Trade, Wages, FDI and Productivity

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Abstract

We present a general equilibrium model of FDI and exporting with heterogeneous firms, endogenous determined wages, firm entrants, and productivity cutoffs. The preference specification displays both income and pro-competitive effects and allows for wage differentials in equilibrium. The framework allows repercussions of FDI costs to domestic and export cutoffs, number of firm entrants and the relative wage. We use the model to investigate the impact of unilateral and bilateral changes in trade costs or lower costs of engaging in FDI. It is important to study a general equilibrium framework with the given features in order to deepen the understanding of the classical "proximity-concentration" trade-off and the welfare implications of promoting FDI or reducing trade costs. We find that increasing the attractiveness of FDI in a foreign country not only allures firms to use FDI, but simultaneously increases the relative wage in that country. This wage effect actually dampens the relocation effect and simultaneously increases the attractiveness of exports. From the welfare perspective we find that attracting FDI firms may actually increase welfare, although it implies a lower number of entrants and softer competition.

JEL-Classification: F12, F23
Keywords: Multinational firms, FDI, firm heterogeneity, general equilibrium, endogenous markups, trade and wages

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1 Introduction

In the last decades, the growth of foreign direct investment (FDI) has been one of the major trends in the global economy. According to UNCTAD 2002 and their World Investment Directory, world FDI stock has increased to over $7 trillion in 2002, which is about ten times the level of 1985. In addition, they report that the tremendous expansion in worldwide FDI outflows since the mid-1980s has outpaced the growth in the worldwide gross domestic product, domestic investments and even exports. According to their data, the sales of all FDI firms in 2001 are about $18 trillion, whereas the sales of all exporting firms amount only to $7 trillion. The UNCTAD 2010 reports, that most of the policy measures affecting FDI in the year 2009 have been to further liberalize and promote FDI. Typical policy instruments to attract FDI are tax holidays, job-creation or facility subsidies. Furthermore the UNCTAD 2001 reports that “Assessing the consequences of promoting FDI for national welfare is a big task [...]”.

The latest strand of the heterogeneous firms literature is concerned about the welfare effects of promoting FDI. Intuitively, FDI saves cross-border trade costs and may lead to lower consumer prices and a consumption gain. Industry spillovers and technology transfers are also identified as pro welfare effects of FDI. Motivated by those policy interventions as reported in the World Investment Report by UNCTAD (2003) and building up on Helpman, Melitz and Yeaple (2004), the important contribution by Chor (2009) analyzes the implications of government subsidies to attract FDI. The key result is that a country can raise its welfare by using a small subsidy. Our paper is an attempt to deepen the understanding how endogenously determined wage differentials and price markups alter the classical results from a heterogeneous firms model with FDI. In the light of the recent debate whether countries should grant FDI subsidies or not, we are in particular interested in the welfare implications of attracting FDI. The aim of the present paper is to contribute to this challenge by constructing a rich framework and call into question, whether promoting FDI is able to raise welfare, and if so, through what channels.

The remarkable change in the nature of trade has been analyzed by economists for a long time. One of the most influential papers in the FDI literature is Helpman, Melitz and Yeaple (2004). They develop the first general equilibrium model with exporting and horizontal FDI, where firms differ in their marginal productivity. They are able to show that only firms with a relatively high productivity are able to penetrate a foreign market by exporting and only the most productive firms are able to adopt the FDI strategy. Their general equilibrium framework is an enhancement of the Melitz (2003) model and is
embedded in the so-called “new” new trade theory. The initial theoretical contribution is the cornerstone model of Melitz (2003). The Melitz model incorporates firm heterogeneity into the monopolistic competition model by Krugman (1980). Firms differ in productivity, as they draw their marginal productivities from an exogenous given distribution. Within the Melitz framework, it is possible to analyze inter-firm reallocations and average productivity growth of trade liberalization. In particular, Melitz shows that only the most productive firms take part in foreign trade and that trade forces firms with lower productivity draws to exit the market. Hence, trade liberalization leads to an aggregate productivity gain.

Starting from the mid-nineties, an enormous academic literature has been provided on the empirical patterns of firms’ behaviour. Bernard and Jensen (1999) observe that firms serving the foreign market via exporting are larger and exhibit a higher productivity than firms that refrain from foreign trade. Aw et al. (2000) verify that plants with a higher productivity take part in exporting whilst plants with low productivity exit the export market. Mayer and Ottaviano (2007) show that international operating firms are rare, bigger, pay higher wages, generate higher added value and employ more capital per worker. Furthermore, multinationals are on average even more productive than exporting firms.

Although Melitz’s (2003) model has deepened our understanding of intra-industry reallocations, it relies on two restrictive assumptions: factor price equalization (FPE) and constant price markups. The assumption of symmetric countries induces FPE while a constant elasticity of substitution (CES) implies constant markups. The more recent heterogeneous firms literature has focused to forego either one of those assumptions. Bernard et al. (2003) introduce exogenous wage differences across countries in a Ricardian framework with Bertrand competition. Melitz and Ottaviano (2008) provide a model with endogenous markups, where markups decrease with trade integration. Although trade liberalization now leads to pro-competitive effects, the model does not allow for income effects as in Melitz (2003). Behrens et al. (2009) propose a promising general equilibrium model of international trade that avoids both of the previous restrictive assumptions. It incorporates heterogeneous firms, endogenously determined firm entrants, wages and productivity cutoffs. Furthermore, the model does not rely on CES but uses a variable elasticity of substitution (VES) specification introduced by Behrens and Murata (2007) instead. Moreover, they do not assume FPE in equilibrium. Their model therefore incorporates endogenous wages and flexible markups in which trade integration leads to both income and pro-competitive effects.

Even though the existing literature yields great insights into the mechanisms that work
in international trade, there exists, to the best of our knowledge, no model of FDI which incorporates wage differentials in equilibrium, flexible price markups and repercussions of FDI costs to the toughness of competition. Developing such a general equilibrium model of FDI is the main contribution of our paper. From a theoretical point of view our model builds up on Behrens et al. (2009), but we move beyond by incorporating horizontal FDI. The focus of the analysis is on the impact of changes in trade and FDI costs. In particular, we study how FDI impacts the wage differential. To the best of our knowledge, this channel has not been analyzed yet. Although such an analysis could also be examined in a standard CES preference framework as in Helpman, Melitz and Yeaple (2003), the pro-competitive effects of trade liberalization on the price markup have to be neglected with such a preference structure.

Our key results can be summarized as follows. Firstly, we investigate the classical “proximity-concentration” trade-off. The standard prediction is that increasing the fixed costs of FDI leads to a substitution of FDI by exporting. The crucial new insight in our framework with endogenous wages is that the substitution effect is dampened by a relative wage effect. More firms export from the domestic country to the foreign country due to higher fixed costs of FDI. Moreover, those firms demand more labor in their domestic country and hence increase the relative wage. This effect reduces the profits from exporting and dampens the relocation from FDI to exporting. We consider this new wage effect to be an important aspect in both the theoretical and the political discussion of whether countries should attract FDI by subsidies or not. In fact, attracting FDI leads to an increase in the relative wage and a reinforcement of the gains from attracting FDI.

Secondly, we study a discrete change in the availability of FDI. We compare a situation where firms are allowed to use FDI with a scenario where firms are restricted to use exporting to serve a foreign market as in the original model by Behrens et al. (2009). Similar to Helpman, Melitz and Yeaple (2004) FDI is only attractive to the firms with the highest productivity. Those firms earn higher profits with the option of FDI than without and consequently decrease expected profits of all other firms. Hence, the mass of entrants decreases and the toughness of competition is softer. Similar to the first result, Helpman, Melitz and Yeaple (2004) and Chor (2009) neglect the effects of attracting FDI on the toughness of competition and firm entrants. From a welfare perspective we find that attracting FDI by decreasing fixed costs may increase total welfare, as welfare is humped shaped. The reason is that the increase in consumed FDI varieties outweighs the decrease in consumed export varieties.
The remainder of the paper is organized as follows. Section 2 deals with the closed economy case. In Section 3 we extend it to an open economy framework and discuss comparative statics in the bilateral and unilateral case. To isolate the various effects of our rich model our approach in this section is to start with the model in its simplest form, with bilateral changes and with restrictive trade costs, so that exporting is not available. We then enhance the analysis step by step to finally reach the throughout model. Section 4 concludes.

2 Closed Economy

Consider a closed economy. Consumers derive utility from the consumption of a final good. Each firm produces exactly one horizontally differentiated final good variety. Let \( \Omega \) denote the endogenously determined set of available varieties with measure \( N \). The number of consumers is denoted by \( L \). Each consumer supplies inelastically one unit of labor, which is the only factor of production.

2.1 Preferences and demands

The preference and demand structure is established in Behrens and Murata (2007). Identical consumers have preferences which display 'love of variety' and give rise to demands with variable elasticity. The utility maximization problem of a representative consumer is given by

\[
\max_{q(j), j \in \Omega} U \equiv \int_{\Omega} [1 - e^{-\alpha q(j)}] \, dj \quad \text{s.t.} \quad \int_{\Omega} p(j) q(j) = E, \tag{1}
\]

where \( E \) denotes expenditure; \( p(j) > 0 \) and \( q(j) \geq 0 \) denote the price and the per capita consumption of variety \( j \); and \( \alpha > 0 \) is a parameter. Solving the maximization problem (1) yields the following demand function for variety \( i \):

\[
q(i) = \frac{E}{N\bar{p}} - \frac{1}{\alpha} \left\{ \ln \left[ \frac{p(i)}{N\bar{p}} \right] + h \right\}, \quad \forall i \in \Omega, \tag{2}
\]

where

\[
\bar{p} \equiv \frac{1}{N} \int_{\Omega} p(j) \, dj \quad \text{and} \quad h \equiv - \int_{\Omega} \ln \left[ \frac{p(j)}{N\bar{p}} \right] \frac{p(j)}{N\bar{p}} \, dj
\]

denote the average price and the differential entropy of the price distribution. The demand for variety \( i \) is positive if and only if its price is lower than the reservation price \( p^d \). Formally,
one can derive from (2) that

\[ q(i) > 0 \iff p(i) < p^d \equiv N\bar{p}e^{\alpha E/N - h}. \]  

(3)

Combining expression (2) and (3) yields to the demand for variety \( i \):

\[ q(i) = \frac{1}{\alpha} \ln \left( \frac{p^d}{p(i)} \right). \]

(4)

From (4) we can calculate the price elasticity of demand for a variety \( i \): \( 1/\alpha q(i) \). Hence, if individuals consume more of this variety (which is e.g. the case if their expenditure increases), they become less price sensitive. Since \( e^{\alpha q(i)} = p(i)/p^d \), indirect utility as specified in the maximization problem (1) is given by

\[ U = N - \int_{\Omega} \frac{p(i)}{p^d} d\Omega = N \left( 1 - \frac{\bar{p}}{p^d} \right). \]

(5)

### 2.2 Technology and market structure

The labor market is perfectly competitive. Hence, firms take the wage \( w \) as given. The market entry costs are fixed costs \( F \) of research and development (R&D) of labor paid at the market wage. After making the irreversible investment in R&D each firm is assigned its marginal labor requirement \( m(i) \). The productivity \( m(i) \) is drawn from a common and known, continuously differentiable distribution \( G \). The R&D costs are sunk and a firm will only stay in the market if it can charge a price \( p(i) \) that is larger or equal its marginal costs \( m(i) w \). The operating profits of a surviving firm are

\[ \pi(i) = L [p(i) - m(i) w] q(i), \]

(6)

where \( q(i) \) is given by (4). With a continuum of firms, no individual firm can alter the market price and hence the first-order conditions for (operating) profits are given by

\[ \ln \left( \frac{p^d}{p(i)} \right) = \frac{p(i) - m(i) w}{p(i)}, \quad \forall i \in \Omega. \]

(7)

A price distribution satisfying (7) is called a price equilibrium. Equations (4) and (7) imply that \( q(i) = (1/\alpha) \left[ 1 - m(i) w/p(i) \right] \), which allows us to derive the upper and lower bounds for the marginal labor requirement. The maximum output is given by \( q(i) = 1/\alpha \) at the lower bound of \( m(i) \), at \( m(i) = 0 \). The upper bound for the marginal labor requirement \( m(i) \) is given by the minimum output \( q(i) = 0 \) at \( p(i) = m(i) w \). This implies that
\( p(i) = p^D \) and gives us the cutoff marginal labor requirement defined as \( m^D \equiv p^D / w \). A firm that draws \( m^D \) is indifferent between producing and not producing, whereas all firms with a draw below (resp. above) \( m^D \) remain in (resp. exit from) the market. Hence, given a mass of entrants \( N^E \), only a fraction \( G(m^D) \) of them will have positive output. The mass of surviving firms is then given by \( N = N^E G(m^D) \).

Behrens et al. (2009) show that the average price across all varieties is given by

\[
\bar{p} = \bar{m} w + \frac{\alpha E}{N}, \quad \text{where} \quad \bar{m} \equiv \left( \frac{1}{N} \right) \int_{\Omega} m(j) \, dj
\]  

(8)

denotes the average marginal labor requirement of the surviving firms. The average markup of surviving firms is given by \( \alpha E / N \). The average price \( \bar{p} \) decreases in the mass of surviving firms \( N \). Hence, similar to Melitz and Ottaviano (2008), but in stark contrast to Melitz (2003), the average price displays a pro-competitive effect for higher \( N \). Furthermore, the average markup rises with expenditure because, as shown above, demands become less price elastic for larger quantities.

Firms differ only by their marginal labor requirement. Hence, all firm-level variables can be expressed in terms of \( m \). A key technical problem is solving (7) for \( m \) by using the Lambert \( W \) function, defined as \( \varphi = W(\varphi) e^{W(\varphi)} \).

\[1\] With the help of the Lambert \( W \) function, the profit-maximizing prices, quantities and operating profits can be expressed in terms of \( m \):

\[
p(m) = \frac{m w}{W}, \quad q(m) = \frac{1}{\alpha} (1 - W), \quad \pi(m) = \frac{L m w}{\alpha} (W^{-1} + W - 2)
\]  

(9)

where the argument \( e m / m^D \) of \( W \) is suppressed to alleviate notation. It is shown by Behrens et al. (2009) that \( W' > 0 \) for all non-negative arguments and that \( W(0) = 0 \) and \( W(e) = 1 \) (see Appendix A.1 in Behrens et al. (2009) for the derivation of (9) and the properties of \( W \)). Hence, \( 0 \leq W \leq 1 \) if and only if \( 0 \leq m \leq m^D \). The expressions in (8) show that a firm with a draw \( m^D \) charges a price equal to marginal cost, faces zero demand, and earns zero operating profits. Since \( W' > 0 \), we readily obtain \( \partial p(m) / \partial m > 0 \), \( \partial q(m) / \partial m < 0 \) and \( \partial \pi(m) / \partial m < 0 \). Firms with better productivity draws (i.e. lower \( m \)) charge lower prices, sell larger quantities, and earn higher operating profits than firms with worse draws.

\[1\] See Corless et al. (1996) for a survey with many applications about the Lambert \( W \) function.
2.3 Equilibrium

The closed economy equilibrium is characterized by the zero expected profit condition and labor market clearing. Using (6), the zero expected profit condition for each firm is given by:

\[ L \int_0^{m^D} [p(m) - mw] q(m) dG(m) = Fw, \] (10)

which, combined with (9), can be rewritten as

\[ \frac{L}{\alpha} \int_0^{m^D} m(W^{-1} + W - 2) dG(m) = F. \] (11)

Behrens et al. (2009) show in their Appendix A.2. that the equilibrium is unique and exists. Furthermore, the labor market clearing condition is given by:

\[ N^E \left[ L \int_0^{m^D} mq(m) dG(m) + F \right] = L \] (12)

which combined with (9), can be rewritten as

\[ N^E \left[ \frac{L}{\alpha} \int_0^{m^D} m(1 - W) dG(m) + F \right] = L. \] (13)

Given the equilibrium cutoff \( m^D \), equation (12) can be uniquely solved for \( N^E \).

A central question in Behrens et al. (2009) is how the population size affects entry and firms’ survival probabilities. Using the equilibrium conditions (11) and (13), they show that a larger \( L \) leads to more entrants \( N^E \) and a smaller cutoff \( m^D \), respectively (see Appendix A.3. in Behrens et al. (2009)). The effect of population size on the mass of surviving firms \( N \) is in general ambiguous. However, under the commonly made assumption that firms’ productivity draws \( 1/m \) follow a Pareto distribution

\[ G(m) = \left( \frac{m}{m_{max}} \right)^k, \]

with upper bound \( m_{max} > 0 \) and shape parameter \( k \geq 1 \), Behrens et al. (2009) derive that \( N \) is increasing in \( L \). Using this distributional assumption, it is possible to derive closed-form solutions for the equilibrium cutoff and the mass of entrants

\(^{2}\)The Pareto distribution has been extensively used in the previous literature on heterogeneous firms (e.g., Bernard et al. (2007); Helpman et al. (2008); Melitz and Ottaviano (2008))
\[ m^D = \left[ \frac{\mu^{\text{max}}}{L} \right]^{\frac{1}{k+1}} \quad \text{and} \quad N^E = \frac{\kappa_2}{\kappa_1 + \kappa_2} \frac{L}{F}, \tag{14} \]

with \( \mu^{\text{max}} \equiv \frac{\alpha F (m^{\text{max}})^k}{\kappa_2} \) and where \( \kappa_1 \) and \( \kappa_2 \) are positive constants that solely depend on the shape parameter \( k \) (see Appendices B.1 and B.2 in Behrens et al. (2009))\(^3\).

The term \( \mu^{\text{max}} \) can be interpreted as a measure of “technological possibilities”: the lower the fixed labor requirement for entry \( F \) or the lower the upper bound \( m^{\text{max}} \), the lower will be \( \mu^{\text{max}} \) and hence the equilibrium cutoff \( m^D \). Selection is therefore tougher in markets with better technological possibilities. Since \( \bar{m} = [k/(k+1)]m^D \) holds when productivity follows a Pareto distribution, a larger population or better technological possibilities also map into higher average productivity \( 1/\bar{m} \). The mass of surviving firms is then given as follows:

\[ N = \frac{1}{\kappa_1 + \kappa_2} \frac{\alpha}{m^D} = \frac{\alpha}{\kappa_1 + \kappa_2} \left( \frac{L}{\mu^{\text{max}}} \right)^{\frac{1}{k+1}}, \tag{15} \]

which is increasing in population size \( L \) and technological possibilities \( \mu^{\text{max}} \).

Finally, plugging (8) into (5), the indirect utility is given by \( U = N - (\alpha N \bar{m})/m^D \).

Using \( \bar{m} = [k/(k+1)]m^D \) and (14), we then have

\[ U = \left[ \frac{1}{(\kappa_1 + \kappa_2)(k+1)} - \alpha \right] \frac{\alpha}{m^D} = \alpha \left[ \frac{1}{(\kappa_1 + \kappa_2)(k+1)} - 1 \right] \left( \frac{L}{\mu^{\text{max}}} \right)^{\frac{1}{k+1}}, \tag{16} \]

where the term in square brackets is, by construction of the utility function, positive for all \( k \geq 1 \). Alternatively, indirect utility can be written as \( U = [1/ (k+1) - (\kappa_1 + \kappa_2)] N \). Hence, as can be seen from expression (14)-(16), larger markets with better technological possibilities allow for higher utility because of greater consumption diversity and tougher selection.

\(^3\)For this solution to be consistent, Behrens et al. (2009) assume that \( m^D \leq m^{\text{max}} \), i.e., \( m^{\text{max}} \geq \alpha F/ (\kappa_2 L) \)
3 Open Economy

Consider two potentially asymmetric countries.

3.1 Preferences and demands

Preferences in the open economy are analogous to the ones described in the autarky. Let \( p_{sr}(i) \) and \( q_{sr}(i) \) denote the price and the per capita consumption of variety \( i \) when it is produced in region \( s \) and consumed in region \( r \). The utility maximization problem of consumer in region \( r \) is given by:

\[
\max_{q_{sr}(j), j \in \Omega_{sr}} U_r \equiv \sum_s \int_{\Omega_{sr}} [1 - e^{-\alpha q_{sr}(j)}] \, dj \quad \text{s.t.} \quad \sum_s \int_{\Omega_{sr}} p_{sr}(j)q_{sr}(j) \, dj = E_r
\]

(17)

where \( \Omega_{sr} \) denotes the set of varieties produced in region \( s \) and consumed in region \( r \). The demand function are given as follows:

\[
q_{sr}(i) = \frac{E_r}{N_r^c \overline{p}_r} - \frac{1}{\alpha} \left\{ \ln \left[ \frac{p_{sr}(i)}{N_r^c \overline{p}_r} \right] + h_r \right\}, \quad \forall i \in \Omega_{sr}
\]

(18)

where \( N_r^c \) is the mass of consumed varieties in region \( r \), and

\[
\overline{p}_r \equiv \frac{1}{N_r^c} \sum_s \int_{\Omega_{sr}} p_{sr}(j) \, dj \quad \text{and} \quad h_r \equiv -\sum_s \int_{\Omega_{sr}} \ln \left[ \frac{p_{sr}(i)}{N_r^c \overline{p}_sr} \right] \frac{p_{sr}(j)}{N_r^c \overline{p}_sr} \, dj.
\]

(19)

denote the average price and the differential entropy of the price distribution of all varieties consumed in region \( r \). As in the closed economy case, the demand for a domestic variety \( i \) (resp., foreign variety \( j \)) is positive if and only if the price of variety \( i \) (resp., variety \( j \)) is lower than the choke price \( p_r^d \). Formally,

\[
q_{sr}(i) > 0 \iff p_{sr}(i) < p_r^D \quad \text{and} \quad q_{rr}(i) > 0 \iff p_{rr}(i) < p_r^D,
\]

(20)

where \( p_r^D \equiv N_r^c \overline{p}_r e^{E_r/(N_r^c \overline{p}_r)} - h_r \) is a function of the price aggregates \( \overline{p}_r \) and \( h_r \). The demands for domestic and foreign varieties can then be concisely expressed as follows:

\[
q_{rr}(i) = \frac{1}{\alpha} \ln \left[ \frac{p_r^d}{p_{rr}(i)} \right] \quad \text{and} \quad q_{sr}(i) = \frac{1}{\alpha} \ln \left[ \frac{p_r^d}{p_{sr}(i)} \right].
\]

(21)

Since \( e^{\alpha q_{sr}(i)} = p_{sr}(i)/p_r^d \), indirect utility as specified in the maximization problem (1) is given by
\[ U_r = N_r^c - \int_{\Omega_{r \cdot}} \frac{p_{r \cdot}(j)}{p_r^d} \, dj = N_r^c \left( 1 - \frac{\bar{p}_r}{p_r^d} \right). \] (22)

### 3.2 Technology and market structure

Technology and the entry process are identical to the ones described in the closed economy. We assume that markets are segmented, where costs of resale or third-party arbitrage are sufficiently high, and that firms are free to price discriminate.

Firms can serve a foreign market by exporting or setting up a new production plant in the foreign country. We call the latter case horizontal foreign direct investment (FDI). Exports have to be shipped from country \( r \) to \( s \) and involve iceberg type trade costs, i.e. shipments from \( r \) to \( s \) are subject to trade costs \( \tau_{rs} > 1 \) for all \( r \) and \( s \) which incur in terms of labor. Setting up a new production plant in the foreign country is assumed to increase the fixed costs of production by \( P \). Hence, as it is discussed at length in the literature the classical proximity concentration trade-off emerges: FDI saves trade costs, while exporting saves additional overhead costs for building up a foreign production plant.

Firms in region \( r \) draw their productivities from a region-specific distribution \( G_r \). The operating profit of firm \( i \) originated in country \( r \) from domestic sales is given by

\[ \pi_r^D (i) = L_r q_{rr} (i) \left[ p_{rr} (i) - \tau_{rr} m_r (i) w_r \right]. \] (23)

The operating profit of a firm \( i \) originated in country \( r \) from exporting to country \( s \) is given by

\[ \pi_r^X (i) = L_s q_{rs} (i) \left[ p_{rs} (i) - \tau_{rs} m_r (i) w_r \right]. \] (24)

Alternatively, a firm originated in country \( r \) can choose to serve the foreign country \( s \) by using horizontal FDI. In this case the operating profits are given by

\[ \pi_r^F (i) = L_s q_{ss} (i) \left[ p_{ss} (i) - \tau_{ss} m_r (i) w_s \right] - m_r (i) w_s P_s. \] (25)

Note that FDI “fixed costs” actually decrease in the firms’ productivity levels.\(^4\)

\(^4\)At first sight, a more classical definition of FDI profits would be

\[ \pi_r^F (i) = L_s q_{ss} (i) \left[ p_{ss} (i) - \tau_{ss} m_r (i) w_s \right] - w_s P_s. \] (26)

with fixed costs independent of the productivity level. However, if we consider the most productive firms we get
Each firm maximizes profits with respect to its price \( p_{rs} (i) \) separately. The first-order conditions are given by:

\[
\ln \left[ \frac{p^D_r}{p_{rr} (i)} \right] = \frac{p_{rr} - \tau_{rr} m_r (i) w_r}{p_{rr} (i)}, \quad i \in \Omega_{sr} \tag{27}
\]

For domestic and exporting equations (21) and (27) still imply that \( q_{rs} (i) = (1/\alpha) \left[ 1 - \tau_{rs} m_r (i) w_r/p_{rs} (i) \right] \), which shows that \( q_{rs} (i) = 0 \) at \( p_{rs} (i) = \tau_{rs} m_r (i) w_r \). It then follows from (27) that \( p_{rs} (i) = p^D_s \). Hence, a firm located in \( r \) with draw \( m^x_{rs} \equiv p^D_s / (\tau_{rs} w_r) \) is just indifferent between selling and not selling in region \( s \) via exporting. All firms in \( r \) with draws below \( m^x_{rs} \) are productive enough to sell to region \( s \). In what follows, we refer to \( m^D_s \equiv m^D_s \) as the domestic cutoff in region \( s \), whereas \( m^X_{rs} \) with \( r \neq s \) is the export cutoff. Export and domestic cutoffs are linked as follows:

\[
m^X_{rs} = \frac{\tau_{ss} w_s}{\tau_{rs} w_r} m^D_s \tag{28}
\]

It is now clear from expression (28) that the “classical ranking”, namely that exporting requires a higher productivity than selling domestically, does not necessarily hold anymore. The usual ranking only prevails if and only if \( \tau_{ss} w_s < \tau_{rs} w_r \). An easy example for that case would be if wages are equalized \((w_r = w_s)\) and internal trade is costless while trade between region is costly.

The first-order conditions can be solved as in the closed economy case. Switching to notation in terms of \( m \), the profit-maximizing prices and quantities, as well as operating profits for domestic, exporting and FDI sales are given by:

\[
p_{rr} (m) = \frac{\tau_{rr} m w_r}{W^D_r}, \quad q_{rr} (m) = \frac{1}{\alpha} \left( 1 - W^D_r \right), \quad \pi^D_r = \frac{L_r \tau_{rr} m w_r \left( 1 - W^D_r \right)^2}{\alpha W^D_r}, \tag{29}
\]

\[
\lim_{m \to 0} \pi^X_r = \frac{L_s w_s \tau_{ss}}{\epsilon \alpha} m^D_s; \quad \lim_{m \to 0} \pi^F = \frac{L_s w_s \tau_{ss}}{\epsilon \alpha} m^D_s - P_s w_s; \quad \lim_{m \to 0} \pi^F = \frac{L_s w_s \tau_{ss}}{\epsilon \alpha} m^D_s.
\]

Hence, with the classical definition the most productive firms would use exporting instead of FDI. However, empirical evidence by Helpman, Melitz and Yeaple (2004) suggests, that this sorting pattern cannot be a desirable feature of the model. In fact, it is rather an artifact of our definition of trade costs. With ice-berg type trade costs and profits bounded from above the most productive firms have zero marginal costs in the limit. Hence, also the trade costs disadvantage \( \tau_{rs} \) in front of the productivity parameter \( m \) vanishes in the limit which leads to in fact no trade costs. To balance this artifact effect of ice berg type trade costs, we need to have fixed FDI costs dependent on the marginal labor requirement as given by (18). Both, the marginal trade costs and the marginal fixed FDI costs now decrease with a lower marginal labor requirement and we have the classical ranking that the most productive firms use FDI while the medium productive firms export to foreign markets.
\[ p_{rs}(m) = \frac{\tau_{rs}mw_r}{W^X_r}, \quad q_{rs}(m) = \frac{1}{\alpha} (1 - W^X_r) \], \quad \pi^X_r = \frac{L_s\tau_{rs}mw_r (1 - W^X_r)^2}{\alpha W^X_r} \quad (30) \]

and

\[ p_{ss}(m) = \frac{\tau_{ss}mw_s}{W^F_r}, \quad q_{ss}(m) = \frac{1}{\alpha} (1 - W^F_r) \], \quad \pi^F_r = \frac{L_s\tau_{ss}mw_s (1 - W^F_r)^2}{\alpha W^F_r} - mw_s P_s \quad (31) \]

where \( W \) denotes the Lambert \( W \) function. The arguments are

\[ W^D_r = W(e\tau_{rr}mw_r/p^D_r), \quad W^X_r = W(e\tau_{rs}mw_r/p^D_r) \], \quad W^F_r = W(e\tau_{ss}mw_s/p^D_s) \]

The more productive firms again charge lower prices, sell larger quantities and earn higher operating profits. We already derived the domestic and exporting cutoff. The analogous technique cannot be used for FDI since with fixed costs zero quantities do not necessarily imply zero profits. Nevertheless, the \( FDI \) cutoff can be derived by numerically solving \( \pi^F_r(m^T_r) = \pi^X_r(m^T_r) \) for \( m^T_r \).

Given a mass of entrants \( N^E_r \) and export cutoffs \( m^x_{rs} \) as in (28), only \( N^p_r = N^E_r G_r (\max \{m^x_{rs}\}) \) firms survive in region \( r \), namely those which are productive enough to sell at least in one market (which does not have to be the local market). Conversely, the mass of varieties consumed in region \( r \) is given by

\[ N^c_r = \sum_s N^E_s G_s (m^x_{sr}) \quad (32) \]

which is the sum of all firms that are productive enough to serve market \( r \).

Multiplying both sides of (27) by \( p_{sr}(i) \), integrating over \( \Omega_{rs} \), and summing the resulting expressions across \( r \), we obtain the average price across all varieties sold in market \( s \):

\[ \bar{p}_s = \frac{1}{N^c_s} \sum_r \int_{\Omega_{rs}} p_{rs}(j) \, dj = \frac{1}{N^c_s} \sum_r \tau_{rs}w_r \int_{\Omega_{rs}} m_r(j) \, dj + \frac{\alpha E}{N^c_s}, \quad (33) \]

where the first term is the average marginal delivered costs, and the second term is the average markups in the market \( s \). Expression (33) shows that the average markup is decreasing in the mass \( N^c_s \) of firms competing in region \( s \) and increasing in expenditure \( E_s \).
which is similar to the results established in the closed economy case.

3.3 Equilibrium

To close the model we have to state the equilibrium conditions. The zero expected profit condition for each firm in region \( r \) is given by

\[
F_r w_r = \int_0^{m^D_r} L_r [p_{rr} (m) - \tau_{rr} w_r m] q_{rr} (m) dG_r (m)
+ \int_{m^X_r}^{m^T_r} L_s [p_{rs} (m) - \tau_{rs} w_r m] q_{rs} (m) dG_r (m)
+ \int_0^{m^T_s} (L_s [p_{ss} (m) - \tau_{ss} w_s m] q_{ss} (m) - P_r w_r m) dG_r (m)
\]

where \( F_r \) is the region-specific fixed labor requirement. The first term are domestic profits, the second term are export profits and the third term are FDI profits. Furthermore, each labor market clears in equilibrium, which requires that

\[
L_r = N_r^E \left( L_r \int_0^{m^D_r} m \tau_{rr} q_{rr} (m) dG_r (m) + F_r \right)
+ N_r^E L_s \int_{m^X_r}^{m^T_r} m \tau_{rs} q_{rs} (m) dG_r (m)
+ N_s^E \left( \int_0^{m^T_s} (L_r m \tau_{rr} q_{rr} (m) + P_r m) dG_s (m) \right).
\]

The first term is “firms from region \( r \) serve their domestic region \( r \)”, the second term is “firms from region \( r \) that serve foreign region \( s \) via exporting” and the third term is “firms from region \( s \) that serve region \( r \) via FDI”. Last, the current account is balanced for each region if \( CA_{rs} = CA_{sr} \) with

\[
CA_{rs} = N_r^E L_s \int_{m^X_r}^{m^T_r} p_{rs} (m) q_{rs} (m) dG_r (m)
+ N_s^E \int_0^{m^T_s} (L_r [p_{rr} (m) - \tau_{rr} w_r m] q_{rr} (m) - P_r w_r m) dG_s (m)
\]
The first term is “exports from domestic region \( r \) to foreign region \( s \)” and the second term is “transfer of FDI profits from domestic region \( r \) back to foreign region \( s \).

As in the foregoing section, we can restate the equilibrium conditions using the Lambert \( W \) function. In what follows, we assume that productivity draws \( 1/m \) follow Pareto distributions with identical shape parameter \( k \geq 1 \). However, to capture differences in local technological possibilities, we allow the upper bounds to vary across regions, i.e. \( G_r(m) = (m/m_r^{max})^k \). A lower \( m_r^{max} \) implies that firms in region \( r \) have a higher probability of drawing a better productivity. Under the Pareto distributions, the equilibrium conditions can be greatly simplified. First, using the the expressions in Appendices B.1 and C.1 in Behrens et al. (2009), labor market clearing requires that

\[
L_r = N_r^E \left[ \frac{\kappa_1}{\alpha (m_r^{max})^k} \left[ L_r \tau_{rr} \left( m_r^D \right)^{k+1} + L_s \tau_{rs} \left( m_r^X \right)^{k+1} - (m_r^T)^{k+1} \right] \right] + F_r \\
+ \frac{N_s^E \kappa_1 L_r \tau_{rr} \left( m_s^T \right)^{k+1}}{(m_s^{max})^k} + \frac{N_s^E P_r \kappa_4 \left( m_s^T \right)^{k+1}}{(m_s^{max})^k} \tag{34}
\]

with \( \kappa_1 = ke^{-(k+1)} \int_0^1 (1 - z^2) z^k e^z e^z dz \). Second, using the expressions in Appendices B.2 and C.2 in Behrens et al. (2009) zero expected profits imply that

\[
\mu_r^{max} = \frac{F_r (m_r^{max})^k \alpha}{\kappa_2} \\
= L_r \tau_{rr} \left( m_r^D \right)^{k+1} + L_s \tau_{rs} \left( m_r^X \right)^{k+1} \\
- L_s \tau_{rs} \left( m_s^T \right)^{k+1} + L_s \tau_{ss} w_s / w_r \left( m_r^T \right)^{k+1} - \frac{\kappa_4}{\kappa_2} \alpha P_s w_s / w_r \left( m_s^T \right)^{k+1} \tag{35}
\]

with \( \kappa_2 = e^{-(k+1)} k \int_0^1 z^k (z^{-1} + z - 2) (1 + z) e^{z} e^{z} dz \) and \( \kappa_4 = e^{-(k+1)} k \int_0^1 z^k (1 + z) e^{z} e^{z} dz \) while \( \mu_r^{max} \) is a monotonic transformation of the upper bounds. Last, using the expressions in Appendices B.3 and C.3 in Behrens et al. (2009), the current account balance requires that \( CA_{rs} = CA_{sr} \) with

\[
CA_{rs} = \frac{N_r^E L_s \tau_{rs} w_r \kappa_3}{\alpha (m_r^{max})^k} \left[ \left( m_r^X \right)^{k+1} - (m_r^T)^{k+1} \right] \\
+ \frac{N_r^E w_r}{\alpha (m_s^{max})^k} \left[ L_r \tau_{rr} \left( m_s^T \right)^{k+1} - \alpha P_r \left( m_s^T \right)^{k+1} \kappa_4 \right] \tag{36}
\]
and \( \kappa_3 = e^{-(k+1)k} \int_0^1 z^k (z^{-1} - z) e^{z} e^z \, dz \). Note, that if we assume sufficiently high fixed costs of FDI, the threshold productivity \( m^T \) is zero. In this case zero profit conditions, labor market clearing and trade balance reduce to the terms as stated in Behrens et al. (2009). An equilibrium in the open economy is characterized by the mass of entrants \( N^E \), the domestic cutoffs \( m^D \) and the relative wage \( \omega \equiv \omega_r / \omega_s \). It is determined by the zero expected profit condition, the labor market clearing condition and the current account balance.

In the following sections 3 and 4 we solve the model by using both analytical and numerical methods. We are interested in whether countries have an unilateral incentive to lower the fixed costs of FDI. Ultimately, we want to answer this question in a setting of potentially asymmetric countries and where firms may also use exporting besides FDI.

To develop the economic intuition for the rich set of possible effects in our model we start in section 3 with the assumption of sufficiently high trade costs such that exporting is not “profitable” for any firm. In this scenario all firms that serve a foreign market do so by using FDI instead of exporting. In section 4 we annul this assumption and consider sufficiently low transport costs such that medium productive firms choose to export and high productive firms rely on FDI.

4 High trade costs

In order to study the most “basic” version of the model we start with the assumption of symmetrical countries. Later we annul this assumption by studying asymmetric countries and unilateral changes in the fixed costs of FDI. In this scenario we have to rely on numerical methods since we cannot solve in principle for the FDI cutoff.

4.1 Symmetric countries

In this section we assume i.) sufficiently high trade costs such that no firm exports and ii.) symmetrical countries. We consider countries as symmetric if they are identical in their country sizes, technological possibilities, internal and external trade costs, entry costs, fixed costs of FDI and the wage rate. As motivated in the introduction we ask ourselves if countries have an bilateral incentive to promote FDI by decreasing fixed costs.

We have already shown that the FDI cutoff \( m^F \) is proportional to the domestic cutoff \( m^D \): \( (m^F)^{k+1} = \chi (m^D)^{k+1} \) with \( \chi^{1/(1+k)} \equiv \xi \cdot e^\xi \). We further show in Appendix B that \( \partial \chi / \partial P < 0 \). Hence, tremendously high fixed costs \( P \to \infty \) lead to \( m^F \to 0 \) while vanishing
fixed costs $P \to 0$ lead to $m^F \to m^D$. The zero expected profit condition eq.(35) and labor market clearing condition eq.(34) reduce to

\[
\mu_r^{\text{max}} = L (m^D)^{k+1} + L\chi (m^D)^{k+1} - \frac{\kappa_4}{\kappa_2} \alpha P \chi (m^D)^{k+1}
\]

and

\[
L = N^E \left[ \frac{\kappa_1 L}{\alpha (m^{\text{max}})^k} (m^D)^{k+1} (1 + \chi) + F + \frac{\kappa_4}{(m^{\text{max}})^k} P \chi (m^D)^{k+1} \right].
\]

Using the zero expected profit condition we can obtain a closed-form solution for the domestic cutoff which is given by:

\[
(m^D)^{k+1} = \frac{\mu^{\text{max}} \kappa_2}{L \kappa_2 (1 + \chi) - P \alpha \kappa_4 \chi}.
\]

With the domestic cutoff we now can also derive a closed form solution for the FDI cutoff since $(m^F)^{k+1} = \chi (m^D)^{k+1}$. With a closed form solution for the domestic cutoff as given by eq.(39) we are able to solve for the mass of entrants and surviving firms:

\[
N^E = \frac{\alpha (m^{\text{max}})^k}{(\kappa_1 + \kappa_2) (1 + \chi)} \cdot \frac{1}{(m^D)^{k+1}} = \frac{\kappa_2}{\kappa_1 + \kappa_2} \frac{L}{F} - \frac{\alpha \kappa_4}{\kappa_1 + \kappa_2} \frac{\chi P}{1 + \chi}
\]

respectively

\[
N^S = N^E G (m^D) = \frac{\alpha}{(\kappa_1 + \kappa_2) (1 + \chi)} \cdot \frac{1}{m^D}.
\]

Note that the mass of entrants $N^E$ substantially differs from mass of entrants as derived in Behrens et al. (2009), see eq.(31). With FDI the mass of entrants is always lower since the second term in eq.(40) is strictly positive for $P > 0$. The mass of consumed varieties is given by

\[
N^C = N^E \left[ G (m^D) + G (m^F) \right] = \left( 1 + \chi \frac{\alpha}{\kappa_1} \right) N^S
\]

and unambiguously rises with lower fixed costs of FDI (higher $\chi$). Similar to trade liberalization in Behrens et al. (2009) lower fixed costs of FDI increases the mass of consumed varieties. The average price $\bar{p}$ can be written as
\[
\bar{p} = \frac{1}{N^C} \left[ \int_{\Omega_{\text{dom}}} p(j) \, dj + \int_{\Omega_{\text{FDI}}} p(j) \, dj \right] = \frac{(1 + \chi)^{1/\kappa + 1}}{1 + \chi^{1/\kappa}} \cdot \frac{k}{1 + k} \cdot p^D + \frac{\alpha}{N^C}
\]  

(43)

where the first term is the average marginal costs, and the second term is the average markup. Finally, using the average price \(\bar{p}\) indirect utility simplifies to

\[
U = N^C \left( 1 - \frac{\bar{p}}{\bar{p}^D} \right) = N^C \left( 1 - \frac{k + \kappa_1 + \kappa_2}{1 + \chi^{1/\kappa}} (1 + \chi) \right) = \frac{\alpha}{m^D} \left[ \frac{H(\chi)}{(\kappa_1 + \kappa_2)} - 1 \right]
\]  

(44)

with \(H = \left[ 1 - k\chi + (1 + k) \chi^{1/\kappa} \right] / [(1 + k) (1 + \chi)]\).

What follows is a detailed discussion of the comparative statics with respect to \(P\). We analyze how the fixed costs of FDI \(P\) change the equilibrium mass of entrants \(N^E\), surviving firms \(N^S\), consumed varieties \(N^C\), average price and markups and most important welfare \(U\). For all variables we determine the extreme cases where FDI is costless \((P \to 0, \chi \to 1, \text{denoted by AUT})\) with the scenario where FDI is tremendously costly \((P \to \infty, \chi \to 0, \text{denoted by OPEN})\). The domestic cutoff is then given by

\[
m_{\text{AUT}}^D = \left( \frac{\mu_{\text{max}}}{\alpha} \right)^{\frac{1}{\kappa + 1}} \text{ and } m_{\text{OPEN}}^D = \left( \frac{\mu_{\text{max}}}{\alpha} \right)^{\frac{1}{\kappa + 1}}
\]  

(45)

At first sight it seems clear that higher costs of doing FDI actually lead to a higher cutoff and softer competition. This would be standard result as if we consider higher trade costs in Behrens et al. (2009), Melitz (2003) or Melitz and Ottaviano (2008). Starting with high fixed costs of FDI \(P\) such that they are larger than a certain threshold \(P^*\), lower fixed costs of FDI first lead to an increase in the domestic cutoff. That means better possibilities to serve the foreign market lead to softer competition in both markets. However, for sufficiently lower fixed costs of FDI \(P < P^*\) a decrease in \(P\) leads to the standard result of tougher competition.\(^5\)

The economic intuition for this “surprising” comparative static result of \(m^D\) is straightforward. For \(P < P^*\) a higher \(P\) leads to lower operating profits that need a not that good domestic cutoff to fulfill the zero profit condition. Hence, the domestic cutoff increases

\(^5\)The threshold \(P^*\) is given by

\[
P^* = \frac{L}{\alpha} \cdot \frac{6k_2 + k_4 - \sqrt{4k_2^2 + 12k_2k_4 + k_4^2}}{4k_4}
\]  

(46)
in $P$ which is the standard result similar to higher trade costs in Behrens et al. (2009). After that, i.e. for a $P > P^*$, the softening of competition is offset by an increase in the fixed costs (see 3 term in the zero profit condition, eq. (37)). This effect is a new effect. Hence, higher fixed costs $P$ need a higher productivity and the domestic cutoff decreases and converges to $m_D^{AUT}$. If $P$ resides beyond the threshold $P^*$, a further raise will decrease the expected FDI profits, due to higher fixed costs, and therefore firms need to be more productive in order to stay in the market.

The mass of entrants is given by

$$N_{AUT}^E = \frac{\kappa_2}{\kappa_1 + \kappa_2} \frac{L}{F} \quad \text{and} \quad N_{OPEN}^E = \frac{\kappa_2}{\kappa_1 + \kappa_2} \frac{L}{F}$$

(47)

From eq.(40) we know that the mass of entrants is inverse proportional to the domestic cutoff $m_D$. Hence, we have a U-shaped relationship and not, as the two extreme points suggest a constant. The mass of surviving firms in both cases is given by

$$N_{AUT}^S = \frac{\alpha}{\kappa_1 + \kappa_2} \left( \frac{L}{\mu^{\max}} \right)^{\frac{1}{\kappa + 1}} \quad \text{and} \quad N_{OPEN}^S = \frac{\alpha}{\kappa_1 + \kappa_2} \left( \frac{L}{2k\mu^{\max}} \right)^{\frac{1}{\kappa + 1}}$$

(48)

and unambiguously increases in $P$. The mass of consumed varieties is important for determining the price markup and given by

$$N_{AUT}^C = \frac{\alpha}{\kappa_1 + \kappa_2} \left( \frac{L}{\mu^{\max}} \right)^{\frac{1}{\kappa + 1}} \quad \text{and} \quad N_{OPEN}^C = \frac{\alpha}{\kappa_1 + \kappa_2} \left( \frac{2L}{\mu^{\max}} \right)^{\frac{1}{\kappa + 1}}$$

(49)

As already discussed the mass of consumed varieties unambiguously increases with lower fixed costs of FDI. After we have discussed the variables that determine the equilibrium, we continue with the average markups and welfare. The average price is given by

$$\bar{p}_{AUT} = \frac{\kappa_3 + k(1 + \kappa_3)}{1 + k} \left( \frac{\mu^{\max}}{L} \right)^{\frac{1}{\kappa + 1}} \quad \text{and} \quad \bar{p}_{OPEN} = \frac{\kappa_3 + k(1 + \kappa_3)}{1 + k} \left( \frac{\mu^{\max}}{2L} \right)^{\frac{1}{\kappa + 1}}$$

(50)

and hence the average price decreases with $P$. The markup is inverse related to the mass of consumed varieties and hence decreases with lower $P$. Finally, utility
\[ U_{AUT} = \alpha \left[ \frac{1}{\kappa_3 (k+1)} - 1 \right] \left( \frac{L}{\mu^{max}} \right)^{\frac{1}{\kappa_1}} \quad \text{and} \quad U_{OPEN} = \alpha \left[ \frac{1}{\kappa_3 (k+1)} - 1 \right] \left( \frac{2L}{\mu^{max}} \right)^{\frac{1}{\kappa_1}} \]

and welfare seems to increase with lower \( P \). However, the relationship is not monotone. To derive the economic intuition we have to reconsider welfare given by:

\[ U(P) = N^C \left( 1 - \frac{\bar{p}}{p^D} \right) \]

Everything else equal indirect utility rises in the mass of consumed varieties \( N^C \), in the domestic cutoff (due to \( p^D = m^D \)) and a lower average price \( \bar{p} \). The mass of consumed varieties increases with lower \( P \) while the the average price \( \bar{p} \) decreases. Both effects lead to a higher utility if the fixed costs of FDI fall. However, the relative average price \( \bar{p}/p^D \) does not unambiguously decrease. It actually increases for low levels of \( P \). In particular for a \( P > P^* \). So how can we explain this U-shaped relative price? For sufficiently high levels of FDI fixed costs new FDI firms are firms that charge a relatively low price since they are high productive compared to the average productive firms. Hence, the relative price decreases. Decreasing the fixed costs further leads to the fact that now also relatively underproductive firms decide to serve the foreign market. Theses firms charge a relatively high price and the relative average price increases again.

Having in mind that the relative average price is not minimal for \( P \to 0 \) countries do not have an bilateral incentive to lower fixed costs of FDI to the absolute minimum as Figure 1 illustrates.

5 Moderate trade costs

5.1 Symmetric countries

If we allow for exporting the productivity threshold, above which FDI will not be chosen, is not the threshold where FDI profits are zero. It is rather the threshold, at which exporting becomes more profitable than FDI. However, we cannot derive a closed form solution for \( m^T \) and we therefore have to rely on numerical methods. As the zero expected profit conditions only depend on the cutoffs and the relative wage, we solve for the cutoffs \( m^D(\omega, m^T) \). Then, using the labor market clearing conditions we can solve for the mass of entering firms \( N^E(\omega, m^D, m^T) \). In a next step we use \( m^D(\omega, m^T) \) in \( N^E(\omega, m^D, m^T) \)
Figure 1: Indirect utility

...to eliminate the domestic cutoffs. Hence, the mass of entrants is given by $N^E(\omega, m^T)$. Using the expression in the current account balance and the two indifference conditions $Z$ we can solve for the equilibrium allocation numerically.

**Comparative statics with respect to $P$:** If the costs of setting up a FDI plant decrease in both countries, competition will be lower inducing higher cutoffs for all modes. This happens, as there are more FDI Firms that are however less productive on average; the average FDI cutoff increases. As FDI is more attractive, exporting becomes less attractive, relative to FDI, and even though the export cutoff increases, the mass of exporting firms decreases. Furthermore we find that this will lead to more consumed varieties and higher utility. Utility is however hump shaped, as for low levels of $P$, utility is decreasing in further decreases in $P$. Utility is hump shaped, as utility is formed by the trade-off between a higher average price and more consumed varieties.

**Comparative statics with respect to $\tau$:** Going over to the comparative statics with respect to a bilateral decrease in trade costs, we find that the mass of entrants increases, leading to tougher competition, reflected by the decrease in the domestic cutoffs. Quite naturally, exporting becomes more attractive, leaving FDI relatively less attractive. Welfare is however humped shaped, even though the mass of consumed varieties rises and the average prices decreases. This effect is driven by the falling domestic cutoff which in turn...
increases the relative average price.

5.2 Asymmetric Countries and Unilateral Changes

Comparative statics with respect to \( P_2 \): In the following we study two potentially asymmetric countries. Firstly, we consider changes in \( P_2 \), the fixed costs of setting up a new plant in country 2 for a firm located in region 1. A lower \( P_2 \) decreases the mass of entering firms in country 2, as they face more competition from foreign firms and lower higher domestic profits. The mass of entering firms in region 1 is higher as the expected profits from serving the foreign market increase. As the FDI strategy for firms in country 1 becomes more profitable due to the lower entry costs in country 2, exporting is substituted by FDI for country 1 firms. Again, this is the standard “proximity-concentration trade-off” argument. However, as our numerical simulations clearly indicate, this effect is dampened by the decrease in the relative wage \( \omega \). With endogenous wages the relative wage \( \omega = w_1/w_2 \) is driven down as there is less labor demand in country 1. This decreasing wage, leaves however exporting for country 1 firms more attractive and for country 2 firms less attractive. This dampens the substitution effect of FDI (becoming more attractive due to lower fixed costs) versus exporting (becoming more attractive due to lower wages in country 1).

Note, that this effect on the endogenous wages cannot be found in the strand of literature that incorporates factor price equalization as e.g. in Helpman, Melitz and Yeaple (2004). Furthermore, we also find that to perform FDI in country 1 becomes easier too, due to the lower relative wage, indicated by the slight increase in the FDI cutoff \( m_2^{FDI} \). That is, in line with Helpman, Melitz and Yeaple (2004) lower fixed costs of FDI in a foreign country leads to a substitution of FDI by exporting. In stark contrast to Helpman, Melitz and Yeaple (2004) we find that also exporting becomes much harder due to the fact that we now have a higher relative wage in the domestic country. We find, that lower fixed costs of FDI increase welfare in the country that grants the subsidy. For the other country, the opposite is true.

Comparative statics with respect to \( t_{12} \): Secondly, we consider a decrease in the transportation costs \( t_{12} \), that is for firms located in country 1, wanting to export to country 2. First of all, FDI becomes less attractive in both countries. Country 1 firms substitute FDI by exporting, leaving a higher relative wage. This higher relative wage is the reason why FDI for country 2 firms becomes less attractive too. Still, our model predicts the mass of entrants to rise in both countries. In country 1 there are more entrants, due to higher
expected profits due to lower transportation costs, in the other country because of the lower relative wage. Simultaneously, the domestic cutoff decreases, due to higher competition. The mass of consumed varieties rises in country 2, whereas the mass of varieties in country 1 decreases, as the fall in domestic and FDI varieties in country 1 cannot be covered by the rise in imported varieties. Welfare is rising in both countries, due to those lower trade costs.

6 Conclusion

The aim of this paper was to setup a model of international trade with exporting and FDI, for the purpose to analyze the effects of attracting FDI and lower trade costs on welfare. For this we setup a general equilibrium model with heterogeneous firms, endogenous determined wages, firm entrants and productivity cutoffs. Our preference specification displays both income and pro-competitive effects and allows for wage differentials in equilibrium.

In our opinion it is important to study a general equilibrium framework with the given features in order to deepen our understanding with respect to the classical “proximity-concentration” trade-off. As our framework allows repercussion of FDI costs to the relative wage, we find that increasing the attractiveness of FDI in one country not only allure foreign firms to use FDI, but simultaneously decreases the wage in the other country raising the attractiveness of exporting. This wage effect actually dampens the relocation effect. From the welfare perspective we find that attracting FDI firms raises welfare in the country that attracts FDI whereas the other country’s welfare decreases. Countries therefore have an incentive to compete in attracting FDI. Our analysis shows, that if countries bilaterally attract FDI, that utility is lumped shaped. That is for very low levels of fixed FDI costs, further decreases will decrease welfare in both countries.

References


Simulations

Moderate trade costs / Bilateral decrease in $P$

\[ \omega = w_1 / w_2 \]

\[ \text{rel. wage} \]

\[ N_{e2} \]

\[ \text{Entrants} \]

\[ m_{e2} \]

\[ \text{Domestic cutoff} \]

\[ m_{x2} \]

\[ \text{Export cutoff} \]

\[ m_{t2} \]

\[ \text{FDI cutoff} \]

\[ \text{Ave. Costs} \]

\[ \text{Average Costs} \]

\[ \text{Markups} \]

\[ \text{Markups} \]

\[ \text{Ave. Price} \]

\[ \text{Average Price} \]

\[ N_{c2} \]

\[ \text{Consumed Varieties} \]

\[ \text{RelAvePrice} \]

\[ \text{Relative Average Price} \]

\[ U_{12} \]

\[ \text{Utility} \]
Moderate trade costs / Bilateral decrease in $\tau$

\[ \omega = w_1 / w_2 \]

relative wage

\[ N_{12}^* \]

Entrants

\[ m_{12}^D \]

Domestic cutoff

\[ m_{12}^E \]

Export cutoff

\[ m_{12}^T \]

FDI cutoff

\[ \text{Ave. Costs} \]

Average Costs

\[ \text{Markups} \]

Markups

\[ \text{Ave. Price} \]

Average Price

\[ N_{12}^c \]

Consumed Varieties

\[ \text{RelAvePrice} \]

RelativeAveragePrice

\[ U_{12} \]

Utility
Moderate trade costs / Unilateral decrease in \( P_2 \)
Moderate trade costs / Unilateral decrease in $\tau_{12}$

\[ w = \frac{w_1}{w_2} \]

\[ N_{12} \]

Entrants

\[ \sqrt{1/\tau_{12}} \]

\[ \text{Ave. Costs} \]

\[ \text{Markups} \]

\[ \text{Ave. Price} \]

\[ \text{Consumed Varieties} \]

\[ \text{RelativeAveragePrice} \]

\[ \text{Utility} \]