Should small countries fear deindustrialization?*

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Abstract

Will small countries deindustrialize when opening up to trade with large countries? Davis (1998) shows that for the home market effect to lead to deindustrialization of small countries, trade costs for homogenous goods must be sufficiently smaller than trade costs in differentiated goods, a condition which is not supported by empirical evidence. We show that if differentiated goods production uses tradeable inputs small countries can become deindustrialized when trading with a sufficiently large country and if trade costs are low.

Keywords: home market effect, deindustrialization, trade costs, economic geography, intermediate goods

JEL code: F1, R12

1 Introduction

The theoretical works on increasing returns, trade and the home market effect (Krugman 1980, Helpman and Krugman 1985) have suggested that market size matters for industrial structure. In a two-country model, economic integration may lead producers of differentiated goods under increasing returns to scale to move their production away from the small economy to the large economy so as to save on transport costs. This leads to the so-called "home market effect" and the small economy then becomes relatively more specialized in the homogenous goods. If we consider homogenous goods as comprising of mainly agricultural products and commodities while differentiated goods are industrial goods, the home market effect implies that small economies may deindustrialize with economic

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integration. Davis (1998), however, shows that such a result depends crucially on the assumption that trade costs in the homogenous good are sufficiently lower than that of differentiated goods. As pointed out by Davis, existing empirical evidence does not provide any support for the assumption that homogenous goods incur lower transport costs. Davis therefore concludes that small economies need not fear deindustrialization stemming from opening to trade.

Following the work of Davis, several authors have re-examined the link between market size and industrial structure in the presence of transport costs in the homogenous good sector. Holmes and Stevens (2005) argue that if the firms have technologies that have a finite minimum efficient scale, then the home market effect may reemerge in the sectors experiencing highest increasing returns. Since the homogenous good is not traded in their model, small economies do not become deindustrialized. Yu (2005) shows that the home market effect can arise, disappear or reverse in sign, depending on the demand elasticity between the homogenous good and the composite of differentiated goods.[1] He also shows that small economies may have a larger (smaller) industrial sector after opening to trade if the demand elasticity is higher (smaller) than one and if transport costs are low enough. The homogenous good remains non-traded in his model. Thus Yu's model cannot capture the other effect of trade on industrial structure, namely, that small countries may become deindustrialized by becoming relatively more specialized in and exporting the homogenous good with trade. This latter effect is in the original spirit of Krugman's (1980) argument.

In this paper we show that if the production of differentiated goods uses tradeable inputs[2] which are produced under constant returns to scale and whose trade is governed by Ricardian comparative advantage, a small economy may become deindustrialized with trade under certain conditions. In line with previous literature, deindustrialization refers to the case whereby there is a reallocation of a country's labor force from the industrial sector towards the production of the homogenous good. We consider the intermediate goods as consisting of basic industrial materials and hence a country is only considered as deindustrialized with trade if it devotes more resources to the production of homogenous goods and less to the production of final differentiated and intermediate goods compared to autarky. In our paper a country becomes deindustrialized if it is an exporter of the homogenous good under trade. Deindustrialization takes place if transport costs are low, the trading partner is large enough and if the small economy has a higher import content in the production of differentiated goods than

[1] See also Crozet and Trionfetti (2007) who find a home market effect by getting rid of the homogenous good whatsoever and analyze a model of Head and Ries (2002) with a differentiated and an Armington sector.

[2] See for example Hummels et al. (2001) on the large and increasing over time import content of OECD countries production and exports.

its trading partner. We also show a surprising result that under some parameter values (in particular, if the size differential between the two trading countries is very large), it is the large country that becomes deindustrialized. This result is different from the existing literature on the home market effect reversal whereby the large country is a net importer of differentiated goods and an exporter of homogenous good (see Feenstra et al. (2001), Head, Mayer and Ries (2002), and Yu (2005)). This is because in our model the large country is a net exporter of the differentiated good as well as the homogenous good while being an importer of the intermediate good.

To understand the role played by imported intermediates, consider first the case where there is no imported intermediate input, that is, if the differentiated good is produced with 100% local labor, as in Krugman (1980). Then the relative cost of production of the differentiated good is just the inverse of the relative wage of the two countries. When transport costs are equal in both the differentiated good and the homogenous good sector, the small country's wage has to be sufficiently smaller than the large country for it to be an exporter of the homogenous good. But at this wage, a final good producing firm in the small country will suffer no disadvantage in serving the large country compared to a firm locating in the large country since the low production cost is sufficient to compensate for the transport cost. On the other hand, it enjoys a cost advantage in serving its small domestic market while avoiding the transport cost faced by producers from the large country at the same time. Thus all producers would want to locate in the small country. As a result, the relative wage cannot fall so much as to warrant trade in the homogenous good and the home market effect cannot hold. This is the essence of the argument in Davis (1998). However, if the production of the differentiated good uses some imported inputs, the wage difference does not translate fully into a corresponding difference in production costs. The larger the proportion of imported intermediate input in the production of the final good, the less sensitive will be the production cost to changes in the local wage. Therefore, even when the wage in the small country is sufficiently small for it to be an exporter of the homogenous good, the production cost in the small country may not be sufficiently low to compensate firms for the transport costs incurred in serving the large market. Thus firms may still prefer to locate in the large country if the savings on transport costs more than compensate for the higher cost of production. The small country may then become deindustrialized if it needs to export the homogenous good to cover the trade imbalance in differentiated and intermediate goods.

To illustrate our idea we consider two trading countries that produce three goods – homogenous, intermediate and final differentiated goods. Homogenous goods are produced using only local labor under a constant returns to scale technology. There are also two varieties of intermediate goods and both are produced under constant returns to scale using local labor. We assume that each country has a Ricardian technological advantage in the production of one variety sufficiently large that under trade each country will specialize in the production of one variety only. Final differentiated goods are produced under increasing returns to scale using the two varieties of intermediate inputs. Our objective is to examine the implications on the industrial structure and trading patterns as the relative size of the two trading economies increases from one.

When the size of one of the trading country increases, there are two opposing forces affecting its trade balance and hence its relative wage. On the one hand, final goods industries may want to relocate to the larger country to save on transport costs (the home market effect) increasing its net exports of differentiated good and this tends to raise the relative wage of the large country. On the other hand, the larger country requires more imported intermediate input from the small country both for its production for local consumption and for its exports of final goods. This tends to lower its relative wage. When trade costs are low, the home market effect dominates and the relative wage of the small country falls as size of the large country increases. If this fall in wage is sufficient, then the small country may become the exporter of the homogenous good and thus deindustrializes. Note however, that before the wage differential reaches such a value, it is possible that the final good industry will have moved completely to the large country. In this case the relative wage of the small country will not fall further as the size of the large country increases but instead will increase as the demand for the intermediate input it produces increases with the size of the large country. Thus deindustrialization of the small country takes place only under certain parameter values. In particular, trade costs need to be low and the small country producers have to use the imported intermediate more intensively in its final good production than the large country. Furthermore, once all final goods industries have moved to the large country and the small country's relative wage starts increasing as the size of the large country increases, there will come a point at which the large country's relative wage is sufficiently low for it to become an exporter of the homogenous good. Thus the large country can deindustrialize while being a net exporter of the differentiated goods.

Our results depend crucially on the assumption that the homogenous good uses less imported intermediate input than the differentiated good. Also for deindustrialization to occur, we need that the small country uses a greater proportion of imported inputs in its production of differentiated goods than that of the large country. How realistic are these assumptions? To get an estimate we present in Table 1 the value of imported intermediates in total sectoral output for manufacturing (associated typically with the differentiated sector) and agriculture and mining (the "homogenous" good sectors)[3]

[3] Rauch (1999) classifies homogenous and differentiated goods on the basis of whether they are traded on an organized exchange or not. Most agricultural and mining products can be classified as homogenous goods in this way.

for selected OECD countries and large emerging economies based on the data available from the OECD.[4] For all countries, the share of imported intermediates in total output of manufacturing is at least two times higher than the share of imported intermediates in agriculture with the same being true for mining in most countries. On average, the end sectoral value of manufacturing output has a 3.3 times more intensive use of imported intermediates than agriculture. The simple average for all 36 countries in the available sample gives an average value of imported intermediates in total output of manufacturing of 0.2. Assuming a markup of 25% in both industries implies that roughly 25% of the cost in manufacturing comes from imported intermediates versus 7.6% in agriculture. The importance of imported intermediates in manufacturing is even more pronounced for smaller economies. For example, Belgium, Czech Republic, Hungary, Luxembourg, the Netherlands and Slovakia all have the imported intermediate share of total output well above 30% with Ireland achieving a stunning 46%. Our assumptions are thus supported by the available OECD data.

In Section 2 we set up the model. In Section 3 we discuss the conditions under which deindustrialization occurs, both for the small and the large country. Section 4 provides simulations and Section 5 concludes. Proofs and figures are in the appendix.

2 The model

2.1 Consumption, Production and International Trade

The setup of the model is standard except for the assumptions on intermediate good production, usage and trade. There are two countries indexed by $k = i, j$ with population L_k. Throughout the paper we assume that country i is a larger country, i.e. $L_i > L_j$. There are three types of goods produced in each economy: differentiated final goods, intermediate goods used in the production of the final goods and a homogenous good. Diffferentiated and intermediate goods are considered as industrial goods while the homogenous good is not.[5] The two economies can exchange all goods that they produce. There are trade costs of the iceberg type on international trade of order $\tau > 1$ on all goods.

Consumers in country k have Cobb-Douglas preferences over available differentiated good varieties (with a Dixit-Stiglitz subindex for the differentiated good consumption with $0 < \sigma < 1$) and a

[4] We do not have finer data to show the share of imported intermediates in the total cost. Note also that the value of imported intermediates itself is typically derived by every reporting country using an import proportionality assumption (i.e. that imports are used for the same purposes as domestically produced goods) while constructing the import-output tables.

[5] Data from the input-output tables reveals that most of the inputs into the production of industrial goods come from other industrial sectors.

homogenous good:

$$U_k = \left(\sum_{l=i,j} N_l \left(c_{l,k} \right)^{\sigma} \right)^{\frac{\gamma}{\sigma}} \left(c_{0,k} \right)^{1-\gamma} \tag{1}$$

where $c_{l,k}$ is the consumption in country k of a typical variety from country l, $c_{0,k}$ is the consumption of the homogenous good in country k and γ is the consumption share of differentiated goods.

Consumers derive their income from selling their endowment of labor services (one unit) and firms' dividends that locate in their home country. We normalize the wage in country i to 1 and label the small country j's wage as w.

There are no barriers to entry in the homogenous good sector. The production function in each country is constant returns to scale with labor as the only factor of production. We normalize the technology so that one unit of local labor is required to produce one unit of the homogenous good. The assumption that the homogenous good production does not use any traded intermediates is of course a simplification. Nevertheless, we observe in Table 1 that the share of imported intermediates in sectors associated with "homogenous" goods such as agriculture or mining is much lower than that in the manufacturing sectors.

There are two varieties of intermediate goods, both are produced using only labor under constant returns to scale. We assume that each country has a sufficiently large Ricardian technological advantage in the production of one variety that under free trade each country will specialize in the production of one variety only. We choose units so that one unit of country k's labor is required to produce one unit of the intermediate good z in which country k has the technological advantage.[6] Differentiated goods are produced in both countries using the two country-specific intermediates with the following Cobb-Douglas technology:

$$f + Y_{is} = \left(z_i \right)^{\beta} \left(z_j \right)^{1-\beta} \tag{2}$$

and

$$f + Y_{js} = \left(z_i \right)^{\varphi} \left(z_j \right)^{1-\varphi} \tag{3}$$

where f is the fixed cost of production measured in units of the final good and Y_{ks} are the amount of variety s produced in country k. Hence the marginal cost of production is constant, but the technology has increasing returns as there is a fixed cost that has to be borne by each firm.

We assume that in each country the production of the differentiated good uses more intensively

[6] Since the absolute value of the relative wage cannot exceed τ in our model, an absolute value of technological advantage of τ^2 is sufficient to ensure that each country specializes in only one variety with free trade.

the local intermediate than the foreign intermediate.[7] Hence, $\beta > 0.5$ and $1 - \varphi > 0.5$.[8] We allow the two countries to differ in the intensity in which the imported intermediate is used in the production of differentiated goods.

A firm that wishes to enter the final good industry can invent costlessly a new product variety. Let the constant marginal cost of production in each country be C_k. There is monopolistic competition in this sector. Each firm maximizes its own profits by setting the price at $p_{kk} = \frac{C_k}{\sigma}$ for the domestic market and $p_{k,-k} = \frac{\tau C_k}{\sigma}$ for the foreign market. There is free entry into this sector so that profit is zero in equilibrium. In country k therefore the zero profit condition is going to be

$$(p_{kk} - C_k)\, c_{kk} + \tau\, (p_{kk} - C_k)\, c_{k,-k} = f C_k \tag{4}$$

As all firms from each country face the same demand and have the same costs, they are the same in size. There are therefore N_k representative firms locating in country k.

2.2 Solving the model

For the ease of comparison with the previous literature and to highlight the role of imported intermediates in final goods production, we first solve the model in terms of marginal costs of production of the final goods in the two countries. We assume first of all that the homogenous good is not traded and that the number of final goods firms in both countries is non-negative. A wage differential of τ is required before trade in the homogenous good will take place.

From the zero profit condition (4) and monopolistic pricing we can derive the equilibrium number of firms in the final good sectors in both countries. The number of firms in the differentiated good sector in each country is given by

$$N_i = \left(\frac{L_i}{\left((C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}} \right)} - \frac{L_j w\, (\tau)^{-\frac{\sigma}{1-\sigma}}}{\left((C_i)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_j)^{-\frac{1}{1-\sigma}} \right)} \right) \frac{(C_j)^{-\frac{1}{1-\sigma}}}{(C_i)\, \widetilde{f}} \tag{5}$$

[7] General insights do not depend on this assumption, but this assumption is realistic and limits the number of cases that need to be discussed. As the intermediates are produced using a constant returns to scale technology, this assumption implies that the share of local labor in the production of the final good is no lower than that of foreign labor. This is the case when for example local labor is required alongside intermediates in a production function that uses the two traded intermediate inputs with the same production share.

[8] If $\beta = 1 - \varphi = 1$ then we have the case of the original Krugman (1980) model.

and

$$N_j = \left(\frac{L_j w}{\left((C_i)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_j)^{-\frac{1}{1-\sigma}} \right)} - \frac{L_i (\tau)^{-\frac{\sigma}{1-\sigma}}}{\left((C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}} \right)} \right) \frac{(C_i)^{-\frac{1}{1-\sigma}}}{(C_j) \widetilde{f}} \tag{6}$$

where $\widetilde{f}$ is a constant depending on the fixed cost f and parameters γ and σ. Keeping the marginal costs constant, the number of firms in country i increases as the market size L_i increases and decreases with the foreign market size.

The trade balance equation from the point of view of the large country can be rewritten as a function of wages, marginal costs and intermediate demands as:

$$N_i c_{ij} p_{ij} - N_j c_{ji} p_{ji} = N_i \left(c_{ii} + \tau c_{ij} + f \right) \widetilde{DI}_j \tau w - N_j \left(c_{jj} + \tau c_{ji} + f \right) \widetilde{DI}_i \tau \tag{7}$$

where $\widetilde{DI}_i$ and $\widetilde{DI}_j$ are the foreign inputs from country i and j demanded to manufacture a unit of the differentiated good respectively.

The expression on the left hand side represents the trade balance in differentiated goods while the right hand side captures the trade balance in intermediate goods. Keeping wages constant, as the size of the large country increases, the trade balance in differentiated goods becomes more positive for the large country (see eq. (8)).

$$\frac{\partial TB_{diff}}{\partial L_i} = \tau^{-\frac{\sigma}{1-\sigma}} \gamma \left(\frac{(C_i)^{-\frac{1}{1-\sigma}}}{(C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}}} \right) > 0 \tag{8}$$

The reverse, however, is true for the trade balance in intermediate goods. Taking the derivative of the trade balance in intermediate goods from the perspective of the large country we obtain

$$\frac{\partial TB_{int}}{\partial L_i} = -\gamma \left(\frac{\frac{(C_j)^{-\frac{1}{1-\sigma}}}{(C_i)} \widetilde{DI}_j \tau w + (\tau)^{-\frac{\sigma}{1-\sigma}} \frac{(C_i)^{-\frac{1}{1-\sigma}}}{(C_j)} \widetilde{DI}_i \tau}{(C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}}} \right) < 0 \tag{9}$$

We can rewrite the trade balance equation (7) as follows:

$$\frac{L_i}{L_j} = w \frac{\left((C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}} \right)}{\left((C_i)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_j)^{-\frac{1}{1-\sigma}} \right)} \frac{\left((C_j)^{-\frac{1}{1-\sigma}} \tau^{-\frac{\sigma}{1-\sigma}} - \frac{(C_i)^{-\frac{1}{1-\sigma}}}{(C_j)} \widetilde{DI}_i \tau - (\tau)^{-\frac{\sigma}{1-\sigma}} \frac{(C_j)^{-\frac{1}{1-\sigma}}}{(C_i)} \widetilde{DI}_j \tau w \right)}{\left((C_i)^{-\frac{1}{1-\sigma}} \tau^{-\frac{\sigma}{1-\sigma}} - \frac{(C_j)^{-\frac{1}{1-\sigma}}}{(C_i)} \widetilde{DI}_j \tau w - (\tau)^{-\frac{\sigma}{1-\sigma}} \frac{(C_i)^{-\frac{1}{1-\sigma}}}{(C_j)} \widetilde{DI}_i \tau \right)} \tag{10}$$

For there to be a positive number of firms in both countries, we require that the firms (because of free entry) do not wish to enter the sector in only one of the countries. The latter can happen if production costs in one location are so much lower than in the other location so that it pays for all firms to enter the sector in the country with lowest costs and serve the other market from abroad. For the former to be fulfilled, we require that both $\left((C_j)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_i)^{-\frac{1}{1-\sigma}}\right) > 0$ and $\left((C_i)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}} (C_j)^{-\frac{1}{1-\sigma}}\right) > 0$ which implies that the final good production cost differential must lie within the following bounds: $\Upsilon = \frac{C_j}{C_i} \in (\tau^{-\sigma}, \tau^{\sigma})$. Otherwise, as one can verify from equations (5) and (6) either $N_i < 0$ or $N_j < 0$.[9] In the case of the original Krugman model, $\Upsilon = w$ (the final good production uses only local labor). Then if $w = \tau^{-1} < \tau^{-\sigma}$, $N_i < 0$. That is, at the wage that would give rise to exports of the homogenous good from the small country, the cost differential of producing in the large (high wage) country is higher than the cost of accessing the foreign (large) market (τ^{σ}) by producing in the small (low wage) country. Hence, all firms will want to locate in the small country. This underlies the gist of Davis (1988) argument that small countries need not fear deindustrialization with economic integration.

In our model with imported intermediate inputs the relative cost of production is given by:

$$\Upsilon = \frac{C_j(Y)}{C_i(Y)} = \tau^{\varphi+\beta-1} (w)^{\beta-\varphi} \frac{\beta^{\beta} (1-\beta)^{1-\beta}}{\varphi^{\varphi} (1-\varphi)^{1-\varphi}} \tag{11}$$

We observe that even when relative wage is equal to τ^{-1}, the relative cost of final good production can still lie within the bounds $(\tau^{-\sigma}, \tau^{\sigma})$.[10] With our assumptions on β and φ it suffices that $\beta \in$

[9] The argument can be also easily seen while inspecting the profits of a firm when it decides to enter a particular production location or not. If the firm locates in country i to serve both markets from that location, the profits that it awaits are $\Pi_i = C_i \left(\left(\widetilde{A}_i (C_i)^{-\frac{1}{1-\sigma}} + \tau \widetilde{A}_j (\tau C_i)^{-\frac{1}{1-\sigma}}\right) - f\right)$ where $\widetilde{A}_i$ and $\widetilde{A}_j$ from the perspective of the firm are two constants comprising the information about markets in country i and j and containing the monopolistic pricing parameters σ. The profits in market j are then $\Pi_j = C_j \left(\left(\tau \widetilde{A}_i (\tau C_j)^{-\frac{1}{1-\sigma}} + \widetilde{A}_j (C_j)^{-\frac{1}{1-\sigma}}\right) - f\right)$. Suppose that zero profit conditions hold in country j. Then $f = \left(\tau^{-\frac{\sigma}{1-\sigma}} \widetilde{A}_i (C_j)^{-\frac{1}{1-\sigma}} + \widetilde{A}_j (C_j)^{-\frac{1}{1-\sigma}}\right)$. Suppose that $C_j = \tau^{-\sigma} C_i$. Then the zero profit condition implies that $f = \left(\tau^{-\frac{\sigma}{1-\sigma}} \widetilde{A}_i (\tau^{-\sigma} C_i)^{-\frac{1}{1-\sigma}} + \widetilde{A}_j (\tau^{-\sigma} C_i)^{-\frac{1}{1-\sigma}}\right) = \left(\widetilde{A}_i (C_i)^{-\frac{1}{1-\sigma}} + \tau^{\frac{\sigma}{1-\sigma}} \widetilde{A}_j (\tau^{-\sigma} C_i)^{-\frac{1}{1-\sigma}}\right) > \left(\widetilde{A}_i (C_i)^{-\frac{1}{1-\sigma}} + \tau^{-\frac{\sigma}{1-\sigma}} \widetilde{A}_j (C_i)^{-\frac{1}{1-\sigma}}\right)$. Hence, if the firm entered in country i, it would not be able to earn enough profits to cover the fixed cost. In other words, its profits while locating in market j are higher.

[10] The cost differential in the production of final goods between countries depends crucially on the production function in place. The introduction of trade in intermediates may not only dampen the cost difference between countries but even reverse it. For example, if the production function is of the CES type and the inputs are complements in production, then the country with the *higher* local wage can be the *cheaper* location for final goods production with positive trade costs. Suppose that the production function of the final goods is $Y = \left(\sum (z_k)^{\nu}\right)^{\frac{1}{\nu}}$. Then the corresponding cost of production in each country is respectively $C_i = \left(1 + (\tau w)^{-\frac{\nu}{1-\nu}}\right)^{\frac{\nu-1}{\nu}}$ and $C_j = \left((\tau)^{-\frac{\nu}{1-\nu}} + (w)^{-\frac{\nu}{1-\nu}}\right)^{\frac{\nu-1}{\nu}}$. If $\nu < 0$ then $C_i < C_j$ if $w < 1$. We did not use a more general production function like this one as the resulting model can only be analyzed numerically.

$(\varphi - \sigma, \varphi + \sigma)$. This is however insufficient to guarantee that the small country will deindustrialize upon opening to trade. We need to derive the conditions under which the small economy's equilibrium relative wage indeed will reach τ^{-1} which is necessary for the small economy to become an exporter of the homogenous good. Note that by becoming a net exporter of the homogenous good, the small economy must necessarily deindustrialize, that is, devote a larger fraction of its labor resources to the production of the homogenous good and less to the industrial intermediate and final differentiated goods compared to autarky. This is because when in autarky an economy devotes a fraction $(1 - \gamma)$ of its labor force to the production of the homogenous good for domestic consumption. Additional labor is needed for export production. Hence, in what follows, deindustrialization is said to occur when a country becomes an exporter of the homogenous good. In the following section we derive the sufficient conditions for deindustrialization to be possible in both the small and the large country.

3 Conditions for deindustrialization

To solve the model completely, one needs to solve equations (5) – (7) and to find the number of firms N_i and N_j and the wage w in the equilibrium without trade in the homogenous good. Unfortunately, one cannot solve for an explicit expression for the wage in general. Therefore, we can only narrow down a set of parameters which are sufficient for deindustrialization to occur both for the small and the large country.

For the small country to deindustrialize, we require first of all that its relative wage is sufficiently smaller than that of the large country. In the previous home market literature, the smaller country necessarily has a lower wage (see Krugman 1980) for otherwise firms will prefer to relocate to the larger market to save on transport costs. In our model however, the small country may have a larger wage depending on parameter values. This is because the equilibrium relative wage depends on the net trade balance on both final and intermediate goods. As seen above, the net trade balance in intermediate goods of the large country is a decreasing function of the relative size of the large country. The large country may have such a high demand for intermediates that at equal wage, the net trade balance is in favor of the small country which must therefore have a higher equilibrium wage. Therefore we need to find conditions such that the relative wage of the small country is a monotonic declining function of the relative size of the large country assuming that both produce differentiated goods (interior equilibrium). This is to ensure that there exists a size differential at which the relative wage of the small country will reach τ^{-1} if an interior equilibrium exists. We have the following Lemma:

Lemma 1 *For* $\tau < \left(\frac{\beta(1-\varphi)}{\varphi(1-\beta)}\right)^{\frac{1-\sigma}{2\sigma}}$ *and* $\beta - \varphi \geq 1 - \sigma$*, the equilibrium relative wage* w *of the small country at an interior equilibrium is a decreasing function of the relative size* $\frac{L_i}{L_j}$.

Proof : see appendix.

Lemma 1 says that the small country's relative wage is a declining function of the relative size of the large country if transport costs are small enough and the share of the domestic intermediate in the final good production in the large country β is large. Small transport costs are needed to generate a strong home market effect so that the demand for the large country's labor is strong and hence the small country's wage is low. To understand why β needs to be high we note that as β falls, for each unit of the final goods produced the large country imports now more small-country intermediates. *Ceteris paribus*, this worsens the large country trade balance and increases the relative wage of the small country. For a β close enough to 0.5 it may well be that an increase in the relative size increases the demand for the small country intermediate so much that the countering final good flow does not balance the increased demand in intermediates. This will be more pronounced as the trade cost is increasing and the strength of the home market effect is weaker. We can show indeed that as $\beta \to 0.5$ and for $\tau > \left(\frac{\beta(1-\varphi)}{\varphi(1-\beta)}\right)^{\frac{1-\sigma}{2\sigma}}$ the relative wage becomes increasing with the relative size $\frac{L_i}{L_j}$ (see also Section 4 below for an example). Note that realistic parameter values fulfill the conditions of Lemma 1: for example for $\beta = 0.8$, $\varphi = 0.2$ (averages taken from Table 1) and $\sigma = 0.8$ the trade cost has to be lower than $\sqrt{2}$ so that the statement is true.

The above restrictions on parameters are however, not sufficient to guarantee the existence of a relative size differential above which the small country will deindustrialize. This is because as relative size increases there will come a point whereby all differentiated goods firms will have moved to the large country and this can occur before the relative wage of the small country declines to τ^{-1}.[11] Once such a corner equilibrium is reached, the relative wage for the small country cannot fall further but instead will rise as the size of the large country increases further. This is because the demand for imported intermediates by the large country increases while there is no counterbalancing increasing trade surplus from the final goods sector (since there is no further reallocation of firms from the small country). The following lemma describes the behavior of the relative wage after the corner equilibrium is reached.

[11] An increase in the size differential may have a weak impact on the wage as a larger country demands also more intermediate goods from the small economy which pushes the relative wage upwards. Hence, before wages fall to τ^{-1} the size difference between the countries may grow so large that all firms in the final good sector want to move to the larger market.

Lemma 2 *In a corner equilibrium whereby all differentiated goods firms are located in the large country, the relative wage is given by:*

$$w = \frac{L_i}{L_j} \frac{(1-\beta)}{\beta} \tag{12}$$

Proof : see appendix.

To summarize, as the relative size increases, the relative wage of the small country falls until the corner equilibrium is reached and thereafter, the relative wage will start to increase. The corner equilibrium may be reached before the small country's equilibrium wage reaches τ^{-1} and hence deindustrialization of the small economy is not possible. We therefore require further restrictions on parameters for deindustrialization to occur. In Proposition 1 below, we find a sufficient condition for there to exist a size differential large enough that the small country deindustrializes with trade.

Proposition 1 *If $\beta > 1 - \varphi$, $\beta - \varphi > 1 - \sigma$ and for trade costs low enough then there exists a size differential between country i and j so that the wage in the (smaller) country j is $w = \tau^{-1}$ and the small economy exports the homogenous good.*

Proof: see appendix.

With trade costs low enough and $\beta - \varphi > 1 - \sigma$ we know from Lemma 1 that wages fall as the size differential between countries increases. Low transport costs also guarantee that the relative wage $w = \tau^{-1}$ implied by an interior equilibrium is reached before the corner equilibrium occurs. Therefore the small economy may become deindustrialized with low trade costs - i.e. be the net exporter of the homogenous good - when the home market effect is strong and the trading partner's relative size lies within a certain range. If the relative size becomes too big, the corner equilibrium in which all final good sector firms move to the larger economy is obtained. We note that it is necessary that the small economy uses the foreign intermediate more intensively than the large country.[12,13] We observe from Table 1 that larger economies typically have a lower usage of foreign intermediates in manufacturing. For a realistic case with parameters $\sigma = 0.8$, $\beta = 0.8$ a small country with $1 - \varphi < 0.8$ paired with a country large enough (for example, twice the size) will deindustrialize with trade opening if trade

[12] In the case with $\beta = 1 - \varphi$, we find that although the home market effect holds for parameters fulfilling the conditions of Lemma 1, it is too weak to induce a wage differential that would make trade in homogenous goods feasible. Before the wage can fall to $w = \tau^{-1}$ as the size differential between the economies increases, the smaller economy loses all its differentiated goods firms. The large country's demand for the small country intermediates is too strong to allow for too large a fall in wages.

[13] Davis (1998) observed that actually trade costs in the homogenous goods appear to be somewhat larger than those in differentiated goods. Here, we can obtain deindustrialization of the small economy with such an assumption if the share of the foreign imported intermediates in the small economy production of the differentiated good is high enough.

costs are small enough.

So far we have discussed the conditions for deindustrialization of the small economy. We observe from Lemma 2 that if the relative size of the large country is sufficiently large, the corner equilibrium wage may eventually reach τ. This implies that the large country then becomes the exporter of the homogenous good. The large country's demand for the small country's intermediates is so large that exports of differentiated goods are not sufficient to cover the trade deficit in intermediates and hence export of the homogenous good becomes necessary. Thus the large country deindustrializes while remaining at the same time an exporter of differentiated goods. This result holds also for the case with $\beta = 1 - \varphi$, i.e. when the share of intermediates in production of the final goods is the same in the small and the large country.[14] We obtain it because of our assumption of *de facto* national differentiation of the intermediate goods. The small economy's intermediate is not easily substitutable with the large economy intermediate.

4 Simulations

We present three types of simulations. First, we show the combinations of parameter values of φ and τ so that deindustrialization can occur in either the small or the large economy. Next, we show how, ceteris paribus, the wage changes with the size differential and finally how it varies as the trade cost is increased.

In Figures 1 − 3 we show parameter values when the implied interior equilibrium wage falls below $w = \tau^{-1}$ and there must be exports of the homogenous good from the small economy. The small economy becomes deindustrialized. In the case presented in Figure 2 we note that we obtain deindustrialization with $\beta = 0.8$ (which corresponds to the average share of intermediates in total production that we have in our data in Table 1) for the size differential $\frac{L_i}{L_j} = 2$, $\sigma = 0.8$ and a wide range of small country intermediate import shares $\varphi > 0.2$.

In Figure 4 we present a case of "deindustrialization" on the part of the large country for trade costs that are large enough. The home market effect is then weak (but holds for the simulations presented here) but the larger economy requires also a lot of the foreign intermediate inputs in production (here $1-\beta = 0.4$). This increases the equilibrium wage of the small country and may actually lead to $w = \tau$ enabling the large economy to be the homogenous good exporter.

[14] If the size differential between the two economies becomes arbitrarily large, the small economy may end up producing only the intermediate goods. Then the wage in the small economy will increase even above $w = \tau$ as long as it is more profitable to engage in international trade to obtain intermediates. We do not consider this special extreme case. Nevertheless, then the large economy would be exporting the homogenous good to the small economy as well.

In Figures 5–6 we present the wages as a function of the size differential (the equilibrium wage is the black solid line). In the first case shown, with $\tau = 1.1, \beta = 0.8, \sigma = 0.8$ and $\varphi = 0.22$ as the size differential increases from one the wage is falling until it hits $w = \tau^{-1}$ when trade in the homogenous good starts (the wage implied by an interior equilibrium is the dashed line). As the size differential increases further, a size differential is reached where there are no more firms in the smaller economy: a new entrant there would be unable to capture a market share (and consequently earn the corresponding profits) high enough to pay for the fixed cost. The small country wage starts increasing with the size differential as the larger economy demands ever more intermediates to produce final goods driving the demand for labor in the small economy up. When the wage implied in the corner equilibrium hits $w = \tau$ the large economy starts to export the homogenous good to equilibrate the trade balance. We can speak then of the deindustrialization of the large economy: labor is driven out of manufacturing of final and intermediate goods.

In the second case, with $\tau = 1.3, \beta = 0.6, \sigma = 0.8$ and $\varphi = 0.42$, the wage in the smaller economy is increasing as the size differential increases even when we have an interior equilibrium. This is because the home market effect (increasing the trade balance in favor of the larger economy) is weak and the value of intermediates purchased by the larger economy is increasing as the size differential rises.

In Figure 7 we show wages (in solid black line) as a hypothethical function of the trade cost. For low trade costs, the small economy becomes deindustrialized. As the trade cost is increasing, the home market effect is weaker; consequently there is a lower trade imbalance in differentiated goods and the equilibrium wage in the small economy increases. With a trade cost that is high enough the home market effect is even weaker; and the large economy imports relatively more intermediate goods from the small economy than it exports the differentiated goods. This causes the wage in the small country to increase above that of the large country.

5 Conclusions

In this paper we have shown that if production of differentiated goods uses imported intermediate inputs, one does not require trade cost in homogenous goods to be sufficiently lower than that of differentiated goods for economic integration to lead to deindustrialization of small countries. The latter is possible because the relative wage of the small country may fall sufficiently to lead to export of the homogenous good without the relative cost of production of the small country being so low that all firms will prefer to produce in the small country. Our simulations results show that for a broad range of reasonable parameter values, one can indeed obtain deindustrialization of the small country.

In addition we also show that when trading with a very large country, the small country may become specialized in the production of intermediate goods while the large country becomes exporter of both differentiated and homogenous good. Thus deindustrialization is possible for a large country too. Our results have been obtained assuming that the intermediate goods are produced under constant returns to scale and whose trade is governed by Ricardian technological advantage. If all inputs are produced under increasing returns to scale with the intermediate producing firms able to choose location our results obviously would not be valid. However, as long as there is some inputs trade governed by comparative advantage or national product differentiation our general insight will carry through.

References

Crozet M. and F. Trionfetti, 2007. Trade costs and the home market effect. mimeo

Davis D., 1998. The home market, trade, and industrial structure. *American Economic Review* Vol. 88, 1264-76

Eaton J. and S. Kortum, 2002. Technology, geography, and trade. *Econometrica* Vol. 70 (5), 1741-79

Feenstra R. C., Markusen, J. R. and A. K. Rose, 2001. Using the gravity equation to differentiate among alternative theories of trade. *Canadian Journal of Economics* Vol. 34 (2), 430-47

Head K., Mayer T. and J. Ries, 2002. On the Pervasiveness of Home Market Effects. *Economica* Vol. 69 (275), 371-90

Head K. and J. Ries, 2002. Increasing returns versus national product differentiation as an explanation for the pattern of US-Canada trade. *American Economic Review* Vol. 91, 858-76

Helpman, E. and P. Krugman, 1985. Market structure and foreign trade. MIT Press, Cambridge, MA

Heston A., R. Summers and B. Aten, Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Holmes T. J., and Stevens J.J., 2005. Does home market size matter for the pattern of trade? *Journal of International Economics* Vol. 65 (2), 489-505

Hummels D., Ishii J. and K.-M. Yi, 2001. The nature and growth of vertical specialization in world trade. *Journal of International Economics* Vol. 54, 75–96

Krugman, P. R., 1980. Scale economies, product differentiation and the pattern of trade. *American Economic Review* Vol. 70 (5), 950-59

OECD, 2006. OECD Input-Output Database, 2006 edition revision 1

Rauch J., 1999. Networks versus markets in international trade. *Journal of International Economics* Vol. 48, 7-35

Yu Z., 2005. Trade, market size, and industrial structure: revisiting the home-market effect *Canadian Journal of Economics* Vol. 38 (1), 255-72

A Appendix

Proof of Lemma 1

Rewrite the trade balance (10) as

$$f(w) = g(w)\, h(w)$$

where

$$\begin{aligned} h(w) &= \frac{\left(\beta\left(\tau^{\varphi+\beta-1}(w)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}}-\varphi\right)}{\left(\tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi)-\left(\tau^{\varphi+\beta-1}(w)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}(1-\beta)\right)} \\ &= \frac{\left(\beta\Theta(w)^{-\frac{\mu}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}}-\varphi\right)}{\left(\tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi)-\Theta(w)^{-\frac{\mu}{1-\sigma}}(1-\beta)\right)} \end{aligned}$$

and

$$g(w) = \frac{w\left((w)^{-\frac{\mu}{1-\sigma}}\Theta-\tau^{-\frac{\sigma}{1-\sigma}}\right)}{\left(1-\tau^{-\frac{\sigma}{1-\sigma}}(w)^{-\frac{\mu}{1-\sigma}}\Theta\right)}$$

where $\mu = \beta - \varphi$ and $\Theta = \left(\tau^{\varphi+\beta-1}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}$.

As argued in the main text, for there not to be incentive for firms to strictly prefer one location to the other we need the relative wage to lie within bounds such that $g(w)$ is positive. Then for trade balance condition to hold we will require that $h(w)$ to be positive as well. Therefore for wages to be a declining function of relative size a sufficient condition is to have $g'(w) < 0$ and $h'(w) < 0$ since then $f'(w) = g'(w)\, h(w) + g(w)\, h'(w) < 0$.

We want to check when the denominator of the derivative of $h(w)$ is negative

$$\begin{aligned} \begin{pmatrix} \left(\beta\Theta(w)^{-\frac{\mu}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}}-\varphi\right)'\left(\tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi)-\Theta(w)^{-\frac{\mu}{1-\sigma}}(1-\beta)\right) \\ -\left(\beta\Theta(w)^{-\frac{\mu}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}}-\varphi\right)\left(\tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi)-\Theta(w)^{-\frac{\mu}{1-\sigma}}(1-\beta)\right)' \end{pmatrix} &< 0 \\ \begin{pmatrix} -\frac{\mu}{1-\sigma}\beta\Theta(w)^{-\frac{\mu}{1-\sigma}-1}\tau^{-\frac{\sigma}{1-\sigma}}\left(\tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi)-\Theta(w)^{-\frac{\mu}{1-\sigma}}(1-\beta)\right) \\ -\left(\beta\Theta(w)^{-\frac{\mu}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}}-\varphi\right)\frac{\mu}{1-\sigma}\Theta(w)^{-\frac{\mu}{1-\sigma}-1}(1-\beta) \end{pmatrix} &< 0 \\ \left(\varphi(1-\beta)-\tau^{-\frac{2\sigma}{1-\sigma}}\beta(1-\varphi)\right) &< 0 \\ \left(\frac{\beta(1-\varphi)}{\varphi(1-\beta)}\right)^{\frac{1-\sigma}{2\sigma}} &> \tau \end{aligned}$$

So if $\tau < \left(\frac{\beta(1-\varphi)}{\varphi(1-\beta)}\right)^{\frac{1-\sigma}{2\sigma}}$ then $h'(w) < 0$. Now we want to check when the numerator of the derivative of $g(w)$ is negative

$$\left(\begin{array}{c} \left[w\left((w)^{-\frac{\mu}{1-\sigma}}\Theta - \tau^{-\frac{\sigma}{1-\sigma}}\right)\right]'\left(1-\tau^{-\frac{\sigma}{1-\sigma}}(w)^{-\frac{\mu}{1-\sigma}}\Theta\right) \\ -\left[w\left((w)^{-\frac{\mu}{1-\sigma}}\Theta - \tau^{-\frac{\sigma}{1-\sigma}}\right)\right]\left(1-\tau^{-\frac{\sigma}{1-\sigma}}(w)^{-\frac{\mu}{1-\sigma}}\Theta\right)' \end{array}\right) < 0$$

$$\left(\begin{array}{c} \left[\left(1-\frac{\mu}{1-\sigma}\right)(w)^{-\frac{\mu}{1-\sigma}}\Theta - \tau^{-\frac{\sigma}{1-\sigma}}\right]\left(1-\tau^{-\frac{\sigma}{1-\sigma}}(w)^{-\frac{\mu}{1-\sigma}}\Theta\right) \\ -\left[w\left((w)^{-\frac{\mu}{1-\sigma}}\Theta - \tau^{-\frac{\sigma}{1-\sigma}}\right)\right]\left(\frac{\mu}{1-\sigma}\tau^{-\frac{\sigma}{1-\sigma}}(w)^{-\frac{\mu}{1-\sigma}-1}\Theta\right) \end{array}\right) < 0$$

We see that $g'(w) < 0$ if $\frac{\mu}{1-\sigma} > 1$. This requires that $\beta - \varphi > 1 - \sigma$.■

Proof of Lemma 2

From the zero profit condition (4) we can find the number of firms N_i and the relative wage in this case:

$$N_i = \left(L_i\gamma + \tau\frac{L_j w\gamma}{\tau}\right)\frac{(1-\sigma)}{C_i f} \tag{13}$$

One can rewrite the trade balance (7) in this case as

$$N_i c_{ij} p_{ij} = N_i\left(c_{ii} + \tau c_{ij} + f\right)\left(\frac{1}{w\theta}\frac{(1-\beta)}{\beta}\right)^{\beta}\theta w \tag{14}$$

because the large country exports final goods whereas the small economy exports intermediates required for production. Solving out eq. (14) after substituting for N_i from eq. (13) we obtain the result in (12).■

Proof of Proposition 1

We need to find conditions such that the relative wage of the small economy reaches $w = \tau^{-1}$ before the corner equilibrium is reached. This requires that at the relative size whereby the interior equilibrium wage is τ^{-1}, the corresponding corner equilibrium wage is below τ^{-1}.[15]

From (10) we can find the size differential that implies a wage in the interior equilibrium of $w = \tau^{-1}$.

[15] If the corresponding corner equilibrium wage is above τ^{-1} it would imply that at the interior equilibrium, the number of firms in the differentiated sector in the smaller economy is negative. The firms from the small economy would be unable to meet their zero profit conditions. Proof available upon request.

When $\beta - \varphi > 1 - \sigma$ we know from Lemma 1 that this requires that $\frac{L_i}{L_j} > 1$.

$$\frac{L_i}{L_j}\left(\tau^{-1}\right) = \frac{\tau^{-1}\begin{pmatrix} \left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} \\ -\tau^{-\frac{\sigma}{1-\sigma}} \end{pmatrix}}{\begin{pmatrix} 1 \\ -\tau^{-\frac{\sigma}{1-\sigma}}\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} \end{pmatrix}} \frac{\begin{pmatrix} \beta\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}} \\ -\varphi \end{pmatrix}}{\begin{pmatrix} \tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi) \\ -\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}(1-\beta) \end{pmatrix}}$$

We want to check when the wage implied by a corner equilibrium w_c is going to be lower than τ^{-1} for such a $\left(\frac{L_i}{L_j}\right)\left(\tau^{-1}\right)$.

$$\begin{aligned} w_c &= \frac{(1-\beta)\tau^{-1}\begin{pmatrix} \left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} \\ -\tau^{-\frac{\sigma}{1-\sigma}} \end{pmatrix}\begin{pmatrix} \beta\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}\tau^{-\frac{\sigma}{1-\sigma}} \\ -\varphi \end{pmatrix}}{\beta\begin{pmatrix} 1 \\ -\tau^{-\frac{\sigma}{1-\sigma}}\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} \end{pmatrix}\begin{pmatrix} \tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi) \\ -\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}(1-\beta) \end{pmatrix}} \\ &< \tau^{-1} \end{aligned}$$

Inspecting this inequality, knowing that $\left(\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} - \tau^{-\frac{\sigma}{1-\sigma}}\right) > 0$ and that $\left(1 - \tau^{-\frac{\sigma}{1-\sigma}}\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}\right) > 0$ by assumption for the equilibrium to exist and that for $\tau < \left(\frac{\beta(1-\varphi)}{\varphi(1-\beta)}\right)^{\frac{1-\sigma}{2\sigma}}$ we have $\begin{pmatrix} \tau^{-\frac{\sigma}{1-\sigma}}(1-\varphi) \\ -\left(\tau^{\varphi+\beta-1}\left(\tau^{-1}\right)^{\beta-\varphi}\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}}(1-\beta) \end{pmatrix} > 0$ so we can get the condition

$$\tau^{\frac{1+\sigma-2\varphi}{1-\sigma}} < \frac{\left(\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{\frac{1}{1-\sigma}}}{\beta\tau^{-\frac{2\sigma}{1-\sigma}} + (1-\beta)} \tag{15}$$

where $\left(\frac{\beta^{\beta}(1-\beta)^{1-\beta}}{\varphi^{\varphi}(1-\varphi)^{1-\varphi}}\right)^{-\frac{1}{1-\sigma}} < 1$ if $\beta > 1-\varphi$. We also know that $\beta\tau^{-\frac{2\sigma}{1-\sigma}} + (1-\beta) \leq 1$ for $\tau \geq 1$ and $1+\sigma-2\varphi > 0$, therefore for trade costs small enough the condition (15) will hold. ■

B Tables and Figures

Table 1: Shares of imported intermediates in total industry output 1991-2000

Country	Agriculture	Mining and quarrying	Manufacturing
Belgium	0.109	0.206	0.373
Canada	0.075	0.070	0.254
China	0.017	0.042	0.081
France	0.069	0.113	0.147
Czech Rep.	0.056	0.092	0.381
Germany	0.073	0.073	0.168
Italy	0.020	0.049	0.179
Japan	0.016	0.007	0.064
Ireland	0.190	0.253	0.462
Korea Rep.	0.026	0.008	0.227
Netherlands	0.072	0.075	0.321
United Kingdom	0.077	0.053	0.171
United States	0.037	0.061	0.077
Simple average for 36 countries	0.061	0.075	0.202
Simple average for largest sampled 18 countries	0.042	0.052	0.155
Simple average for smallest sampled 18 countries	0.080	0.071	0.248

Data source: OECD Input-Output Database, 2006 edition revision 1. "Agriculture" contains the sector "Agriculture, hunting, forestry and fishing" (sectors 1+2+5 according to the ISIC Rev.3 code), "Mining and quarrying" contains data from sectors labeled 3+4 according to the ISIC Rev.3 code while manufacturing contains sectors classified in positions 4-25 in the OECD input-output tables (sectors labeled 15 to 37 according to the ISIC Rev.3 code). Countries ranked in size according to 1995 GDP at PPP levels taken from the Penn World Tables 6.2.

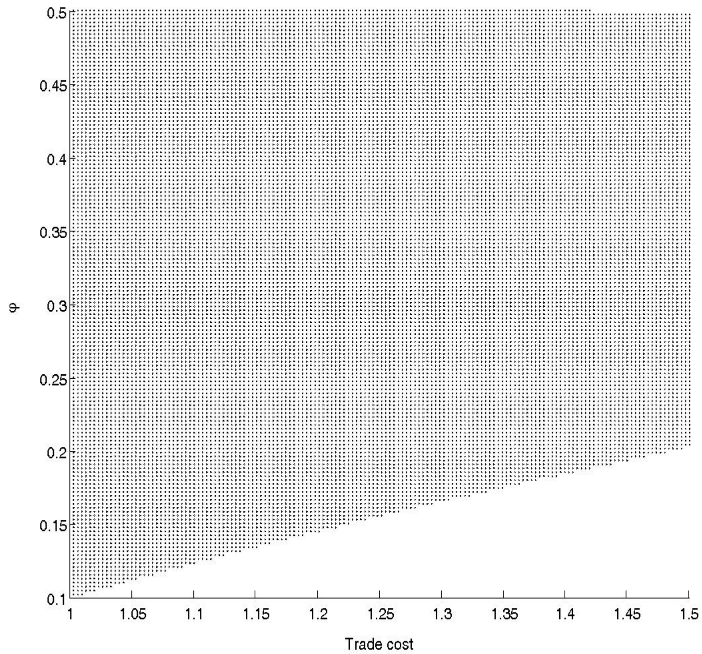

Figure 1: Parameters for which deindustrialization of the small economy takes place. Case: $\frac{L_i}{L_j} = 2, \beta = 0.9, \sigma = 0.8$

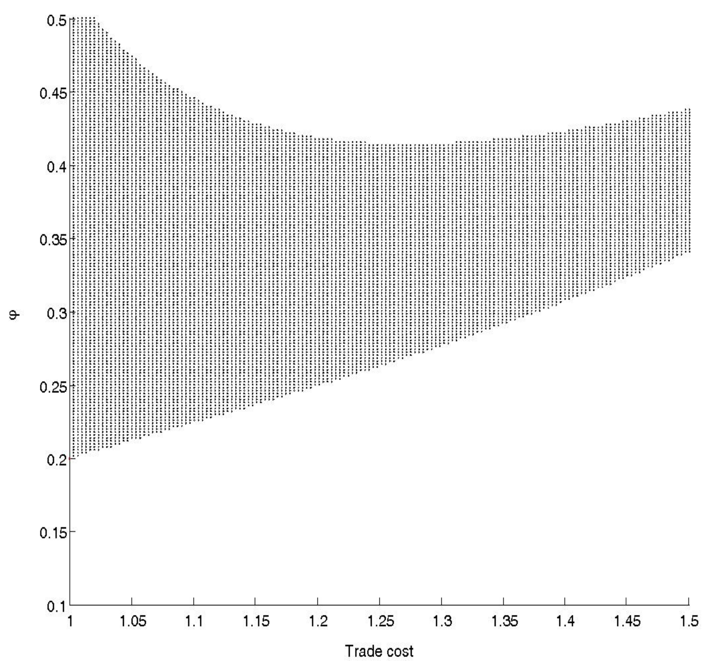

Figure 2: Parameters for which deindustrialization of the small economy takes place. Case: $\frac{L_i}{L_j} = 2, \beta = 0.8, \sigma = 0.8$

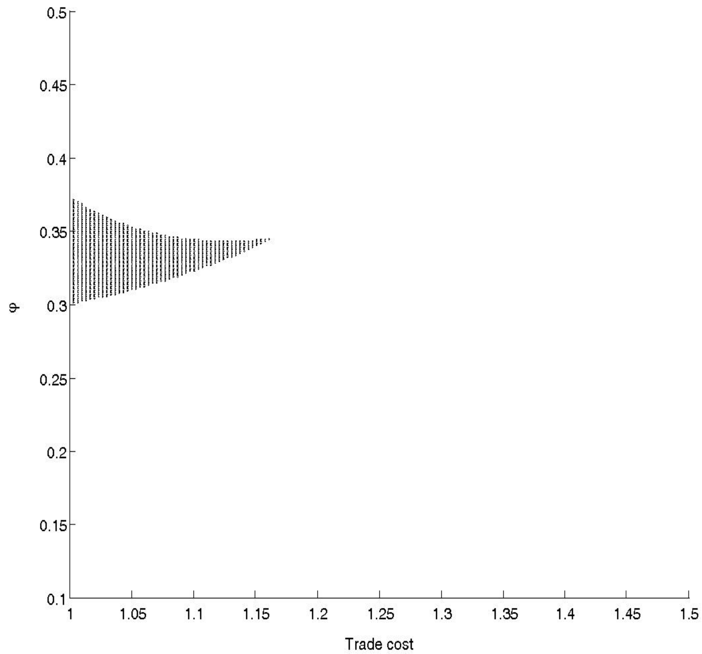

Figure 3: Parameters for which deindustrialization of the small economy takes place. Case: $\frac{L_i}{L_j} = 2, \beta = 0.7, \sigma = 0.8$

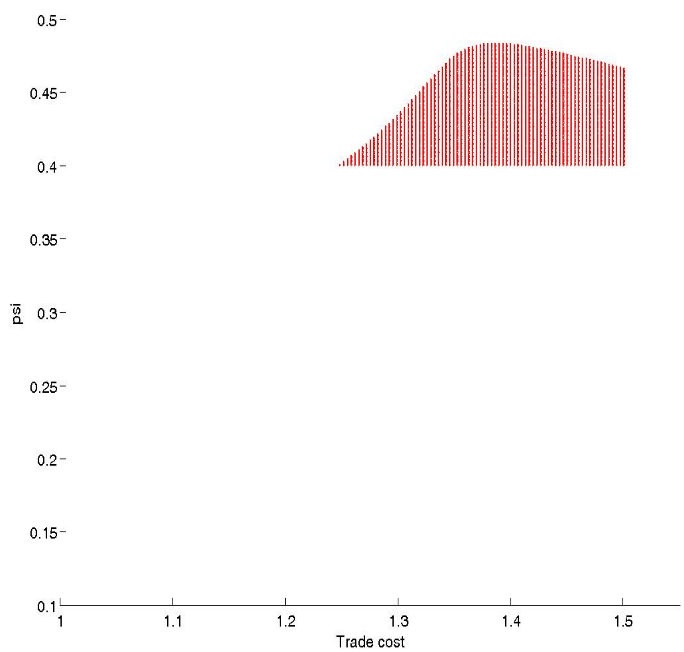

Figure 4: Parameters for which deindustrialization of the large economy takes place. Case: $\frac{L_i}{L_j} = 2, \beta = 0.6, \sigma = 0.8$

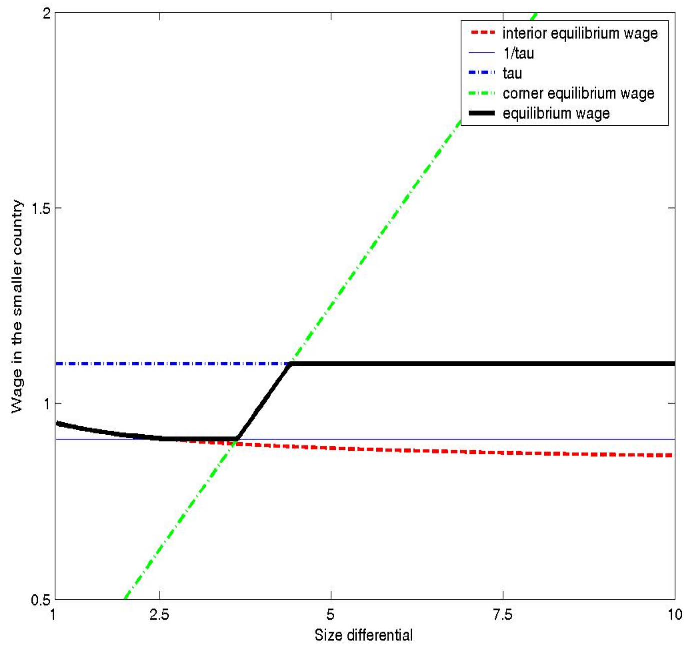

Figure 5: Wages in the small economy as a function of the size differential. Case: $\tau = 1.1, \beta = 0.8, \sigma = 0.8, \varphi = 0.22$

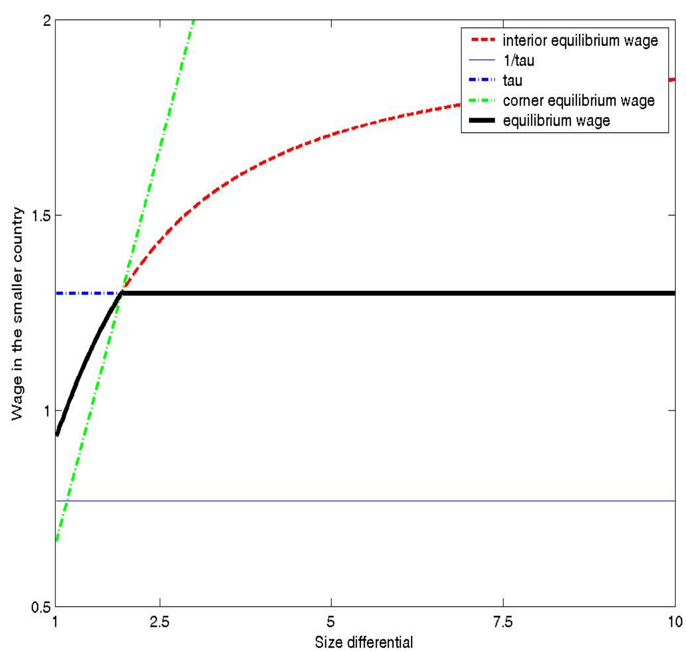

Figure 6: Wage in the smaller economy as a funtion of the size differential. Case: $\tau = 1.3, \beta = 0.6, \sigma = 0.8, \varphi = 0.42$

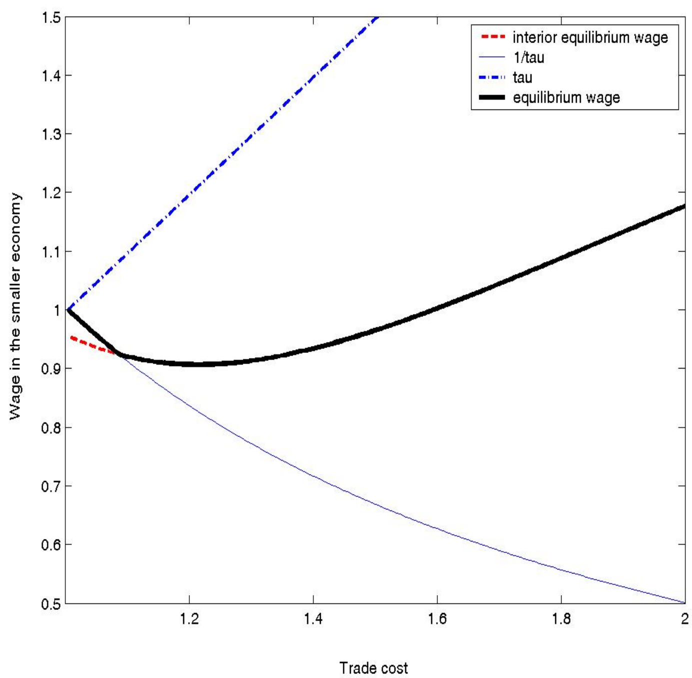

Figure 7: Wages in the small economy as a function of trade cost. Case: $\frac{L_i}{L_j} = 2, \beta = 0.8, \sigma = 0.8, \varphi = 0.22$