using a model closer to ours, Bacchigga (2004) proves that losses might arise from trade liberalization equivalent to our Goods’ Mobility case. The author considers workers’ surplus in his welfare analysis but assumes asymmetries in human capital’s structure. Bacchigga (2004) distinguishes between skilled and unskilled workers and supposes that one country provides both unskilled and skilled workers while the other provides only skilled ones. In addition, the author assumes that unskilled workers are wage takers and that the wage for skilled workers is determined through a bargaining process between firms and the union. This turns out to be the key difference with our model. Indeed, losses from trade liberalization depend mainly on the degree of unionization and on the market expansion of the country which provides skilled workers.

4.2 Migration

We now assume that each firm is a monopoly on the product market in its own country, i.e. there is no competition on the product market. But workers may move between countries, which gives them the choice to work either in the local firm or abroad, thus there is competition on the labor market. As a consequence, the supply of labor is doubled whereas the demand for product remains the same compared to Autarky. The equilibrium outcome is given in Proposition 3.

Corollary 2 compares Migration and Autarky outcomes.

**Proposition 3 (Migration).** At the equilibrium of the Migration scenario (M), Firm i (from Country i, i = 1, 2) sells its quality \( q_i = q(M) = \bar{q} \) on the local market at price \( p_i = p(M) = \frac{4}{7} \bar{q} \) and pays the wage \( \omega_i = \omega(M) = \frac{2}{7} \bar{q} \), making the profit \( \pi_i = \pi(M) = \frac{6}{39} \bar{q}^2 \).

The level of employment in Country i is given by: \( L_i = L(M) = \frac{2}{7} \bar{q} \).

At equilibrium firms choose not to differentiate their products. Indeed, the absence of competition on the product market inhibits the incentive for firms to differentiate their qualities. In addition, competition on the labor market incites firms to increase their salaries pushing up their qualities, insofar as an increase in qualities has a positive effect on salaries.

**Corollary 2.** Comparison between Autarky and Migration for the global world gives:
– For qualities, prices, employment and salaries:

\[ q(A) = q(M), \ p(A) > p(M), \ L(A) < L(M), \ \omega(A) < \omega(M). \]

– For consumers, producers, workers and the social planner:

- \( S_C(A) < S_C(M) \),
- \( S_P(A) > S_P(M) \),
- \( S_L(A) < S_L(M) \),
- \( S_W(A) < S_W(M) \).

Under Migration, competition on the labor market enhances salaries and employment levels (demand for labor), which increases workers’ satisfaction. Moreover, a higher demand for labor generates a higher product’s offer, which reduces prices. Hence, consumers and workers are better off with Migration than Autarky but producers prefer Autarky to Migration. Despite profit’s deterioration, total surplus with Migration is higher than with Autarky (due to a better satisfaction of workers and consumers) as it is the case in Galor (1986) in the steady-state equilibrium case.

4.3 Foreign Investment

In this scenario, each firm produces and sells its product in each country. Workers are assumed to be unable to move between countries but have the choice to work either in the local firm or in the foreign one established in their country. Hence firms compete on the product market as duopolies and on the labor market as duopsonies. This scenario is strictly formally equivalent to a mixture of the two previous globalization scenarios: goods and workers’ mobility. Proposition 4 provides the equilibrium outcome for each country. Denote by \( q_i, \ p_i, \ \omega_i, \) and \( \pi_i \), respectively the quality, the price, the wage and the profit of Firm \( i \) \( (i = 1, 2) \) in both countries.

**Proposition 4 (Foreign Investment).** At equilibrium of the Foreign Investment scenario (FI), firms are asymmetric and the equilibrium outcome is given by:
<table>
<thead>
<tr>
<th></th>
<th>Firm i</th>
<th>Firm j</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Qualities</strong></td>
<td>$q_i(\text{FI}) = \frac{4}{7} \bar{q}$</td>
<td>$q_j(\text{FI}) = \bar{q}$</td>
</tr>
<tr>
<td><strong>Prices</strong></td>
<td>$p_i(\text{FI}) = \frac{9}{58} \bar{q}$</td>
<td>$p_j(\text{FI}) = \frac{5}{8} \bar{q}$</td>
</tr>
<tr>
<td><strong>Salaries</strong></td>
<td>$\omega_i(\text{FI}) = \frac{7\bar{q}}{4}$</td>
<td>$\omega_j(\text{FI}) = \frac{3\bar{q}}{8}$</td>
</tr>
<tr>
<td><strong>Profits</strong></td>
<td>$\pi_i(\text{FI}) = \frac{\bar{q}^2}{48}$</td>
<td>$\pi_j(\text{FI}) = \frac{7\bar{q}^2}{48}$</td>
</tr>
</tbody>
</table>

The mirror equilibrium also holds.\(^4\)

The employment level in each country is given by: $L(\text{FI}) = \frac{7}{16} \bar{q}$.

In the Foreign Investment case, there is competition on both labor and goods’ markets. For a given quality of the competitor, an increase of the lowest firm’s quality has a positive direct effect on demand and a negative direct one on prices (as competition is fiercer). As there is competition on the labor market, the increase of the firm’s quality has a positive direct effect on salaries, thus on firms’ costs, which pushes up prices. It appears that the direct negative effect on prices and the direct positive effect on salaries (costs) outweigh the other positive direct and indirect ones, discouraging the firm from increasing its quality, hence leading to differentiation.

We compare the Foreign Investment scenario and Autarky in Corollary 3.

**Corollary 3.** Comparison between Autarky and the Foreign Investment case for the global world, gives:

- For qualities: $q(\text{A}) > q_1(\text{FI})$ and $q(\text{A}) = q_2(\text{FI})$,
- For prices: $p(\text{A}) > p_1(\text{FI})$ and $p(\text{A}) > p_2(\text{FI})$,
- For employment and salaries: $L(\text{A}) < L(\text{FI})$ and $\omega(\text{A}) = \omega_1(\text{FI})$, $\omega(\text{A}) < \omega_2(\text{FI})$.
- For consumers, producers, workers and the social planner:
  - $S_C(\text{A}) < S_C(\text{FI})$,
  - $S_P(\text{A}) > S_P(\text{FI})$,
  - $S_L(\text{A}) < S_L(\text{FI})$.\(^4\)

\(^4\)In which Firms $i$ and $j$ play the reverse roles.
Compared with Autarky, competition is introduced in both labor and product markets. Competition on the product market reduces prices and increases the product’s demands increasing the labor demand, thus increasing salaries. Competition on the labor market increases salaries and employment, which enhances the product’s offer (one additional unit of labor produces one additional product unit) and reduces prices. Due to this double effect on prices and salaries, consumers and workers are clearly better off with Foreign Investment than Autarky. As for producers, the firm offering the highest quality improves its profit, while the other, offering the lowest quality at the lowest price, has a lower profit. The total profit is however lower with Foreign Investment relative to Autarky, the lowest quality firm losing more than is gained by the highest quality one. The loss in producers’ surplus is however compensated by the gain in workers and consumers’ surpluses and the social welfare is higher in the Foreign Investment case relative to Autarky. This is not in line with Cordella and Grilo (1998)’s results who prove that Foreign Investment is not welfare improving compared with Autarky.

5 General comparison

In this section we compare the studied scenarios, two by two, in terms of consumers’ satisfaction, workers’ surplus, global profit and total surplus. We classify various scenarios in Table 2 of Appendix B. Denote by $\bar{C}$ and $C$, respectively the no competition and competition cases. The first scenario corresponds to the autarkic situation ($A$) with no competition on both product and labor markets. Moving to the right, competition is introduced on the labor market and there is still no competition on the product market, which corresponds to Migration ($M$). Goods’ Mobility ($GM$) corresponds to competition on the product market with no competition on the labor one. Finally, Foreign Investment ($FI$) implies competition on both markets.

Comparison for workers, consumers, producers and the social planner are provided respectively in Results 1, 2, 3 and 4 followed by interpretations. The proofs stem simply from the

$SW(A) < SW(FI)$. 
comparison of the equilibrium values of each type of economic agent summarized in Table 1 of Appendix B.

**Result 1 (Workers).** *Comparing for workers, Autarky and the three globalization scenarii, we have:*

- for employment: \( L(FI) > L(GM) > L(M) > L(A) \).
- for workers’ surplus: \( S_L(GM) > S_L(FI) > S_L(M) > S_L(A) \).

Surprisingly, workers prefer Goods’ Mobility and Foreign Investment rather than Migration. This means that they prefer the mobility of goods and capital to their own one.

**Result 2 (Consumers).** *Comparing for consumers, Autarky and the three globalization scenarii, we have:*

\[
S_C(FI) > S_C(GM) > S_C(M) > S_C(A).
\]

Consumers prefer Foreign Investment to all other scenarii.

**Result 3 (Producers).** *Comparing for producers, Autarky and the three globalization situations, we have:*

\[
\]

Firms prefer Autarky to any form of globalization, what is natural as autarky avoids competition on both markets. Among the three considered globalization scenarii, firms prefer Goods’ Mobility and Migration to Foreign Investment, which mean that firms prefer the mobility of goods and workers to the mobility of capital.

**Result 4 (Social welfare).** *Comparing in terms of social welfare, Autarky and the three globalization scenarii, we have:*

\[
SW(GM) > SW(FI) > SW(M) > SW(A).
\]

Considering all various interests (consumers, workers, firms), Goods’ Mobility provides the highest social welfare level, before Foreign Investment, then Migration, Autarky being the
worst scenario in social terms. Thus, it appears that the preferences of governments for Foreign Investment and Goods’ Mobility, is theoretically founded.

As an obvious consequence, *if countries choose cooperatively whether to open to globalization and which globalization system among the three possible ones prior to the considered game, they would choose Goods’ Mobility.*

To interpret the obtained results, we suggest pair wise comparisons of the three globalization scenarii, using Table 2 of Appendix B which classifies them in terms of competition or not on each market, along with the resulting effects (direct and indirect) on elementary variables (qualities, prices, demands, salaries and employment).

Comparing Migration with Goods’ Mobility, consumers are better off with Goods’ Mobility, as competition on the product market reduces prices and enhances the demand for the product. As for workers, the indirect effect of competition on the product market on salaries and employment is higher than the effect of direct competition on the labor market. Hence workers prefer Goods’ Mobility to their own one. For producers, Migration ensures a greater profit, insofar as this scenario leads to higher prices and lower salaries than Goods’ Mobility. These effects on prices and salaries offset the demand decrease compared to Goods’ Mobility. Hence producers prefer Migration to Goods’ Mobility.

Moving from Migration to Foreign Investment amounts to add competition on the product market, which improves consumers’ satisfaction. Moreover, as we explained in previous sections, competition on the product market enhances salaries and employment, which improves workers’ surplus. As for producers, due to the introduction of competition on the product market resulting in lower prices, Foreign Investment procures a lower total profit than Migration. In fact, things are more subtle. Indeed, the highest quality firm makes in the Foreign Investment scenario a profit higher than the profit common to both firms under Migration but the lowest quality firm makes a lower profit. The introduction of competition on the product market increases demands and reduces prices, which increases employment and salaries (firms’ costs).
The overall effect is positive for the highest quality firm and negative for the lowest quality one.

Moving from the Goods’ Mobility scenario to the Foreign Investment one amounts to add competition on the labor market. Recall that there is no differentiation under Goods’ Mobility, while products are differentiated under Foreign Investment. As we already explained, competition on the labor market enhances directly employment and workers’ satisfaction and indirectly consumers’ satisfaction. Hence workers and consumers are better off with Foreign Investment than with Goods’ Mobility. However, producers realize globally higher profits under Goods’ mobility than Foreign Investment, salaries being higher in the latter case due to competition on the labor market.

6 Discussion and conclusion

We introduced and analyzed a new model linking vertical differentiation and the labor market in four cases: Autarky, Goods’ Mobility, Migration and Foreign Investment. Then we compared the four scenarii from the viewpoint of workers, consumers, producers and the social planner.

Interestingly, we prove that in the case of Goods’ Mobility, i.e. when firms compete on the product market with no competition on the labor one, they choose not to differentiate their product. However, when competition is introduced on the labor market, i.e. under Foreign Investment, firms choose to differentiate their products at equilibrium. Surprisingly, we prove that workers prefer Goods’ Mobility and Foreign Investment to their own mobility (Migration) and that producers prefer workers’ mobility (Migration) to capital mobility (Foreign Investment). Moreover, we prove that globalization is always welfare improving relative to Autarky and that among the three globalization’s scenarii, Migration ensures the lowest level of welfare. Hence the preference of governments for Goods’ Mobility and Foreign Investment rather than Migration, is theoretically founded.
In our paper, the globalization scenario is exogenous and the same in both countries. As we already explained, a cooperative choice by countries would lead to Goods’ Mobility. But what if the choice is non-cooperative? A simple way to deal with the issue is to introduce for each considered scenario, prior to the considered game, an additional non-cooperative step where each country has the choice to open trade barriers or not. Hence three games are considered (as much as the considered scenarios of globalization) and the question for each is to determine endogenously the countries’ choice when they can choose between one possible globalization strategy (say Goods’ Mobility) and Autarky. In a world where there are only two countries, the unilateral choice by only one firm to close its frontiers prevents globalization, leading to the same outcome as Autarky. To solve these suggested new games, we construct the payment matrix of the first step: a finite game between the two countries having each two possible strategies (open or not). We report the already calculated equilibrium total surpluses of the considered scenario (for instance Goods’ Mobility) as the payment of the countries in the symmetric case where both countries choose openness. In all the three remaining cases, we report the equilibrium surpluses in Autarky. A simple analysis shows that at equilibrium both countries choose openness in the Goods’ Mobility and Migration cases, and Autarky in the Foreign Investment one.

As a perspective, one may consider three identical countries. The difference in the first non-cooperative step is that a country may not unilaterally prevent globalization by simply closing its frontiers as in the case of two countries. The analysis is necessarily less simple but may lead to interesting less obvious results. For instance, it would be interesting to know whether we can have at equilibrium two open countries and a closed one.
Appendix A

Proof of Proposition 1

A worker is better off working when \( \omega - \alpha q > 0 \). Hence the segment of employed workers is given by \([0, \frac{\omega}{q}]\). The level of employment is then given by: \( \frac{\omega}{q} \). A consumer buys a unit of the product when his/her utility is strictly positive which leads to the product demand \( \bar{\theta} - \frac{p}{q} \). This demand equals the demand for labor as we suppose constant returns to scale. The salary that balances the demand and offer for labor must satisfy:

\[
\frac{\omega}{q} = \bar{\theta} - \frac{p}{q}.
\]

Thus \( \omega = \bar{\theta}q - p \).

The profit then writes:

\[
\pi = (p - \omega)(\bar{\theta} - \frac{p}{q}) = (2p - \bar{\theta}q)(\bar{\theta} - \frac{p}{q}).
\]

First order condition w.r.t. \( p \) gives \( p = \frac{3}{4}\bar{\theta}q \). Integrating the expression of \( p \) in the profit gives the profit \( \pi = \frac{5}{8}\bar{\theta}q \), which is increasing with \( q \). Hence the monopoly chooses \( q = \bar{q} \). \( \square \)

Result 5. In Autarky, workers and consumers surpluses and social welfare are given by:

- The workers’ surplus: \( S_L(A) = \frac{5}{16}\bar{\theta}q \),
- The consumers’ surplus: \( S_C(A) = \frac{5}{16}\bar{\theta}q \),
- The social welfare: \( SW(A) = \frac{5}{16}\bar{\theta}q \).

Proof of Result 5

The workers’ surplus and consumers’ surplus are given respectively by:

\[
S_L(A) = \int_{0}^{\frac{\omega(A)}{\pi q}} \left[ \omega(A) - \alpha q(A) \right] d\alpha
\]

20
\[ S_C(A) = \int_{p(A)}^{\theta} [\theta q(A) - p(A)] d\theta \]

We substitute the value of \( q(A) \), \( p(A) \) and \( \omega(A) \) given in Proposition 1 in the expression of \( S_L(A) \) and \( S_C(A) \). The social welfare \( SW(A) \) is computed as the sum of \( S_L(A) \), \( S_C(A) \) and the profit \( \pi(A) \) (given in Proposition 1).

\[ \square \]

Proof of Proposition 2

Salaries balancing the offer and demand for labor must satisfy:

\[
\begin{cases}
\frac{\omega_1}{q_1} = 2\left(\frac{p_2 - p_1}{q_2 - q_1} - \frac{p_1}{q_1}\right), \\
\frac{\omega_2}{q_2} = 2(\bar{\theta} - \frac{p_2 - p_1}{q_2 - q_1}),
\end{cases}
\]

which is equivalent to:

\[
\begin{cases}
\omega_1 = \frac{2q_1 p_2}{q_2 - q_1} - \frac{2q_2}{q_2 - q_1} p_1, \\
\omega_2 = 2q_2 \bar{\theta} - 2q_2 \frac{p_2 - p_1}{q_2 - q_1}.
\end{cases}
\]

Profits are then given by:

\[
\begin{align*}
\pi_1 &= 2(p_1 - \omega_1)\left(\frac{p_2 - p_1}{q_2 - q_1} - \frac{p_1}{q_1}\right) = 2\left(\frac{3q_2 - q_1}{q_2 - q_1} p_1 - \frac{2q_1 p_2}{q_2 - q_1} \frac{p_2 - p_1}{q_2 - q_1}\right), \\
\pi_2 &= 2(p_2 - \omega_2)\left(\bar{\theta} - \frac{p_2 - p_1}{q_2 - q_1}\right) = 2\left(\frac{3q_2 - q_1}{q_2 - q_1} p_2 - \frac{2q_2 p_1}{q_2 - q_1} - 2q_2 \bar{\theta} \frac{p_2 - p_1}{q_2 - q_1}\right).
\end{align*}
\]

Each firm maximizes its profit relative to its own price.

Hence the best response of Firm 1 is given by:

\[
p_1(p_2) = \frac{q_1(5q_2 - q_1)p_2}{2(3q_2 - q_1)q_2}.
\]

Similarly, the best response of Firm 2 is given by:

\[
p_2(p_1) = \frac{(5q_2 - q_1)(p_1 + (q_2 - q_1)\bar{\theta})}{2(3q_2 - q_1)}.
\]
The price equilibrium is then given by:

\[
\begin{align*}
\frac{p_1}{q_1} &= \frac{q_1 (5q_2 - q_1)^2}{(9q_2 - q_1)(4q_2 - q_1)}, \\
\frac{p_2}{q_2} &= \frac{2q_2 (5q_2 - q_1)(3q_2 - q_1)}{(9q_2 - q_1)(4q_2 - q_1)},
\end{align*}
\]

yielding the equilibrium profits:

\[
\begin{align*}
\pi_1 &= \frac{2q_1 q_2 (5q_2 - q_1)^2 (3q_2 - q_1)}{(9q_2 - q_1)(4q_2 - q_1)^2}, \\
\pi_2 &= \frac{8q_2^2 (3q_2 - q_1)^3}{(9q_2 - q_1)(4q_2 - q_1)^2}.
\end{align*}
\]

The profit for each firm \(i\) at price equilibrium is given by:

\[
\pi_i = \begin{cases} 
2q_i q_j (5q_j - q_i)^2 (3q_j - q_i) \\
8q_i^2 (3q_j - q_i)^3 
\end{cases} \frac{1}{(9q_j - q_i)(4q_j - q_i)^2},
\]

if \(q_i \leq q_j\),

\[
\pi_i = \begin{cases} 
2q_i q_j (5q_j - q_i)^2 (3q_j - q_i) \\
8q_i^2 (3q_j - q_i)^3 
\end{cases} \frac{1}{(9q_j - q_i)(4q_j - q_i)^2},
\]

if \(q_i > q_j\).

We calculate equilibrium qualities by maximizing \(\pi_i\) w.r.t \(q_i\). Profit \(\pi_i\) is a piecewise function continuously increasing in \(q_i\). Thus, at equilibrium both firms choose \(q_i = \bar{q}\).

\[\square\]

**Proof of Proposition 3**

Salaries that balance the offer and demand for labor satisfy the following system:

\[
\begin{align*}
\bar{\theta} - \frac{p_2}{q_2} &= 2\frac{\omega_2 - \omega_1}{q_2 - q_1}, \\
\bar{\theta} - \frac{p_1}{q_1} &= 2\left(\frac{\omega_1}{q_1} - \frac{\omega_2 - \omega_1}{q_2 - q_1}\right),
\end{align*}
\]

which is equivalent to

\[
\begin{align*}
\omega_1 &= \bar{\theta} q_1 - p_1/2 - \frac{q_1}{2q_2} p_2, \\
\omega_2 &= \frac{(q_1 + q_2)}{2} - p_1/2 - p_2/2.
\end{align*}
\]

Replacing salaries by their preceding expressions in the profits: \(\pi_i = (p_i - \omega_i)(\bar{\theta} - \frac{p_i}{q_i})\), then writing first order conditions w.r.t. prices leads to the equilibrium price:

\[22\]
\begin{align*}
 p_1 &= \frac{\theta (26q_2 - q_1)q_1}{36q_2 - q_1}, \\
 p_2 &= \frac{\theta (24q_2 + q_1)q_2}{36q_2 - q_1}.
\end{align*}

Profits at price equilibrium are given by:
\begin{align*}
 \pi_1 &= 150 \frac{\theta^2 q_1 q_2^2}{(36q_2 - q_1)^2}, \\
 \pi_2 &= 6 \frac{\theta^2 q_2 (6q_2 - q_1)^2}{(36q_2 - q_1)^2}.
\end{align*}

For the quality step, we prove that each profit \( \pi_i \) is increasing in \( q_i \), thus, both firms choose at equilibrium, quality \( \bar{q} \).

\[ \square \]

**Proof of Proposition 4**

In each country, each worker has the choice between 3 options: Firm 1, Firm 2 or unemployment. The marginal worker between the two firms is given by:

\[ \alpha_{1,2} = \frac{\omega_2 - \omega_1}{q_2 - q_1}. \]

The marginal worker indifferent between working in Firm 1 and unemployment is given by:

\[ \alpha_1 = \frac{\omega_1}{q_1}. \]

If both firms are active, we have necessarily:

\[ 0 < \alpha_{1,2} < \alpha_1 < \bar{\alpha}. \]

The demands for labor are respectively given by:

\[ D_1 = \alpha_1 - \alpha_{1,2}, \]
and

\[ D_2 = \alpha_{1,2}. \]

Salaries that balance the demand and offer of labor must then satisfy:

\[
\begin{align*}
\frac{p_2-p_1}{q_2-q_1} - \frac{p_1}{q_1} &= \frac{\omega_1}{q_1} - \frac{\omega_2}{q_2-q_1}, \\
\bar{\theta} - \frac{p_2-p_1}{q_2-q_1} &= \frac{\omega_2}{q_2-q_1},
\end{align*}
\]

which is equivalent to:

\[
\begin{align*}
\omega_1 &= \bar{\theta}q_1 - p_1, \\
\omega_2 &= \bar{\theta}q_2 - p_2.
\end{align*}
\]

Profits are given by:

\[
\begin{align*}
\pi_1 &= 2(p_1 - \omega_1)(\frac{p_2-p_1}{q_2-q_1} - \frac{p_1}{q_1}), \\
\pi_2 &= 2(p_2 - \omega_2)(\bar{\theta} - \frac{p_2-p_1}{q_2-q_1}).
\end{align*}
\]

Factor 2 in profits’ expressions comes from the fact that each firm is present in two identical markets. First order conditions yield after calculations the equilibrium prices:

\[
\begin{align*}
p_1 &= \frac{\bar{\theta}q_1(5q_1-2q_2)}{8q_2-2q_1}, \\
p_2 &= \frac{3\bar{\theta}q_2(2q_2-q_1)}{8q_2-2q_1}.
\end{align*}
\]

Hence salaries at price equilibrium are given by:

\[
\begin{align*}
\omega_1 &= \frac{3\bar{\theta}q_1q_2}{8q_2-2q_1}, \\
\omega_2 &= \frac{\bar{\theta}q_2(2q_2+q_1)}{8q_2-2q_1}.
\end{align*}
\]

Profits at price equilibrium are then given by:

\[
\begin{align*}
\pi_1 &= \frac{3\bar{\theta}q_1q_2(q_2-q_1)}{2(4q_2-q_1)^2}, \\
\pi_2 &= \frac{3\bar{\theta}q_2(q_2-q_1)}{(4q_2-q_1)^2}.
\end{align*}
\]

For the quality step, we prove that \( \frac{\partial \pi_1}{\partial q_1} \) has the same sign as \( 4q_2^2 - 7q_1q_2 \), which implies that \( \pi_1 \) reaches its maximal value at \( q_1 = \frac{4}{7}q_2 \); and that \( \frac{\partial \pi_2}{\partial q_2} \) is always increasing in \( q_2 \), thus is maximal at \( q_2 = \bar{q} \).
Proof of Corollary 1

For the global world, the workers and consumers’ surpluses are given respectively by:

\[ S_L(GM) = \sum_{i=1}^{2} \int_0^{\omega_i(GM)} [\omega_i(GM) - \alpha q_i(GM)] d\alpha \]

\[ S_C(GM) = 2\int_{\frac{p_2(GM)-p_1(GM)}{q_2(GM)-q_1(GM)}}^{\frac{p_2(GM)-p_1(GM)}{q_2(GM)-q_1(GM)}} [\theta q_1(GM) - p_1(GM)] d\theta + \int_{\frac{p_2(GM)-p_1(GM)}{q_2(GM)-q_1(GM)}}^{\int_{\frac{p_2(GM)-p_1(GM)}{q_2(GM)-q_1(GM)}}} [\theta q_2(GM) - p_2(GM)] d\theta \]

At equilibrium, we substitute the value of \( q_i(GM) \), \( p_i(GM) \) and \( \omega_i(GM) \) given in Proposition 2 in \( S_L(GM) \) and \( S_C(GM) \). The social welfare for the global world \( SW(GM) \) is computed as the sum of \( S_L(GM), S_C(GM) \) and the global profit \( \sum_{i=1}^{2} \pi_i(GM) \) where \( \pi_i(GM) \) is the Firm \( i \)'s equilibrium profit given in Proposition 2. We compare for the global world the equilibrium outcome of Autarky and Goods’ Mobility, all values are given in Table 1.

Proof of Corollary 2

For the global world, the workers and consumers’ surpluses are given respectively by:

\[ S_L(M) = 2\int_0^{\frac{\omega_2(M)-\omega_1(M)}{q_2(M)-q_1(M)}} [\omega_2(M) - \alpha q_2(M)] d\alpha + \int_{\frac{\omega_2(M)-\omega_1(M)}{q_2(M)-q_1(M)}}^{\omega_1(M)} [\omega_1(M) - \alpha q_1(M)] d\alpha \]

\[ S_C(M) = \sum_{i=1}^{2} \int_{\frac{p_2(M)-p_1(M)}{q_2(M)-q_1(M)}}^{\frac{p_2(M)-p_1(M)}{q_2(M)-q_1(M)}} [\theta q_i(M) - p_i(M)] d\theta \]

At equilibrium, we substitute the value of \( q_i(M) \), \( p_i(M) \) and \( \omega_i(M) \) given in Proposition 3 in \( S_L(M) \) and \( S_C(M) \). Hence The social welfare for the global world is \( SW(M) = S_L(M) + S_C(M) + \sum_{i=1}^{2} \pi_i(M) \), where \( \pi_i(M) \) is the equilibrium profit of Firm \( i \) given in Proposition 3. We compare for the global world the equilibrium outcome of Autarky and Migration, all values are given in Table 1.
Proof of Corollary 4

For the global world, the workers and consumers’ surpluses are given respectively by:

\[
S_L(FI) = 2\left( \int_0^{\omega_2(FI)-\omega_1(FI)} [\omega_2(FI) - \alpha q_2(FI)]d\alpha + \int_{\omega_2(FI)-\omega_1(FI)}^{\omega_1(FI)} [\omega_1(FI) - \alpha q_1(FI)]d\alpha \right)
\]

\[
S_C(FI) = 2\left( \int_{\omega_2(FI)-\omega_1(FI)}^0 [\theta q_1(FI) - p_1(FI)]d\theta + \int_{\omega_2(FI)-\omega_1(FI)}^{\bar{\theta}} [\theta q_2(FI) - p_2(FI)]d\theta \right)
\]

At equilibrium, we substitute the value of \( q_i(FI) \), \( p_i(FI) \) and \( \omega_i(FI) \) given in Proposition 4 in \( S_L(FI) \) and \( S_C(FI) \). The social welfare for the global world is \( SW(FI) = S_L(FI) + S_C(FI) + \sum_{i=1}^2 \pi_i(FI) \), where \( \pi_i \) is the equilibrium of Firm \( i \) given in Proposition 4. We compare for the global world the equilibrium outcome of Autarky and Foreign investment, all values are given in Table 1.

□
Table 1: Equilibrium for the global world in the four globalization scenarios

Note: In the autarkic case we compute for the global world the consumers, workers, producers and social planners’ surpluses by multiplying by two the equilibrium values given in Result 5.
Table 2: Classification of the globalization scenarios in terms of competition on the product and labor markets.

<table>
<thead>
<tr>
<th>Product market</th>
<th>Č</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Č</td>
<td>A</td>
<td>M</td>
</tr>
<tr>
<td>C</td>
<td>GM</td>
<td>FI</td>
</tr>
</tbody>
</table>

Č: no competition.
C: competition.
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References


