Heterogeneous agrifood firms, agricultural prices and access to foreign markets.

Léo Le Mener

INRA-LERECO – UR1134, Rue de la Géraudière, BP 71627, 44316 Nantes Cedex 3, France

Abstract

We analyze how a change of input (agricultural) price impacts the selection process and market shares in foreign markets for firms in the final good (agrifood) sector. To do so we developp a model with heterogeneous firms and intermediate good where input use is technologically constraint. We show that the effect of input price is dependant on labor productivity level and fixed cost and lead to a reallocation process among firms in final good sector. Moreover, we show that a decrease of input price in all countries can decrease the probability to enter foreign markets, through export or HFDI. Finally, we show that the decrease of the intermediate good price always increases the share of HFDI relative to export, even if it can modify the HFDI-Export trade-off in favor of HFDI or in favor to export.

Key words: Horizontal Foreign Direct Investment, exports, firm heterogeneity, processing sectors, agricultural prices.

JEL classification: F12 ; L11.

1. Introduction

Over the last two decades, the growth of multinational enterprise activity in the form of foreign direct investment has grown at a faster rate than trade flows between countries (see UNCTAD 2002). This trend has several implications for policy makers as the local economy is affected in various ways by outgoing and incoming FDI (employment, economic growth, etc.). These facts explain the increasing interest of the international economics literature in explaining the fundamental factors that drive FDI behavior (Blonigen 2005, Helpman 2006). It appears that an analysis of the determinants of FDI should not be based on a single theoretical model but on a combination of factors from a variety of theoretical models such as ownership advantages or agglomeration economics, market size and characteristics, the cost of production factors, transport costs, protection, risk factors and policy variables.

Theoretical models that analyze factors that determine whether a firm becomes a multinational firm fall into two main groups[1]. The first group deals with the vertical fragmentation

[1] See Markusen (2004), Barba Navaretti and Venables (2004), Blonigen (2005) and Helpman (2006) for surveys of this literature.

of the production process, and focuses on the sourcing strategy of firms. This approach is based on comparative advantages and intangible assets, or on the theory of incomplete contracts, and mainly explains outsourcing and vertical FDI strategies. The second group deals with the choice to serve foreign markets, and is based on the proximity-concentration or horizontal model (Markusen 1984, Horstmann and Markusen 1987 and 1992, Brainard 1993, Markusen and Venables 1998 and 2000). This literature explains why some firms choose to export while others invest abroad to serve foreign markets.

The proximity-concentration model considers multi-plant firms that produce the same good in different countries to serve local markets. Firms choose between producing at home and exporting to a foreign market with variable trade costs (custom tariff, transport costs, etc.), and producing abroad with additional fixed costs of setting up a plant in the host country but with a lower variable cost to serve the market.

In proximity-concentration models, the cost of intermediate goods affects the strategy of firms if prices differ between the home country and the destination market. Different input prices affect the trade-off between producing at home and investing abroad in favor of locating production in the country where intermediate goods are less expensive. Indeed, it seems obvious that, as the choice of setting up an affiliate abroad is driven by a reduction of variable costs, firms are more likely to make horizontal FDI in countries where intermediate goods are less expensive.

However, while intermediate good costs are a major determinant of vertical FDI (Zhang and Markusen 1999 and Markusen and Maskus 2002), the impact of these costs on horizontal FDI (HFDI) has not received much attention. To our knowledge, no study has investigated the impact of these costs when countries are perfectly symmetric. In Chevassus-Lozza, Gaigné and Le Mener, 2013 (hereafter CGL), we showed that the price of intermediate goods affects the structures of firms' export market shares. In this paper, we argue that the same mechanism may influence FDI sales. Thus, due to firm heterogeneity, the trade-off between export and HFDI may be affected by input prices even if the countries remain perfectly symmetric.

In Melitz's (2003) model, less productive firms remain on domestic markets while more productive firms produce more and thus are able to pay fixed export costs to access foreign markets. Helpman, Melitz and Yeaple (2004) (hereafter HMY) extended the proximity-concentration models of Brainard (1993, 1997) by introducing firm heterogeneity according to Melitz in order to include the decision to set up an overseas affiliate. They built a proximity-concentration theoretical model with heterogeneous firms, and tested their predictions econometrically. They found that, compared to foreign affiliates sales, export sales are negatively impacted by the heterogeneity of the domestic sector. In other words, the higher the heterogeneity of firms, or the higher the elasticity of substitution, the more FDI sales there will be compared to export sales. They validated their theoretical predictions with firm level data. This result highlights a new determinant of HFDI. However, this result is not very useful for policy makers as it is difficult to influence total factor productivity distribution and elasticity of substitution.

In models with heterogeneous firms, the only production factor is labor. In order to go further in the analysis, some authors include other production factors to account for comparative advantages or for differences in factor endowment (Bernard 2007). To investigate the effect of input characteristics, some models use an intermediate good as the second factor of production. However, both theoretical models and empirical studies (Amiti and Konings 2007 or Halpern et al. 2009) always assume that either the elasticity of substitution between production factors is equal to one (Cobb-Douglas production function), or that heterogeneity applies to the whole marginal cost, so that more productive firms are more efficient with respect to both production factors. Thus, in these models, a fall in prices of one of the production factor affects all firms without affecting the share of final demand across varieties.

As in the CGL, we assume that production factors are not substitutes, and that the heterogeneity applies only to labor use while the use of the intermediate good is homogeneous across firms. Under this assumption, firms react differently to a change in the price of the intermediate good or in the cost of labor, leading to a change in relative prices and to a reallocation of market shares.

Consequently, depending on the relative prices of production factors, some firms are able (or not) to access foreign markets while others serve them through exports or HFDI. In this paper, we show that production heterogeneity also depends on the price of the intermediate good and on wages in the final good sector. Consequently, as in HMY (2004), more heterogeneity leads to a higher share of FDI compared to exports.

These results may be useful for policy makers since, although they are not able to modify the distribution of labor productivity, they can affect production factor prices through several policies. For example, policy makers can subsidize final sector firms in order to reduce wages or the cost of intermediate goods.

In this paper, we investigate the effect of such subsidies on the export performance of national firms and FDI. We show that both subsidies on intermediate goods and on wages support total exports, reduce outgoing FDI and attract incoming FDI. However, reducing the cost of intermediate goods leads to reallocation of market shares from less productive national firms to more productive affiliates of foreign firms, and decreasing wages leads to reallocation from more productive firms to less productive ones.

For this investigation, we extend the Helpman Melitz and Yeaple (2004) model with heterogeneous firms by introducing an upstream sector. As in CGL (2013), the linkage between the final good sector and the intermediate good sector is made via a fixed proportion technology, thus, whatever the level of final good production, firms need a constant fraction of the intermediate good to produce one unit of the final good.

In the first part, we build the model and give some results in open economy where firms can access foreign markets through exports or HFDI. We show that the reallocation process that results from a simultaneous and identical change in the intermediate good price in both countries is highly dependent on fixed costs. In the second part, we analyze the impacts of subsidies depending if they are on labor or on the intermediate good and give some policy recommendations. The last part concludes.

2. Set-up of the model

This model is based on CGL (2013) and on HMY (2004) models. We consider a world with two vertically related sectors. The intermediate sector uses labor to produce a homogeneous good, and the final sector uses labor and the intermediate good to produce a differentiated good in monopolistic competition. The intermediate good is used entirely by the final sector, so the representative consumer only consumes the final good.

The quantity of intermediate good used to produce one unit of final good is exogenously determined by the nature of the good and the final sector activity, so there is a technological constraint on the composition of the final good. For a given sector, all firms use the same quantity of homogeneous good to produce one unit of differentiated good. As in Melitz (2003) and HMY (2004), firms in the final sector are heterogeneous in their labor productivity. In other words, the quantity of labor used by a firm to produce one unit of final good depends on its labor productivity which differs among firms.

To ensure full employment, the amount of labor available in the economy is given inelastically at its aggregate level by the size of the country, and is used by the two sectors. For the sake of simplicity and without loss of generality, here we assume that the number of domestic firms is exogenous and is the same in both countries.

In this paper, the world is assumed to be composed of two symmetric countries, namely the home country h and the foreign country f. To simplify the presentation, we focus on the results of firms in country h, keeping in mind that the results are exactly the same for firms in country f.

The assumption of symmetric countries ensures that wages and the price of the intermediate good are the same in each country, and that the consumption of this intermediate good by firms in the final sector is also the same. Thus, for a given level of labor productivity, production costs are the same in the two countries. Assuming that input trade costs are strictly positive and that the intermediate good is homogeneous, there is no international trade in this sector. Thus, firms use locally produced intermediate goods.

Firms in the final good sector can choose to sell part of their output in foreign countries via exports. To do so, firms pay a fixed cost, f_{ex}, which represents the adaptation costs to international markets (distribution and servicing network) and an iceberg transport cost $\tau > 1$.

We assume that firms are indifferent between paying the export cost f_{ex} and paying the amortized per period portion of this cost $f_x = \delta f_{ex}$ in each period.

Alternatively, firms can serve foreign markets by creating an affiliate abroad. To do so, they must pay a fixed cost f_I. As in HMY (2004), this fixed cost includes the adaptation costs to foreign markets (distribution and servicing network) like for f_x, as well as the cost of creating or acquiring an affiliate overseas, so $f_I > f_x$.

The location of production does not affect the characteristics of the varieties or the productivity of the firms. Each firm still produces only one variety, regardless of which country the variety is produced in. As multinational firms produce the same variety in each of their plants, there is no intra-firm trade and these varieties are provided by local plants only. Thus, a firm remains on its domestic market and does not serve foreign markets, or it exports, or it sets up an affiliate abroad. Thus, while all firms produce for their domestic market, domestic firms only sell in the home country and do not access the foreign market; exporting firms produce in the home country and sell part of their production abroad; multinational firms serve both the country with a local plant: domestic production is sold on the domestic market, and the production of the foreign affiliate is sold in the foreign country.

2.1. Demand

The preferences of a representative consumer are given by a C.E.S. utility function over a continuum of goods indexed by ω:

$$U = \left[\int_{\omega \in \Omega} y(\omega)^{\rho} d\omega \right]^{1/\rho} \tag{1}$$

This utility function only depends on final good consumption and Ω represents the set of available varieties. Varieties are substitutes; this implies that $0 < \rho < 1$, and the elasticity of substitution between any two varieties is given by $\sigma = \frac{1}{1-\rho} > 1$. As in the Dixit-Stiglitz model, we can consider the set of varieties consumed as an aggregated good $Y \equiv U$ associated with an aggregated price P.

Optimization of consumer preferences leads to the optimal consumption of each variety ω: $y(\omega) = \frac{p(\omega)^{-\sigma}}{\int p(\omega)^{1-\sigma} d\omega} R$, which can be written with the aggregated price index $P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$

$$y(\omega) = Y \left(\frac{p(\omega)}{P} \right)^{-\sigma} \tag{2}$$

The expenditure for each variety is given by

$$r(\omega) = R \left(\frac{p(\omega)}{P} \right)^{1-\sigma} \tag{3}$$

where R is aggregate expenditure. These results are standard in monopolistic competition.

2.2. Production

2.2.1. Intermediate good sector

The intermediate good sector is perfectly competitive. Firms produce a homogeneous good by using a single input, labor, and its entire production will be processed to produce the final good.

Let A be the quantity of intermediate good produced, which is a function of the labor used by the representative firm L_A and of z which is the labor needed to produce one unit of intermediate good. w is the common wage of the economy.

The profit function of a representative firm is given by

$$\pi_A = zA - wL_A \tag{4}$$

In perfect competition, the representative firm will sell its production at its marginal cost, so by normalizing the common wage to 1 we have the price of the intermediate good $p_A = z$

2.2.2. Final good sector

There is a continuum of firms, each choosing to produce a different variety ω. The production of variety ω requires two inputs, labor l_ω and intermediate goods a_ω.

The focus of this model is on sectors closely related to their intermediate goods, so, as in CGL (2013), we assume that inputs are complementary. However, the main mechanisms hold as long as the elasticity of substitution between inputs is less than 1 (see CGL for a discussion of this hypothese).

We also assume that each unit of final good produced in a given sector requires the same amount of intermediate good (α), so there is a technological constraint on the production of the final good. Each firm uses α units of the intermediate good and $1/\varphi$ units of labor to produce one unit of final good. Nevertheless, a firm can be more efficient, than others and use a less labor-intensive technology to produce its variety. So, like in Melitz (2003), the marginal productivity of labor φ differs across firms. Hence, each firm produces its own variety (ω), and each firm varies with respect to its labor productivity φ. As for a given φ we have one ω, we can refer to a firm either by its variety (ω), or by its labor productivity (φ). Indeed, even if a firm decides to set up an affiliate abroad, this multinational firm will produce the same variety in the affiliate as at its headquarters, and will use the same amount of labor to produce one unit of the variety.

For a firm in the final good sector, the total cost function to serve a market will differ according to the modality to access it:

- on the domestic market, this is given by

$$TC_d(\varphi) = \left(z\alpha + \frac{1}{\varphi}\right) y_d(\varphi) \tag{5}$$

- to serve the foreign market through export, the cost function is given by

$$TC_x(\varphi) = \tau\left(z\alpha + \frac{1}{\varphi}\right) y_x(\varphi) + \mathrm{f}_x \tag{6}$$

- and to serve it by FDI:

$$TC_I(\varphi) = \left(z\alpha + \frac{1}{\varphi}\right) y_I(\varphi) + \mathrm{f}_I \tag{7}$$

where z is the price of the intermediate good, α is the amount of intermediate good needed to produce one unit of final good, φ is the labor productivity of the firm, and $y_d(\varphi)$ is its production destined for the domestic market.

Under monopolistic competition, each firm faces a residual demand curve with constant elasticity σ. Thus, whatever the market, a firm sells its production with a markup $\frac{1}{\rho}$ over its marginal cost and the pricing rules in each market become:

$$\begin{array}{ll} p_d = \frac{1}{\rho} MC_d = \frac{1}{\rho}(z\alpha + 1/\varphi) & \text{For varieties produced by domestic firms} \\ p_x = \frac{1}{\rho} MC_x = \frac{1}{\rho}(z\alpha + 1/\varphi)\,\tau & \text{For imported varieties} \\ p_I = \frac{1}{\rho} MC_I = \frac{1}{\rho}(z\alpha + 1/\varphi) & \text{For varieties produced by affiliates of} \\ & \text{foreign firms} \end{array} \tag{8}$$

We observe that when a firm invests abroad, the pricing rule for the domestic market and for the foreign market is the same ($p_I(\varphi) = p_d(\varphi)$). In other words, on a given market, the price depends on the location of production, but not on the nationality of the firm. Thus, as the price of a good produced at the firm's headquarter and at its affiliates is the same, and as countries are symmetric, the level of production and revenues are also the same for the headquarter and its affiliates: $y_d(\varphi) = y_I(\varphi)$ and $r_d(\varphi) = r_I(\varphi)$.

The price elasticity to a change in the intermediate product price is the same for each market and is given by:

$$\varepsilon_{p(\varphi),z} \equiv \frac{\partial p(\varphi)}{\partial z}\frac{z}{p(\varphi)} = \frac{z\alpha}{z\alpha + 1/\varphi} \tag{9}$$

where $\mathrm{d}\varepsilon_{p(\varphi),z}/\mathrm{d}z$ increases with φ. Thus, high productivity firms react more to a change in intermediate good prices than low productivity firms because the share of the cost of intermediate goods in total production costs is higher for high productivity firms. Thus, a change in intermediate product price leads to a change in relative prices in the final good sector.

Revenue levels The firm revenue can be broken down into what it earns on each market: namely domestic sales and export sales or affiliate sales if the firm is able to access the foreign market.

The combined revenue of a firm $r(\varphi)$, depends on its status.

$$r(\varphi)=\begin{cases}\text{For domestic firms} & r_d(\varphi)\\ \text{For exporting firms} & r_d(\varphi)+r_x(\varphi)=\left(1+\tau^{1-\sigma}\right)r_d(\varphi)\\ \text{For multinational firms} & r_d(\varphi)+r_I(\varphi)=2r_d(\varphi)\end{cases} \tag{10}$$

The ratios of any two firms' outputs or revenues associated with each market are the same for each status[2] and can be written as a function of their labor productivity only

$$\begin{aligned}\frac{y_d(\varphi_1)}{y_d(\varphi_2)} &= \frac{y_x(\varphi_1)}{y_x(\varphi_2)}=\frac{y_I(\varphi_1)}{y_I(\varphi_2)}=\left[\frac{\varphi_1}{\varphi_2}\frac{(1+z\alpha\varphi_2)}{(1+z\alpha\varphi_1)}\right]^{\sigma}\\ \frac{r_d(\varphi_1)}{r_d(\varphi_2)} &= \frac{r_x(\varphi_1)}{r_x(\varphi_2)}=\frac{r_I(\varphi_1)}{r_i(\varphi_2)}=\left[\frac{\varphi_1}{\varphi_2}\frac{(1+z\alpha\varphi_2)}{(1+z\alpha\varphi_1)}\right]^{\sigma-1}\end{aligned} \tag{11}$$

Output and revenue ratios depend not only on labor productivity but also on the price of the intermediate good and its use in production process. Greater use of the intermediate good to produce the final good or a higher price of the intermediate good reduces these ratios. In other words,

Proposition 1 *The use of an intermediate good at a fixed proportion reduces the advantage of more productive firms.*

Proposition 2 *A fall in prices of an intermediate good increases the differences between firms in terms of production and revenues.*

Thus, the price of intermediate goods affects the impact of heterogeneous labor productivity. The lower the price of the intermediate good, the greater the heterogeneity of output, revenue and profit.

2.2.3. Effect of intermediate good price on revenues and profits.

The impact of z on $r(\varphi)$ at a given labor productivity (or for a given firm) is not obvious. Input price affects not only the variety price but also price indexes. Let φ_ω be the labor productivity of the firm producing the variety ω. According to the calculations in Appendix A, the effect of the price of the intermediate good on the domestic revenue of this firm is given by

$$\frac{\partial r_d(\varphi_\omega)}{\partial z}=(\sigma-1)\frac{r_d(\varphi_\omega)}{z}\left(\frac{\partial P}{\partial z}\frac{z}{P}-\frac{\partial p(\varphi_\omega)}{\partial z}\frac{z}{p(\varphi_\omega)}\right) \tag{12}$$

or, equivalently,

$$\varepsilon_{r_d(\varphi),z}=(\sigma-1)\left(\varepsilon_{P,z}-\varepsilon_{p(\varphi),z}\right) \tag{13}$$

where $\varepsilon_{r_d,z}$ and $\varepsilon_{P,z}$ are the elasticities of the domestic revenue and price index to input price, respectively. In other words, the effect of input price on domestic revenue can be positive or

[2] Because firms are either only domestic firms, or exporters, or multinational, these ratios do not represent effective output and revenues but potential ones.

negative depending on the gap between the elasticity of the price index and that of the variety price. If the fall in the variety price is greater than the fall in the price index, the variety ω will be relatively more competitive, and the firm φ_ω will increase its market share. Conversely, if the fall in price index is greater, then the variety ω will become relatively less competitive and market share of the firm φ_ω will shrink with a fall in input price.

It will be recalled that more productive firms are more affected by changes in intermediate good prices. Thus, $\varepsilon_{p(\varphi),z}$ is more likely to be higher than $\varepsilon_{P,z}$ for high productive firms. Indeed, we show in appendix B that the sign of the effect of intermediate good price on the revenue of the firm φ_ω is given by:

$$\begin{aligned} & \operatorname{sign}\left\{\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\} \qquad (14) \\ = \; & \operatorname{sign}\Bigg\{\left[\int_0^{\infty}\frac{p(\varphi)^{1-\sigma}}{p(\varphi)}g(\varphi)\mathrm{d}\varphi+\tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p(\varphi)^{1-\sigma}}{p(\varphi)}g(\varphi)\mathrm{d}\varphi+\int_{\varphi_I^*}^{+\infty}\frac{p(\varphi)^{1-\sigma}}{p(\varphi)}g(\varphi)\mathrm{d}\varphi\right] \\ & -\left[\int_0^{\infty}\frac{p(\varphi)^{1-\sigma}}{p(\varphi_\omega)}g(\varphi)\mathrm{d}\varphi+\tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p(\varphi)^{1-\sigma}}{p(\varphi_\omega)}g(\varphi)\mathrm{d}\varphi+\int_{\varphi_I^*}^{+\infty}\frac{p(\varphi)^{1-\sigma}}{p(\varphi_\omega)}g(\varphi)\mathrm{d}\varphi\right]\Bigg\} \end{aligned}$$

The impact of the intermediate good price on domestic revenue and profit is positive when the price of the variety is high (when the labor productivity of the firm is low), and is negative when the price of the variety is low (when the labor productivity of the firm is high).

This result can also be used to determine the effect of intermediate good prices on exports and affiliate revenues.

As $r_x(\varphi)=\tau^{1-\sigma}r_d(\varphi)$, thus sign$\left\{\frac{\partial r_x(\varphi_\omega)}{\partial z}\right\}$ =sign$\left\{\frac{\partial \tau^{1-\sigma}r_d(\varphi_\omega)}{\partial z}\right\}$ =sign$\left\{\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\}$

Moreover, as $r_I(\varphi)=r_d(\varphi)$, sign$\left\{\frac{\partial r_I(\varphi_\omega)}{\partial z}\right\}$ = sign$\left\{\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\}$.

$$\operatorname{sign}\left\{\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\}=\operatorname{sign}\left\{\frac{\partial r_x(\varphi_\omega)}{\partial z}\right\}=\operatorname{sign}\left\{\frac{\partial r_I(\varphi_\omega)}{\partial z}\right\} \qquad (15)$$

The sign of the effect of intermediate good prices on sales is the same for domestic, export and FDI sales. It is positive when the price of the variety is high (when the labor productivity of the firm is low), and is negative when the price of the variety is low (when the labor productivity of the firm is high).

Thus,a unique labor productivity value $\hat{\varphi}$ exists such that the revenue on each market of a firm with this labor productivity is not affected by variations in the pr ofices intermediate good $\partial r(\hat{\varphi})/\partial z=0$. Regardless of the destination market, every firm whose labor productivity is greater than $\hat{\varphi}$ will benefit from a decrease in the price of the intermediate good, at the expense of less productive firms.

The marginal costs of more productive firms are more affected by variations in the price of the intermediate good. Thus, when the price of the intermediate good falls, the marginal cost and the variety price of more productive firms decrease more than those of less productive firms.

Thus, changes in relative prices between varieties lead to a reallocation of market shares from less productive firms ($\varphi < \hat{\varphi}$) to more productive ones ($\varphi > \hat{\varphi}$).

Proposition 3 *Regardless of the destination market, a symmetric fall in prices of the intermediate good leads to market share reallocations from less productive firms to more productive ones in both countries.*

2.3. Entry and exit of firms on foreign markets

We separate the domestic profit from the export and FDI profit.

$$\begin{array}{ll} \text{Domestic profit:} & \pi_d(\varphi) = r_d(\varphi)/\sigma \\ \text{Export profit:} & \pi_x(\varphi) = r_x(\varphi)/\sigma - \mathrm{f}_x \\ \text{Affiliate profit:} & \pi_I(\varphi) = r_I(\varphi)/\sigma - \mathrm{f}_I \end{array} \tag{16}$$

The combined profit of a firm, $\pi(\varphi)$, then depends on its status.

$$\pi(\varphi) = \begin{cases} \pi_d(\varphi) = r_d(\varphi)/\sigma & \text{For domestic firms} \\ \pi_d(\varphi) + \pi_x(\varphi) = \left(1 + \tau^{1-\sigma}\right) r_d(\varphi)/\sigma - \mathrm{f}_x & \text{For exporting firms} \\ \pi_d(\varphi) + \pi_I(\varphi) = 2r_d(\varphi)/\sigma - \mathrm{f}_I & \text{For multinational firms} \end{cases} \tag{17}$$

Labor productivity threshold φ_x^* and φ_I^*:

A firm will export only if its export profit is positive $\pi_x(\varphi) \geq 0$ and will invest abroad only if its investing profit is positive $\pi_I(\varphi) \geq 0$ and higher than its export profit $\pi_I(\varphi) \geq \pi_x(\varphi)$. Then, for a successful entrant, combined profit can be written as:

$$\pi(\varphi) = \pi_d(\varphi) + \max\{0, \pi_x(\varphi), \pi_I(\varphi)\} \tag{18}$$

Thus, we define the export cutoff level as the labor productivity level below which a firm will not export:

$$\varphi_x^* = \inf\{\varphi : \pi_x(\varphi) \geq 0\} \tag{19}$$

and the FDI cutoff level as the labor productivity level below which a firm will not invest abroad:

$$\varphi_I^* = \inf\{\varphi : \pi_I(\varphi) \geq 0 \text{ and } \pi_I(\varphi) \geq \pi_x(\varphi)\} \tag{20}$$

Coexistence of exporting firms and multinational firms

If $\varphi_x^* = \varphi_I^*$, all firms which can serve the foreign market will do so by FDI, and there will be no exporting firms. For exporting and multinational firms ot coexist, we must have $\varphi_I^* > \varphi_x^*$. To do so, we assume a cost structure such as:

$$\mathrm{f}_I > \tau_x^{\sigma-1}\mathrm{f}_x. \tag{21}$$

Then, if $\tau_x^{\sigma-1}\mathrm{f}_x < \mathrm{f}_I$, there will be a range of thresholds such as $\varphi_x^* < \varphi_I^*$, and less productive firms will serve only domestic markets, more productive firms will serve the foreign market through exports, and the most productive firms will serve the foreign market through FDI.

Hence we assume that the structure of costs satisfies this inequality. Thus, we have a partitioning of firms by export and FDI status.

Distribution of labor productivity and the status of the firm

Equilibrium is characterized by a mass M of firms in each country and a distribution $g(\varphi)$ of labor productivity over a subset of $[0,\infty[$. M and $g(\varphi)$ are exogenous.

Moreover, we set $\upsilon(\varphi)$ as the conditional distribution of $g(\varphi)$ on $[\varphi_I^*;+\infty[$:

$$\upsilon(\varphi) = \begin{cases} \frac{g(\varphi)}{1-G(\varphi_I^*)} = \frac{g(\varphi)}{\theta_I} & \text{if } \varphi \geq \varphi_I^* \\ 0 & \text{if } \varphi < \varphi_I^* \end{cases} \tag{22}$$

The probability that a successful entrant invests abroad is equal to $\theta_I = 1 - G(\varphi_I^*)$. There is thus a proportion θ_I of firms which invest abroad, and hence an endogenous mass $M_I = \theta_I M$ of multinational firms.

Only firms whose labor productivity lies between φ_x^* and φ_I^* export. The probability that a successful entrant exports is given by $\theta_x = 1 - G(\varphi_x^*) - [1 - G(\varphi_I^*)] = G(\varphi_I^*) - G(\varphi_x^*)$.

We set $\eta(\varphi)$ as the ex-ante distribution $g(\varphi)$ conditional on export status:

$$\eta(\varphi) = \begin{cases} 0 & \text{if } \varphi \geq \varphi_I^* \\ \frac{g(\varphi)}{G(\varphi_I^*)-G(\varphi_x^*)} = \frac{g(\varphi)}{\theta_x} & \text{if } \varphi_x^* \leq \varphi < \varphi_I^* \\ 0 & \text{if } \varphi < \varphi_x^* \end{cases} \tag{23}$$

So there is a fraction θ_x of firms which export and hence an endogenous mass $M_x = \theta_x M$ of exporting firms. The total mass of available varieties in a country (M_t) is given by the mass of varieties produced by national firms (M), the mass of imported varieties (M_x) and the mass of affiliates producing in the country (M_I) : $M_t = M + M_x + M_I$.

2.4. Market equilibrium

2.4.1. Effect of intermediate good price on threshold values

Impact of intermediate good price on the export threshold

We now are in a position to determine the impact of the price of intermediate goods on the export threshold.

At equilibrium, $r_x(\varphi_x^*) = \mathrm{f}_x/\sigma$, we thus have

$$\frac{\mathrm{d}r(\varphi_x^*)}{\mathrm{d}z} = \frac{\partial r_x(\varphi)}{\partial \varphi}\frac{\mathrm{d}\varphi_x^*}{\mathrm{d}z} + \frac{\partial r_x(\varphi)}{\partial z} = 0 \tag{24}$$

And we can write

$$\frac{\mathrm{d}\varphi_x^*}{\mathrm{d}z} = \underset{\substack{>0\ \forall\varphi<\hat{\varphi}\\ <0\ \forall\varphi>\hat{\varphi}}}{-\frac{\partial r_x(\varphi)}{\partial z}} \Big/ \underbrace{\frac{\partial r_x(\varphi)}{\partial \varphi}}_{>0} \tag{25}$$

where $\hat{\varphi}$ is the labor productivity of the firm whose revenues are not affected by variations of the price of intermediate goods (see section 2.2.3). Let $\widehat{\mathrm{f}_x}$ be the export fixed costs such as $\widehat{\mathrm{f}_x} = r_x(\hat{\varphi})/\sigma$. For such a value of export fixed costs, the export profit of the firm with productivity $\hat{\varphi}$ is zero. Thus, at this level of fixed costs, the productivity threshold $\varphi_x^* = \hat{\varphi}$ and does not vary with the input price $\left(\frac{\mathrm{d}\varphi_x^*}{\mathrm{d}z} = \frac{\mathrm{d}\hat{\varphi}}{\mathrm{d}z} = 0\right)$. Thus, there is a unique level of export fixed costs $\widehat{\mathrm{f}_x}$ such that the probability to export is not affected by variations in the price of inputs.

Impact of intermediate good price on FDI threshold

Keeping in mind that the FDI labor productivity threshold is given by the equalization of export and FDI profit, we can determine the impact of intermediate good prices on the FDI threshold.

$$\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z} = \underset{\substack{>0\ \forall\varphi<\hat{\varphi}\\ <0\ \forall\varphi>\hat{\varphi}}}{-\left[\frac{\partial r_I(\varphi)}{\partial z} - \frac{\partial r_x(\varphi)}{\partial z}\right]} \Big/ \underset{>0}{\left[\frac{\partial r_I(\varphi)}{\partial \varphi} - \frac{\partial r_x(\varphi)}{\partial \varphi}\right]} \tag{26}$$

As for export fixed costs, let $\widehat{\mathrm{f}_I}$ be the FDI fixed costs such as $\pi_I(\hat{\varphi}) = \pi_x(\hat{\varphi}) \Leftrightarrow \widehat{\mathrm{f}_I} = [r_I(\hat{\varphi}) - r_x(\hat{\varphi})]/\sigma + f_x$. For such a value of FDI fixed costs, the FDI profit of the firm with productivity $\hat{\varphi}$ is equal to its export profit so that $\hat{\varphi} = \varphi_I^*$. We know that the firm with a labor productivity $\hat{\varphi}$ is not affected by input price variation whatever its destination market. Thus, as its export revenue and its investing revenue do not vary, the trade-off between exporting and investing abroad remains unchanged for this firm. Thus, at this level of FDI fixed costs, the productivity threshold φ_I^* does not vary with the input price $\left(\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z} = \frac{\mathrm{d}\hat{\varphi}}{\mathrm{d}z} = 0\right)$. Thus, for a given export fixed cost, there is a unique level of FDI fixed costs $\widehat{\mathrm{f}_I}$ such that the probability to invest abroad is not affected by an input price variation. Note that $\widehat{\mathrm{f}_I} = \tau^{\sigma-1}\widehat{\mathrm{f}_x}$.

Impact of intermediate good price on Export/FDI trade-off

We know that if a firm has a productivity level above $\hat{\varphi}$, a fall in intermediate good price increases its market share on the domestic market and on the foreign market, if the firm can access it. However, the export FDI trade off may be affected if export and FDI profit do not vary in exactly the same way. In order to compare the effect on export and FDI sales and profits, we know that

$$\begin{aligned}\frac{\partial\pi_I(\varphi)}{\partial z} &= \frac{\partial r_d(\varphi)}{\partial z}\\ \frac{\partial\pi_x(\varphi)}{\partial z} &= \frac{\partial\tau^{1-\sigma}r_d(\varphi)}{\partial z}\end{aligned}$$

Thus,

$$\left|\frac{\partial\pi_I(\varphi)}{\partial z}\right| > \left|\frac{\partial\pi_x(\varphi)}{\partial z}\right| \tag{27}$$

The effect of the intermediate good price is always greater on FDI revenue and profit than on export revenue and profit.

In other words, when $\frac{\partial r_d(\varphi)}{\partial z} > 0$, i.e. $\varphi < \hat{\varphi}$

$$\frac{\partial\pi_I(\varphi)}{\partial z} > \frac{\partial\pi_x(\varphi)}{\partial z} \tag{28}$$

but when $\varphi > \hat{\varphi}$, then $\frac{\partial r_d(\varphi)}{\partial z} < 0$ and

$$\frac{\partial\pi_I(\varphi)}{\partial z} < \frac{\partial\pi_x(\varphi)}{\partial z} \tag{29}$$

On the one hand, for less productive firms, a fall in the intermediate good price will decrease FDI and export profit and sales, but export sales will decrease less. Thus, the FDI/export trade-off will change in favor of export.

On the other hand, for high productive firms $(\varphi > \hat{\varphi})$, a fall in the intermediate good price will increase FDI and export profit and sales, but export sales will increase less. Thus, the FDI/export trade-off will change in favor of FDI.

Thus, if the less productive firm which invests abroad is a low productivity firm $(\varphi_I^* < \hat{\varphi})$, a fall in intermediate good price will change its export/FDI trade-off in favor of export, and the labor productivity threshold above which the firm decides to invest abroad will increase; and if the less productive firm investing abroad is a high productivity firm $(\varphi_I^* > \hat{\varphi})$, a fall in intermediate good price will change its export/FDI trade-off in favor of FDI, and the labor productivity threshold above which the firm decides to invest abroad will decrease.

2.4.2. Levels of fixed costs and reallocation process

The status of the firm which is not affected by a fall in input price $(\varphi = \hat{\varphi})$ depends on fixed costs. Indeed, if $\mathrm{f}_I > \widehat{\mathrm{f}_I}$ the firm with a labor productivity $\hat{\varphi}$ is not able to invest abroad $(\varphi_I^* > \hat{\varphi})$ and if $\mathrm{f}_x > \widehat{\mathrm{f}_x}$ this firm is not able to export $(\varphi_x^* > \hat{\varphi})$. As we assume that exporting firms and multinational firms coexist (i.e. $\mathrm{f}_I > \tau_x^{\sigma-1}\mathrm{f}_x$) and knowing that $\widehat{\mathrm{f}_I} = \tau^{\sigma-1}\widehat{\mathrm{f}_x}$, we cannot have both $\mathrm{f}_x > \widehat{\mathrm{f}_x}$ and $\mathrm{f}_I < \widehat{\mathrm{f}_I}$, and three cases are possible depending on the level of fixed costs:

- *High* fixed export and *high* fixed FDI costs.($\mathrm{f}_x > \widehat{\mathrm{f}_x}$ and $\mathrm{f}_I > \widehat{\mathrm{f}_I}$):

In this case, the selection process on foreign market is tough, only highly productive firms are able to access them. Thus both export and FDI labor productivity thresholds are above $\hat{\varphi}$ ($\hat{\varphi} < \varphi_x^* < \varphi_I^*$). More productive domestic firms benefit from a fall in input prices ($\varphi \in]\hat{\varphi}, \varphi_x^*[$), like all firms, and firms which export and invest abroad. The market share of all these firms increases both on their domestic market and on the foreign market at the expense of less productive domestic firms ($\varphi < \hat{\varphi}$). The less productive exporting firm (φ_x^*) increase its market share so that its profit also increases and becomes strictly positive and the threshold labor productivity to export decreases in order to have $\pi(\varphi_x^*) = 0$. Due to these new imported varieties, the share of firms that can access foreign markets increases and the number of available varieties increases in both countries. In addition, as shown in eq. 28, export revenue increases less than that of affiliates, the FDI/export trade-off is modified in favor of FDI for all firms accessing the foreign market so that φ_I^* decreases.

- *Low* fixed export and *high* fixed FDI costs. ($\mathrm{f}_x < \widehat{\mathrm{f}_x}$ and $\mathrm{f}_I > \widehat{\mathrm{f}_I}$):

Impact on price indexes and domestic revenues

Marginal costs of firms producing in country h decrease thanks to the subsidy, leading to a fall in the price index in this country due to the lower price of domestic varieties and of varieties sold by foreign affiliates. Firms producing in country f still have the same marginal costs and variety prices. However, the price index in country f also decreases due to the fall in prices of imported varieties from country h.

Thus, in country h, imported varieties from country f lose market shares because their prices remain constant while the price index decreases. In country f, varieties produced locally (domestic varieties and varieties produced by affiliates) also lose market shares. Thus, all firms producing in country f lose market shares, whatever their destination market, because their marginal costs remain constant while price indexes decrease in both countries.

In addition to firms producing in country f, some firms in country h will also lose market shares even if they are able to reduce their variety price. Indeed, we saw in previous sections that more productive firms are more affected by changes in intermediate good prices. Thus, in country h, less productive firms will not reduce their variety price sufficiently relative to the fall in the price index, and their market share will decrease to the benefit of more productive firms. The higher the productivity of firms, the higher the gain due to the subsidy. Thus, the gain in the share of the market will be higher for affiliates of multinational firms from country f and headquarters of multinational firms in country h. In addition, the loss will be greater for less productive domestic firms. This reallocation process from low productivity firms to high productivity firms leads to a better allocation of resources among firms in country h.

Impact on exports

The extent to which a firm is affected by the reallocation process depends on the relative variation of its variety price with respect to the variation of the price index of its destination market. Export fixed costs and fixed costs to invest abroad influence the share of firms able to export from country h to country f, and hence the fall in the price index in country f and the reallocation process.

When export fixed costs are high or when fixed costs to invest abroad are low, φ_x^* and φ_I^* are close and the share of firms exporting from country h to country f is low $(\theta_{hx} = G(\varphi_I^*) - G(\varphi_x^*))$. In country f, only prices of imported varieties produced in country h decrease. As the share of varieties with falling prices is low in country f, the fall in the price index is low. If this fall in the price index is low enough, the variety prices of all exporting firms from country h decrease more than the price index, and the export market shares of all firms exporting from country h to country f increase. The subsidy on the price of the intermediate good in country h leads to a decrease in the labor productivity threshold above which a firm is able to export. In other words, when export fixed costs are high enough or when fixed costs to invest abroad are low enough, a subsidy reducing the intermediate good price paid by final good sector firms increases the share of national firms able to access the foreign country.

When export fixed costs are low enough or fixed costs to invest abroad are high enough, the share of firms exporting from country h to country f is high, and the drop in the price index in country f is high. Consequently, some low productive exporting firms will reduce their variety price less than the fall in price index of country f and will lose market shares. Thus, even if the aggregated market share of exporting firms increases, less productive exporting firms lose export market shares and are forced to exit the country f: the labor productivity threshold above which a firm is able to export to country f rises. In other words, when export fixed costs are low enough or fixed costs to invest abroad are high enough, a subsidy reducing the intermediate good price paid by final good sector firms decreases the share of national firms able to access the foreign country.

In both cases, aggregated exports increase, but the number of exporting firms varies depending on export fixed costs. In other words, the share of firms able to access foreign markets increases only if subsidized firms are few enough so they do not have too much impact on the foreign price index.

Impact on the export/FDI trade-off

As the intermediate good price is lower in country h, the trade-off between export and FDI for firms in country h is modified in favor of exporting (the potential gain in variable cost is lower because of the higher price of the intermediate good in country f). This leads to relocation in country h of a share of the production destined for country f. For firms in country f, the reduction in marginal cost due to less expensive inputs is an additional incentive to serve country h through FDI. Thus, for firms in country f, the trade-off between export and FDI is modified in favor of FDI. However, if fixed costs to invest abroad are low enough, some MNF have a low productivity and lose market shares. Thus, the number of varieties produced in country h by affiliates of firms from country f can decrease, even if the aggregated sales of these affiliates constantly increase.

The policy consisting in decreasing input costs has the expected results when export fixed costs are high enough: the number of exporting firms and the number of foreign affiliates increase in country h, aggregated incoming FDI and aggregated exports increase, outgoing FDI decreases and the price index decreases leading to an increase in consumer welfare. When export fixed costs are low enough, the number of exporting firms in country h decreases, but the effect on aggregated exports and other variable remains positive. In addition, if fixed costs to invest abroad are also low enough, the number of affiliates of firms from country f decreases, but the aggregated market share of these affiliates nevertheless increases.

Proposition 4 *A policy that decreases the cost of inputs for the final good sector firms leads to a reallocation of market shares in a subsidized country from low productive firms to high productive ones, supports incoming FDI and aggregated exports, reduces outgoing FDI, and increases the share of firms able to access foreign markets provided that these firms are not too numerous.*

The following table summarizes the impact of a subsidy on an intermediate good on final sector firms.

[Table 1 about here.]

As the subsidy is only paid in country h, the labor productivity threshold above which firms gain or lose from the subsidy is not the same for exporting firms and for firms producing in country h. Thus, $\hat{\varphi}_{hd}$ represents the labor productivity threshold above which a firm producing and selling in country h (national firms and affiliates of f) gain from the fall in input prices, while $\hat{\varphi}_{hx}$ represents the labor productivity threshold above which exporting firms from country h gain from the fall in input prices.

It is important to note that the level of fixed costs changes the effect of a subsidy on an intermediate good only for exporting firms in country h, and only for firms investing abroad in country f. While for exporting firms in country h, the share of exporting firms (the relative level of fixed costs) determines the triggering of a reallocation process among exporting firms, for firms in country f, only the (absolute) level of fixed costs to invest abroad determines the triggering of a reallocation process among multinational firms.

2.5. Wage subsidy

Policy makers may also support firms in the final good sector by reducing the cost of labor. This policy could be a decrease in labor taxes.

New prices

Let s_l be the subsidy expressed as a share of wages in the final good sector. Thus wages in country h are now given by

$$w_h = (1 - s_l)\, w \tag{30}$$

while wages in country f remain unchanged so that $w_h < w_f = 1$.

This wage policy leads to the following pricing rules:

- in country h

$$\begin{array}{ll} p_{hd} = \frac{1}{\rho} MC_{hd} = \frac{1}{\rho}\left(z\alpha + (1 - s_l)\, w/\varphi\right) & \text{For varieties produced by national firms} \\ p_{fx} = \frac{1}{\rho} MC_{fx} = \frac{1}{\rho}\left(z\alpha + w/\varphi\right)\tau & \text{For imported varieties from country } f \\ p_{fI} = \frac{1}{\rho} MC_{fI} = \frac{1}{\rho}\left(z\alpha + (1 - s_l)\, w/\varphi\right) & \text{For varieties produced by affiliates of foreign firms} \end{array} \tag{31}$$

- in country f

$$\begin{array}{ll} p_{fd} = \frac{1}{\rho} MC_{fd} = \frac{1}{\rho}\left(z\alpha + w/\varphi\right) & \text{For varieties produced by national firms} \\ p_{hx} = \frac{1}{\rho} MC_{hx} = \frac{1}{\rho}\left(z\alpha + (1 - s_l)\, w/\varphi\right)\tau & \text{For imported varieties from country } h \\ p_{hI} = \frac{1}{\rho} MC_{hI} = \frac{1}{\rho}\left(z\alpha + w/\varphi\right) & \text{For varieties produced by affiliates of foreign firms} \end{array} \tag{32}$$

Impact on price indexes and domestic revenues

As was the case with a subsidy on the intermediate good, marginal costs of firms producing in country h decrease, leading to a decrease in the price index in country h, while firms producing in country f have similar marginal costs and the price remains the same as in previous sections. As before, the price index in country f also decreases due to less expensive imported varieties. Thus, all firms producing in country f lose market shares whatever their destination market (domestic or export market) and whatever their nationality (national firms or affiliates of firms from country h).

We saw in the previous section that more productive firms are more affected by changes in intermediate good prices because they use relatively more intermediate goods, and less labor. Conversely, as less productive firms use relatively more labor to produce one unit of final good, they will be more affected by a fall in labor price. Thus, their prices will decrease more than prices of varieties produced by more productive firms, leading to reallocation of market shares from more productive firms to less productive ones, and to unsatisfactory allocation of resources. This market share reallocation favors less productive national firms, at the expense of more productive multinational firms.

Thus, while a fall in agricultural price leads to an anticlockwise rotation of revenue, a fall in labor prices leads to a clockwise rotation of revenues. (see fig. 1)

However, the impact on firms' revenue still depends on how the price of the variety varies with respect to the price index of the destination market.

[Figure 1 about here.]

In country h, the fall in the price index is always lower than the fall in the price of varieties of less productive firms (as they are more affected), but is greater than the fall in the price of varieties of more productive affiliates from country f (as they are less affected) and of exporting firms from country f (as their prices remain constant). Thus, less productive domestic firms always benefit from a fall in labor prices, while exporting firms from country f and more productive affiliates always lose market shares. However, if export fixed costs are high enough, some domestic firms are highly productive and may reduce their market share, and if fixed costs to invest abroad are also low enough, some less productive affiliates from country f increase their market share.

In country f, the price index will decrease because of less expensive imported varieties from country h. Thus, as firms producing in country f have constant variety prices, domestic firms and affiliates of multinational firms from country h lose market shares in this country.

Impact on exports

The impact of a fall in labor price on firms producing in country h and exporting to country f is more complex.

In country f, the fall in the price index will be greater if the market share of imported varieties is large.

If fixed export costs are high enough or if fixed costs to invest abroad are low enough, few firms export to country f, and the fall in production costs in country h leads to a limited decrease in the price index in country f. If the share of imported varieties is small enough, the fall in the variety price is higher than the fall in the price index, leading to an increase in the market shares of all firms exporting to country f. All firms exporting from country h increase their market share in country f so that the labor productivity threshold above which a firm is able to export is lowered. In this case, all exporting firms benefit from the fall in wages, and more firms are able to export to country f. However, the gain is greater for less productive exporting firms.

Alternatively, when fixed export costs are low enough and fixed costs of investing abroad are high enough, many firms in country h export to country f, and the fall in the price of imported varieties in country f leads to a relatively large fall in its price index. As the fixed costs of investing abroad are high, some exporting firms are highly productive, and are little affected by the fall in wages. If these firms are productive enough, the fall in their variety price may be lower than the fall in the price index in country f. These high productive exporting firms thus lose market shares in favor of less productive exporting firms. Both mechanisms (a lower marginal cost and a reallocation process) increase the market share of less productive exporting firms, leading to a drop in the labor productivity threshold above which a firm is able to export to country f. In this case, even if some exporting firms lose market shares (the most productive firms), aggregated exports increase because of the increased competitiveness of firms producing in country h, and more firms are able to export to country f.

To sum up, a subsidy on wages always increases the share of firms able to access foreign markets. However, if the share of exporting firms is high enough, some high productive exporting firms may see their market share decrease to the advantage of less productive exporting firms.

Impact on the export/FDI trade-off

Focusing on the trade-off between export and FDI, as before marginal costs are lower for firms producing in country h. Thus, the subsidy on wages in country h favors exports from firms in country h and favors FDI for firms in country f.

Indeed, for firms in country h, the potential gain in variable trade cost from switching from export to FDI is reduced by the higher labor cost in country f. Thus, outgoing FDI from country h is reduced.

For firms in country f, when fixed costs to invest abroad are low enough, some low productivity firms investing in country h reduce their price more than the fall in the price index. These multinational firms thus increase their market share whereas their market share would decrease if they were exporting. This leads to a clear effect on the export/FDI trade-off in favor of FDI for firms in country f.

When fixed costs to invest abroad are high enough, all firms investing in country h reduce their price less than the price index, and reallocation occurs leading to a decrease in the market share of all affiliates located in country h. However, the fall in market shares of affiliates is less than if they were exporting. Thus, even if less productive firms investing in country h have their market share reduced, the trade-off between export and FDI still changes in favor of FDI.

The policy consisting in decreasing labor costs has the expected results for policy makers: a drop in the price index leading to an increase in welfare, access to foreign markets is facilitated and exports are supported at the expense of outgoing FDI. Moreover, incoming FDI are supported because firms in the foreign country will switch from export to FDI in order to serve the subsidized country. However, the allocation of resources is not optimal as more efficient firms will see their market share reduced.

Proposition 5 *A policy that decreases labor costs for firms in the final good sector leads to a reallocation of market shares in the subsidized country from high productive firms to low productive ones, supports incoming FDI and aggregated exports, reduces outgoing FDI, and increases the share of firms able to access foreign markets whatever the fixed costs.*

The following table summarizes the impact of a wage subsidy on final sector firms.

[Table 2 about here.]

As the subsidy is only paid in country h, the labor productivity threshold above which firms gain or lose from the subsidy is not the same for exporting firms and for firms producing in country h. Thus, $\hat{\varphi}_{hd}$ represents the labor productivity threshold above which a firm producing and selling in country h (national firms and affiliates of f) lose from the fall in wages, while $\hat{\varphi}_{hx}$ represents the labor productivity threshold above which exporting firms in country h lose from the fall in wages.

Like for subsidies on intermediate good, fixed cost levels change the effect of a subsidy on labor only for exporting firms in country h, and only for firms investing abroad in country f. For exporting firms in country h, the share of exporting firms (the relative level of fixed costs) determines the existence of a reallocation process among exporting firms, for firms in country f, only the (absolute) level of fixed costs to invest abroad determines the triggering of a reallocation process among multinational firms.

2.6. Comparison of the two policies and discussion

To sum up, both policies favor aggregated export by national firms and incoming FDI, and reduce outgoing FDI. However, as firms from country f do not benefit from these subsidies, it becomes more difficult to access country h through export and φ^*_{xf} increases. As we assume that $\varphi^*_x < \varphi^*_I$ in both countries, all firms with a labor productivity above φ^*_x serve the other market. Thus, the amount of available varieties in country h only depends on φ^*_{xf}, and decreases with both policies. However, both policies decrease the price index of both countries, leading to an increase in consumer' welfare. Note that the fall in the price index is greater in the country whith the subsidy, so consumer welfare increases more in the subsidized country, namely country h.

The two policies have different effects on the allocation of revenues among firms and on the ability of firms to access foreign markets. On one hand, the subsidy on intermediate goods favors more productive firms (affiliates of foreign firms), and leads to a better allocation of resources, but it may reduce the ability of national firms to access foreign markets if export fixed costs are low. On other hand, the subsidy on wages favors small national firms leading to unsatisfactory allocation of resources. However, it increases the share of firms able to access foreign markets whatever the fixed costs.

Proposition 6 *A subsidy on wages always increases the share of firms in the final good sector able to access foreign markets while a subsidy on intermediate good may decrease the share of firms accessing foreign markets*

Proposition 7 *A subsidy on wages favors less productive domestic firms while a subsidy on the price of an intermediate good favors affiliates of more productive foreign firms.*

To conclude, the choice between these two policies depends on the aim of the policy makers. If the aim is to favor domestic production and small producers (in order to decrease market power and concentration in the final good sector), a subsidy on wages appears to be a better choice, as it induces market share reallocation from high productive firms to low productive ones, leading to a reduction of differences between firms in terms of revenue and production levels.

If the aim is to support exports of national firms, the subsidy on wages may be the preferred policy. Indeed, a subsidy on an intermediate good can decrease the share of firms able to access foreign markets provided that export fixed costs are low and investment costs are high. However, it may be difficult for policy makers to know the level of fixed costs, all the more because they differ depending on the destination market (see Chevassus-Lozza and Latouche 2011). Thus, a subsidy on an intermediate good may increase the ability of firms to export to more selective foreign markets (high export fixed costs), but reduce the ability to export to less selective foreign markets (low export fixed costs). This may be detrimental to firms in the final good sector and to the exporting process of firms. Less productive firms accessing less selective markets may increase their productivity thanks to confrontation with other exporters (learning by exporting), and this may allow them to subsequently access more selective markets. Thus, a subsidy on wages may be preferred because it favors exports whatever the fixed export costs, and, even though it may be detrimental to high productive firms, it does not force them to exit foreign markets.

Even if this model does not account for the effect of attracting FDI because the employment level is exogenously given by the size of the country, the attraction of incoming FDI can have several positive externalities (see Barry and Bradley, 1997 or Buckley and Ruane, 2006 for Ireland) supplying foreign capital to the economy and leading to increased competition and a better allocation of resources. Thus, the aim of policy makers may be to attract foreign capital through incoming FDI, and in this case both policies may be appropriate.

However, even if the subsidy on wages favors incoming FDI with respect to imports from foreign countries, more productive firms lose market shares due to the reallocation process, unlike in the case of a subsidy on an intermediate good, which favors more productive firms. Thus, if there is competition between countries to attract FDI, firms may choose to invest in the country that subsidizes intermediate goods, as their market share will be higher.

Finally, these policies may affect entry to the domestic market. If there exist fixed domestic costs, since a fall in intermediate good price decreases the domestic revenues of less productive firms, some of them will be forced to exit the market. A subsidy on intermediate goods may have exactly the same effect. Conversely, a subsidy on wages triggers reallocation of market share from more productive firms to less productive ones. Thus, less productive firms may increase their market shares, and if there are fixed domestic costs, the labor productivity threshold above which a firm is able to produce would be lowered, leading to an increase in the number of domestic varieties.

3. Conclusion

In this paper, we described an extension of the Helpman Melitz and Yeaple (2004) model of heterogeneous firms with intermediate goods. We showed that the characteristics of intermediate goods can shape the international strategy of firms aside from any consideration of comparative advantages. Indeed, as firms are assumed to use one input heterogeneously and one input homogeneously, the greater the use of either input in the final good, or the higher its price, the greater the impact of this input. At aggregated level, an increase in the share of an intermediate good in production costs, which depends on its share in the production process and on its price, reduces differences in production levels and in revenues between firms in the final good sector.

Moreover, all firms do not respond to a change in the price of an intermediate good in the same way. As more productive firms use relatively less labor to produce the final good, the share of intermediate good in their total cost is higher, and they react more to variations in the price of an intermediate good. In this case, a fall in input price leads to a bigger fall in the variety price for high productive firms than for low productive firms. This effect, by leading to a change in relative prices between varieties in the final good sector, affects the allocation of the demand for final goods. Market shares are reallocated from less productive firms to more productive ones, resulting in better allocation of resources and an increase in the aggregate production level.

The effect on access to foreign markets through export or FDI is more complex. When countries are perfectly symmetric, the reallocation process does not depend on the firms' status but only on their labor productivity. Thus, when fixed costs are high enough, selection on foreign markets is strong and only very productive firms can access them. As more productive firms benefit from a fall in the price of intermediate goods, if fixed costs are high enough, all firms that access foreign markets benefit from the decrease in production costs, and the probability of serving foreign markets increases.

Alternatively, when fixed cost to access foreign markets are low, the selection process is weak and some low productivity firms are able to access foreign markets. In this case, some of these low productive firms will suffer from the fall in intermediate good prices, some will be forced to exit foreign markets, and the probability of accessing foreign markets decreases.

Concerning the effect of the price of intermediate goods on the export/FDI trade-off, a fall in the price of intermediate goods always increases the share of FDI sales over export sales. However, depending on the level of fixed costs, the impact on the probability to invest abroad can vary: the effect of a fall in intermediate good price increases the probability of investing abroad when fixed investment costs are high, and decreases this probability when fixed investment costs are low. As in Helpman, Melitz and Yeaple's (2004) model, increased heterogeneity leads to a higher share of FDI compared to exports.

Moreover, production factors used in a fixed proportion (here an intermediate good) and heterogeneously (here labor) have opposite effects on the heterogeneity of firms and on reallocation processes. While a fall in intermediate good price increases the heterogeneity of production and revenues and triggers a reallocation process from less productive firms to more productive ones, a fall in wages reduces heterogeneity of production and revenues and triggers a reallocation process from more productive firms to less productive ones.

In this paper, we also compared two policies: a subsidy on the intermediate good price and a subsidy on the price of labor. The introduction of subsidies causes asymmetry between countries depending on the wages and intermediate good prices paid by firms in the final good sector. Such subsidies generate advantages for firms producing in the subsidized country.

However, even if these two types of subsidies increase aggregated exports of national firms, attract FDI from foreign countries, reduce outgoing FDI and improve consumer welfare, they have different effects on the reallocation of market shares.

On the one hand, subsidizing the price of intermediate goods triggers a reallocation process from low productivity firms to high productivity firms, but may also force some exporting firms to exit foreign markets and increase the concentration of market shares in the hands of a few highly productive firms. On the other hand, subsidizing wages triggers a reallocation process from high productivity firms to low productivity firms, making the allocation of resources less efficient, but increasing the ability of domestic firms to access foreign markets whatever the level of fixed costs, and reducing the concentration of market shares in the final good sector.

To sum up, this model introduces a new determinant of FDI with symmetric countries. The relative share of production factors in production costs affects the heterogeneity of firms, which has an impact on both the allocation of market shares and on the share of FDI sales compared to exports. As in Helpman, Melitz and Yeaple (2004), the greater the heterogeneity, the higher the share of FDI sales compared to exports.

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Appendices

A. Proof that $\varepsilon_{r_d,z} = (\sigma-1)\left(\varepsilon_{P,z} - \varepsilon_{p(\varphi_\omega),z}\right)$

The domestic revenue of a firm with labor productivity φ_ω is given by

$$r_d(\varphi_\omega) = R\left(\frac{P}{p(\varphi_\omega)}\right)^{\sigma-1}$$

The effect of input price variation on its revenue is given by

$$\begin{aligned}
\frac{\partial r_d(\varphi_\omega)}{\partial z} &= (\sigma-1)R\left(\frac{P}{p(\varphi_\omega)}\right)^{\sigma-2}\left[\frac{\frac{\partial P}{\partial z}p(\varphi_\omega) - P\frac{\partial p(\varphi_\omega)}{\partial z}}{p(\varphi_\omega)^2}\right] \\
&= (\sigma-1)r_d(\varphi_\omega)\frac{p(\varphi_\omega)}{P}\left[\frac{\partial P}{\partial z}\frac{p(\varphi_\omega)}{p(\varphi_\omega)^2} - \frac{\partial p(\varphi_\omega)}{\partial z}\frac{P}{p(\varphi_\omega)^2}\right] \\
&= (\sigma-1)r_d(\varphi_\omega)\left[\frac{\partial P}{\partial z}\frac{1}{P} - \frac{\partial p(\varphi_\omega)}{\partial z}\frac{1}{p(\varphi_\omega)}\right] \\
\frac{\partial r_d(\varphi_\omega)}{\partial z} &= (\sigma-1)\frac{r_d(\varphi_\omega)}{z}\left(\frac{\partial P}{\partial z}\frac{z}{P} - \frac{\partial p(\varphi_\omega)}{\partial z}\frac{z}{p(\varphi_\omega)}\right)
\end{aligned}$$

so that

$$\begin{aligned}
\frac{\partial r_d(\varphi_\omega)}{\partial z}\frac{z}{r_d(\varphi_\omega)} &= (\sigma-1)\left(\frac{\partial P}{\partial z}\frac{z}{P} - \frac{\partial p_d(\varphi_\omega)}{\partial z}\frac{z}{p_d(\varphi_\omega)}\right) \\
\varepsilon_{r_d,z} &= (\sigma-1)\left(\varepsilon_{P,z} - \varepsilon_{p_d(\varphi_\omega),z}\right)
\end{aligned}$$

B. Sign of $\varepsilon_{r_d,z}$

From previous appendix, we know that $\varepsilon_{r_d,z} = (\sigma-1)\left(\varepsilon_{P,z} - \varepsilon_{p_d(\varphi_\omega),z}\right)$.

The price index in both countries is given by:

$$P = (MG)^{\frac{1}{1-\sigma}} \tag{33}$$

where M is the mass of firms in each country and:

$$G \equiv \int_0^\infty p_d(\varphi)^{1-\sigma}g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*} p_d(\varphi)^{1-\sigma}g(\varphi)\,d\varphi + \int_{\varphi_I^*}^\infty p_d(\varphi)^{1-\sigma}g(\varphi)\,d\varphi$$

where the first term corresponds to the price of varieties produced by domestic firms, the second term corresponds to the price of varieties imported from the other country and the last term corresponds to the price of varieties produced by affiliates of foreign firms. The elasticity of the price index to input price is given by

$$\varepsilon_{P,z} = \frac{\partial P}{\partial z}\frac{z}{P}$$

$$
\begin{aligned}
&= \frac{\partial (MG)^{\frac{1}{1-\sigma}}}{\partial z}\frac{z}{(MG)^{\frac{1}{1-\sigma}}} \\
&= \frac{1}{1-\sigma}\frac{z}{G}\frac{\partial G}{\partial z}
\end{aligned}
$$

We have $\frac{\partial G}{\partial z}$ such that

$$\frac{\partial G}{\partial z} = \int_0^\infty \frac{\partial p_d(\varphi)^{1-\sigma}}{\partial z} g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{\partial p_d(\varphi)^{1-\sigma}}{\partial z} g(\varphi)\,d\varphi + \int_{\varphi_I^*}^\infty \frac{\partial p_d(\varphi)^{1-\sigma}}{\partial z} g(\varphi)\,d\varphi$$

where

$$\frac{\partial p_d(\varphi)^{1-\sigma}}{\partial z} = (1-\sigma)\,\frac{\alpha}{\rho}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)}$$

So $\frac{\partial G}{\partial z}$ is given by

$$
\begin{aligned}
\frac{\partial G}{\partial z} &= (1-\sigma)\,\frac{\alpha}{\rho}\left[\int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right. \\
&\quad \left. + \int_{\varphi_I^*}^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right]
\end{aligned}
$$

and the elasticity of the price index to input price can be written as

$$
\begin{aligned}
\varepsilon_{P,z} &= \frac{z\alpha}{\rho G}\left[\int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right. \\
&\quad \left. + \int_{\varphi_I^*}^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right]
\end{aligned}
$$

Knowing that

$$\varepsilon_{p_d(\varphi_\omega),z} = \frac{z\alpha}{\rho}\frac{1}{p_d(\varphi_\omega)} = \frac{z\alpha}{\rho G}\frac{G}{p_d(\varphi_\omega)}$$

we have:

$$
\begin{aligned}
\varepsilon_{P,T} - \varepsilon_{p_d(\varphi_\omega),T} &= \frac{z\alpha}{\rho G}\left[\int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right. \\
&\quad + \int_{\varphi_I^*}^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi - \int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)} g(\varphi)\,d\varphi \\
&\quad \left. - \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)} g(\varphi)\,d\varphi - \int_{\varphi_I^*}^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)} g(\varphi)\,d\varphi\right]
\end{aligned}
$$

And the elasticity of the firm φ_ω domestic revenue to input price $\varepsilon_{r_d,z} = (\sigma-1)\left(\varepsilon_{P,z} - \varepsilon_{p_d(\varphi_\omega),z}\right)$ is given by:

$$
\begin{aligned}
\varepsilon_{r_d,z} &= \sigma\frac{z\alpha}{G}\left[\int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi + \tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi\right. \\
&\quad + \int_{\varphi_I^*}^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi)} g(\varphi)\,d\varphi - \int_0^\infty \frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)} g(\varphi)\,d\varphi
\end{aligned}
$$

$$-\tau^{1-\sigma}\int_{\varphi_x^*}^{\varphi_I^*}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)}g(\varphi)\,d\varphi-\int_{\varphi_I^*}^{\infty}\frac{p_d(\varphi)^{1-\sigma}}{p_d(\varphi_\omega)}g(\varphi)\,d\varphi\Bigg].$$

C. Effect of intermediate good price on the investment threshold

At equilibrium, the firm with labor productivity φ_I^* is indifferent between exporting or investing abroad, thus $\pi_x(\varphi_I^*)=\pi_I(\varphi_I^*)$ where:

$$\begin{aligned}\pi_x(\varphi_I^*) &= \frac{r_x(\varphi_I^*)}{\sigma}-f_x\\ \pi_I(\varphi_I^*) &= \frac{r_I(\varphi_I^*)}{\sigma}-f_I\end{aligned}$$

Thus, at the equilibrium we have:

$$\begin{aligned}\frac{\mathrm{d}\left[r_I(\varphi_I^*)-r_x(\varphi_I^*)\right]}{\mathrm{d}z} &= \frac{\mathrm{d}r_I(\varphi_I^*)}{\mathrm{d}z}-\frac{\mathrm{d}r_x(\varphi_I^*)}{\mathrm{d}z}=0\\ &= \frac{\partial r_I(\varphi)}{\partial\varphi}\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z}+\frac{\partial r_I(\varphi)}{\partial z}-\frac{\partial r_x(\varphi)}{\partial\varphi}\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z}-\frac{\partial r_x(\varphi)}{\partial z}=0\end{aligned}$$

So we can write

$$\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z}=-\left[\frac{\partial r_I(\varphi)}{\partial z}-\frac{\partial r_x(\varphi)}{\partial z}\right]\Big/\left[\frac{\partial r_I(\varphi)}{\partial\varphi}-\frac{\partial r_x(\varphi)}{\partial\varphi}\right]$$

We know that $r_I(\varphi)=r_d(\varphi)$ and $r_x(\varphi)=\tau^{1-\sigma}r_d(\varphi)$, thus $\partial r_I(\varphi)/\partial\varphi-\partial r_x(\varphi)/\partial\varphi=\left(1-\tau^{1-\sigma}\right)\partial r_d(\varphi)/\partial\varphi>0$.

Moreover,

$$\operatorname{sign}\left\{\frac{\partial r_I(\varphi_\omega)}{\partial z}-\frac{\partial r_x(\varphi_\omega)}{\partial z}\right\}=\operatorname{sign}\left\{\left(1-\tau^{1-\sigma}\right)\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\}=\operatorname{sign}\left\{\frac{\partial r_d(\varphi_\omega)}{\partial z}\right\}$$

so we have:

$$\begin{aligned}\frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z} &= -\left[\left(1-\tau^{1-\sigma}\right)\frac{\partial r_d(\varphi)}{\partial z}\right]\Big/\left[\left(1-\tau^{1-\sigma}\right)\frac{\partial r_d(\varphi)}{\partial\varphi}\right]\\ \frac{\mathrm{d}\varphi_I^*}{\mathrm{d}z} &= -\left[\frac{\partial r_I(\varphi)}{\partial z}-\frac{\partial r_x(\varphi)}{\partial z}\right]\Big/\underbrace{\left[\frac{\partial r_I(\varphi)}{\partial\varphi}-\frac{\partial r_x(\varphi)}{\partial\varphi}\right]}_{>0}\\ &\quad >0\ \ \forall\varphi<\hat{\varphi}\\ &\quad <0\ \ \forall\varphi>\hat{\varphi}\end{aligned}$$

Tables

Table 1. Effects of intermediate good subsidy on revenues and thresholds.

	Thresholds and firms' revenues in country h		
Level of fixed costs	Domestic revenues	Export revenues	FDI revenues
(1) f_x high enough and f_I low enough	$r_{hd} \searrow \forall \varphi < \hat{\varphi}_{hd}$ $r_{hd} \nearrow \forall \varphi \in]\hat{\varphi}_{hd}, \infty[$	$r_{hx} \nearrow \forall \varphi \in [\varphi^*_{hx}, \varphi^*_{hI}[$ $\varphi^*_{hx} \searrow$	$r_{hI} \searrow \forall \varphi \in]\varphi^*_{hI}, \infty[$ $\varphi^*_{hI} \nearrow$
(2) f_x low enough and f_I high enough	$r_{hd} \searrow \forall \varphi < \hat{\varphi}_{hd}$ $r_{hd} \nearrow \forall \varphi \in]\hat{\varphi}_{hd}, \infty[$	$r_{hx} \searrow \forall \varphi \in [\varphi^*_{hx}, \hat{\varphi}_{hx}[$ $r_{hx} \nearrow \forall \varphi \in]\hat{\varphi}_{hx}, \varphi^*_{hI}[$ $\varphi^*_{hx} \nearrow$	$r_{hI} \searrow \forall \varphi \in]\varphi^*_{hI}, \infty[$ $\varphi^*_{hI} \nearrow$
	Thresholds and firms' revenues in country f		
Level of fixed costs	Domestic revenues	Export revenues	FDI revenues
f_I low ($f_I < \widehat{f}_I$)	$r_{fd} \searrow \forall \varphi$	$r_{fx} \searrow \forall \varphi \in [\varphi^*_{fx}, \varphi^*_{fI}[$ $\varphi^*_{fx} \nearrow$	$r_{fI} \searrow \forall \varphi \in [\varphi^*_{fI}, \hat{\varphi}_{hd}[$ $r_{fI} \nearrow \forall \varphi \in [\hat{\varphi}_{hd}, \infty[$ $\varphi^*_{fI} \searrow$
f_I high ($f_I > \widehat{f}_I$)	$r_{fd} \searrow \forall \varphi$	$r_{fx} \searrow \forall \varphi \in [\varphi^*_{fx}, \varphi^*_{fI}[$ $\varphi^*_{fx} \nearrow$	$r_{fI} \nearrow \forall \varphi \in [\varphi^*_{fI}, \infty[$ $\varphi^*_{fI} \searrow$

Table 2. Effects of wage subsidy depending on fixed costs level.

	Thresholds and firms revenues in country h		
Level of fixed costs	Domestic revenues	Export revenues	FDI revenues
(1) f_x high enough and f_I low enough	$r_{hd} \nearrow \forall\varphi < \hat{\varphi}_{hd}$ $r_{hd} \searrow \forall\varphi \in]\hat{\varphi}_{hd}, \infty[$	$r_{hx} \nearrow \forall\varphi \in [\varphi^*_{hx}, \varphi^*_{hI}[$ $\varphi^*_{hx} \searrow$	$r_{hI} \searrow \forall\varphi \in]\varphi^*_{hI}, \infty[$ $\varphi^*_{hI} \nearrow$
(2) f_x low enough and f_I high enough	$r_{hd} \nearrow \forall\varphi < \hat{\varphi}_{hd}$ $r_{hd} \searrow \forall\varphi \in]\hat{\varphi}_{hd}, \infty[$	$r_{hx} \nearrow \forall\varphi \in [\varphi^*_{hx}, \hat{\varphi}_x[$ $r_{hx} \searrow \forall\varphi \in]\hat{\varphi}_{hx}, \varphi^*_{hI}[$ $\varphi^*_{hx} \searrow$	$r_{hI} \searrow \forall\varphi \in]\varphi^*_{hI}, \infty[$ $\varphi^*_{hI} \nearrow$
	Thresholds and firms revenues in country f		
Level of fixed costs	Domestic revenues	Export revenues	FDI revenues
f_I low ($f_I < \widehat{f}_I$)	$r_{fd} \searrow \forall\varphi$	$r_{fx} \searrow \forall\varphi \in [\varphi^*_{fx}, \varphi^*_{fI}[$ $\varphi^*_{fx} \nearrow$	$r_{fI} \nearrow \forall\varphi \in [\varphi^*_{fI}, \hat{\varphi}_{hd}[$ $r_{fI} \searrow \forall\varphi \in [\hat{\varphi}_{hd}, \infty[$ $\varphi^*_{fI} \searrow$
f_I high ($f_I > \widehat{f}_I$)	$r_{fd} \searrow \forall\varphi$	$r_{fx} \searrow \forall\varphi \in [\varphi^*_{fx}, \varphi^*_{fI}[$ $\varphi^*_{fx} \nearrow$	$r_{fI} \searrow \forall\varphi \in [\varphi^*_{fI}, \infty[$ $\varphi^*_{fI} \searrow$

Figures

Figure 1. Impact of wage subsidy on domestic revenues.