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## Trade Policy: Home Market Effect vs Terms of Trade Externality

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### Abstract

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We study trade policy in a two-sector Krugman type model of trade. We conduct a general analysis allowing for three different instruments: tariffs, export taxes and production subsidies. For each instrument we consider unilateral trade policy without retaliation. When carefully disentangling the different effects that determine policy makers' choices and modeling general equilibrium effects of taxes/tariffs, we find that production subsidies are always inefficiently low and driven by terms of trade effects. In the cases of tariffs and export taxes the home market effect prevails for some parameter combinations but mostly trade policy is determined by terms of trade effects and the desire to reduce distortions arising from monopolistic competition. Hence, our analysis sheds new light on trade policy in a model of intra-industry trade.

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**Keywords:** Home Market Effect, Terms of Trade, Tariffs and Subsidies

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# Trade Policy: Home Market Effect vs Terms of Trade Externality

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## Abstract

We study trade policy in a two-sector Krugman type model of trade. We conduct a general analysis allowing for three different instruments: tariffs, export taxes and production subsidies. For each instrument we consider unilateral trade policy without retaliation.

When carefully disentangling the different effects that determine policy makers' choices and modeling general equilibrium effects of taxes/tariffs, we find that production subsidies are always inefficiently low and driven by terms of trade effects. In the cases of tariffs and export taxes the home market effect prevails for some parameter combinations but mostly trade policy is determined by terms of trade effects and the desire to reduce distortions arising from monopolistic competition.

Hence, our analysis sheds new light on trade policy in a model of intra-industry trade.

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# 1 Introduction

The aim of this paper is to study trade policy in a version of the Krugman (1980) model of intra-industry trade with monopolistic competition and increasing returns. We consider a generalized two country version of the Krugman model with two sectors - one with monopolistic competition, increasing returns and iceberg trade costs and one that features perfect competition and constant or decreasing returns. Within this framework we study the unilateral incentives to set import tariffs, export taxes as well as production subsidies.<sup>1</sup>

In our analysis we disentangle the different effects that drive policy makers' incentives to set trade policy unilaterally and which they have to trade off against each other. First, a standard terms of trade externality - the desire to manipulate international prices in favor of the domestic economy by decreasing the relative price of imported bundles. Second, a home market (production relocation) externality which leads policy makers to induce firms to locate in the domestic economy so that domestic consumers can save on transport costs. Third, an inefficiency in the allocation between the differentiated and the homogeneous sector due to monopolistic pricing that implies a too low number of firms in the differentiated sector.

We show that in the case of the production subsidy the terms of trade externality always dominates the other effects. Indeed, production subsidies are inefficiently low compared to the ones that would implement the Pareto-optimal allocation. Lower subsidies imply lower relative prices of importables in world markets, while the home market effect would call for over-subsidizing production in order to attract firms to the domestic economy.

When considering tariffs and export subsidies, we find that the home market effect is sometimes the dominating effect for unilateral policy makers' decision. However, for large parts of the parameter space trade policies are still driven by the terms of trade externality, even when considering constant returns in the homogeneous sector. In addition, if monopolistic distortions are removed by an appropriately chosen production subsidy the terms of trade externality always determines unilateral policy choices.

As we explain below, our results differ from those of the previous literature that has analyzed trade policy in a two sector Krugman model. There are several reasons for this. First, we

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<sup>1</sup>We investigate cooperative and strategic determination of trade policy in a companion paper, Campolmi, Fadinger and Forlati (2009).

consider income effects of trade and production taxes, while previous contributions have either assumed that tariffs are a pure waste (Venables (1987), Ossa (2008)) or that utility is quasi-linear (Helpman and Krugman (1989) Bagwell and Staiger (2009)). While these assumptions guarantee analytical tractability, both eliminate important general equilibrium effects. Second, we carefully analyze the different channels that determine policy makers' incentives, which allows to interpret existing results in a new light. Third, we use a different - and as we will argue the relevant - definition of the terms of trade. This makes clear that also policy instruments that do not have a direct effect on world market prices of individual varieties (e.g. tariffs) have terms of trade effects even in the case of constant returns in the homogeneous sector (which implies factor price equalization). The reason is that all policy instruments affect the number of domestic and foreign differentiated varieties and therefore the welfare relevant price indices.

As for the previous literature, Venables (1987) was the first to study import tariffs as well as export- and production subsidies in a two-sector Krugman model with transport costs. His analysis considers unilateral trade policy and shows that: first, a country's welfare is always raised by a unilateral increase in its import tariffs when tariff revenues are not redistributed; second, a small production subsidy or an export subsidy also increase welfare. He interprets those results in the light of a home market effect. In his analysis Venables never corrects for the presence of inefficiency in the economy due to monopolistic competition.

We show that the subsidy to domestic production that is optimal from the domestic policy maker's viewpoint is always smaller than the one chosen by the world planner. This implies that domestic policy makers try to improve their terms of trade rather than to increase the number of domestic firms above the efficient level. Still, they choose a positive level of subsidy because the number of firms in the decentralized equilibrium without policy intervention is too low.

Turning to his result on tariffs, which has recently been confirmed by Ossa (2008) in a strategic setting, we find that having a tariff as an optimal policy is not a robust result. When intra-industry elasticities of substitution are somewhat larger than import elasticities, results turn around: the terms of trade externality becomes dominant and the optimal policy is to set an import subsidy. This reduces the domestic number of varieties and therefore improves the domestic terms of trade. Import subsidies are also always optimal when monopolistic distortions have been eliminated by a production subsidy.

Bagwell and Staiger (2009) consider a variant of the two sector Krugman model with quasi-linear utility and allow policy makers to simultaneously choose tariffs and export taxes in a strategic setting. They show that in this special case Nash equilibrium policy choices are explained only by the desire to manipulate international prices and not by the the home market externality. However, they do not disentangle the different effects that govern policy choices and they consider the prices of individual varieties instead of the welfare relevant terms of trade. We study strategic interaction in our more general framework in a companion paper (Campolmi et al. (2009)).

Finally, Gros (1987) analyzes optimal (strategic and non-strategic) import tariffs in a one sector Krugman model without trade costs. He computes the optimal tariff on imports and shows that it is positive even for a small open economy because of terms of trade effects.

Our model collapses to the model analyzed by Gros (1987) when there is only one sector and becomes qualitatively very similar when there are strong decreasing returns in the production of the homogeneous good. In this case relative wages are pinned down in the homogeneous sector and dominate the effect of variety on aggregate terms of trade. Policy makers now have an incentive to set a positive import tariff in order to improve the terms of trade. A tariff increases production in the differentiated sector and therefore the relative domestic wage.

Summarizing, the main contributions of our paper are the following ones. We isolate the different incentives that determine policy makers' objective and show how they interact. Moreover, we clarify what the welfare relevant terms of trade are in this model and make clear that both home market and terms of trade effects coexist even when we consider the baseline model with a linear outside good and tariffs as the only policy instrument. Finally, we show that home market effects never determine trade policy in the case of production subsidies and that their dominance is fragile when we consider tariffs and export taxes as the trade policy instrument.

The paper proceeds as follows: The next section 2 presents the model and section 3 the equilibrium conditions. In the following sections we discuss the definition of the terms of trade and the different incentives that determine policy makers' choices. Section 6 is dedicated to studying trade policy, while section 7 concludes.

## 2 The Model

The world economy consists of two countries: Home and Foreign. Each country produces a homogenous good and a continuum of differentiated goods. All goods are tradable but only the differentiated goods are subject to transport costs. The differentiated goods sector is characterized by monopolistic competition while there is perfect competition in the homogenous good sector. The two countries are identical in terms of preferences, production technology and market structure. In what follows foreign variables will be denoted by a (\*).

### 2.1 Households

Household's utility function in the Home country is given by:

$$U(C, Z) \equiv C^\alpha Z^{1-\alpha} \quad (1)$$

where  $C$  aggregates over the differentiated goods,  $Z$  represents the homogeneous good and  $\alpha$  is the share of the differentiated goods in the aggregate consumption basket. While the homogeneous good is identical across countries, each country produces a different subset of differentiated goods. In particular,  $N$  varieties are produced in the Home country while  $N^*$  are produced by Foreign. We allow for a general specification of the consumption aggregators with two different elasticity of substitutions, one between home and foreign goods ( $\eta$ ) and one between goods produced in the same country ( $\varepsilon$ ):

$$C = \left[ C_H^{\frac{\eta-1}{\eta}} + C_F^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \quad \eta > 0 \quad (2)$$

$$C_H = \left[ \int_0^N c(h)^{\frac{\varepsilon-1}{\varepsilon}} dh \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad C_F = \left[ \int_0^{N^*} c(f)^{\frac{\varepsilon-1}{\varepsilon}} df \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad \varepsilon > 1 \quad (3)$$

Foreign consumers face an analogous utility function. Let  $p(h)$  ( $p^*(h)$ ) be the price paid by home (foreign) consumers for domestically produced varieties while  $p(f)$  ( $p^*(f)$ ) is the price paid by home (foreign) consumers for imported varieties. In general,  $p(h) \neq p^*(h)$  and  $p^*(h) \neq p(f)$  because of transport costs and tariffs/subsidies on imports and exports. Households inelastically supply  $L$  units of labor. The budget constraint of Home consumers reads as follows:

$$PC + p_Z Z = WL + T + \Pi, \quad (4)$$

where  $W$  is the wage,  $p_Z$  is the price paid for the homogeneous good,  $P$  is the price of the differentiated bundle,  $\Pi$  are firm profits redistributed to consumers and  $T$  is a lump sum tax/transfer which depends on the tariff/subsidy scheme adopted by the domestic government and which will be defined later. Then the solution to the consumer problem gives the following demand functions and price indices:

- Home's and Foreign's demand for differentiated varieties produced by Home:

$$c(h) = \left[ \frac{p(h)}{P_H} \right]^{-\varepsilon} C_H \quad c^*(f) = \left[ \frac{p^*(f)}{P_F^*} \right]^{-\varepsilon} C_F^* \quad (5)$$

$$C_H = \left[ \frac{P_H}{P} \right]^{-\eta} C \quad C_F^* = \left[ \frac{P_F^*}{P^*} \right]^{-\eta} C^* \quad (6)$$

- Home's and Foreign's demand for differentiated varieties produced by Foreign:

$$c(f) = \left[ \frac{p(f)}{P_F} \right]^{-\varepsilon} C_F \quad c^*(h) = \left[ \frac{p^*(h)}{P_H^*} \right]^{-\varepsilon} C_H^* \quad (7)$$

$$C_F = \left[ \frac{P_F}{P} \right]^{-\eta} C \quad C_H^* = \left[ \frac{P_H^*}{P^*} \right]^{-\eta} C^* \quad (8)$$

- Demand for the homogeneous good in Home and Foreign:

$$Z = \frac{1 - \alpha}{\alpha} \frac{P}{p_Z} C \quad Z^* = \frac{1 - \alpha}{\alpha} \frac{P^*}{p_Z^*} C^* \quad (9)$$

- Domestic price indices:

$$P = [P_H^{1-\eta} + P_F^{1-\eta}]^{\frac{1}{1-\eta}} \quad (10)$$



$$P_H = \left[ \int_0^N p(h)^{1-\varepsilon} dh \right]^{\frac{1}{1-\varepsilon}} \quad P_F = \left[ \int_0^{N^*} p(f)^{1-\varepsilon} df \right]^{\frac{1}{1-\varepsilon}} \quad (11)$$

- Foreign price indices:

$$P^* = [P_H^{*1-\eta} + P_F^{*1-\eta}]^{\frac{1}{1-\eta}} \quad (12)$$

$$P_H^* = \left[ \int_0^{N^*} p^*(h)^{1-\varepsilon} dh \right]^{\frac{1}{1-\varepsilon}} \quad P_F^* = \left[ \int_0^N p^*(f)^{1-\varepsilon} df \right]^{\frac{1}{1-\varepsilon}} \quad (13)$$

## 2.2 Firms in the Differentiated Sector

Firms in the differentiated sector operate in a regime of monopolistic competition. They pay a fixed cost in terms of labor  $f$  and then produce with a constant returns to scale technology:

$$y(h) = L_C(h) - f, \quad (14)$$

where  $L_C(h)$  is the amount of labor allocated to the production of the differentiated good  $h$ . Goods sold in the foreign market are subject to an iceberg transport cost  $\tau \geq 1$ . Governments in both countries can use three policy instruments: a production tax/subsidy on fixed and marginal costs ( $\tau_C$ ) and tariffs/subsidies on imports ( $\tau_I$ ) and exports ( $\tau_X$ ).<sup>2</sup> A (\*) indicates the Foreign policy instruments. We assume that those subsidies (taxes) are received (payed) directly by the firms. Equivalently, we could have consumers receiving (paying) them from (to) the government.

Given the constant price elasticity of demand, optimal prices charged by Home firms in the domestic market are a fixed markup over their perceived marginal cost  $\tau_C W$  and optimal prices payed by foreign consumers equal domestic prices augmented by transport costs and tariffs:<sup>3</sup>

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<sup>2</sup>In general  $\tau_i$  indicates the gross subsidy/tax for  $i \in \{C, I, X\}$  i.e.,  $\tau_i < 1$  indicates a subsidy,  $\tau_i > 1$  indicates a tax while when  $\tau_i = 1$  the policy instrument is not used.

<sup>3</sup>Following the previous literature (Venables (1987), Ossa (2008)), we assume that tariffs and export taxes are charged ad valorem on the factory gate price augmented by transport costs. This implies that transport services are taxed.

$$p(h) = \tau_C \frac{\varepsilon}{\varepsilon - 1} W \qquad p^*(f) = \tau_I^* \tau_X \tau p(h) \qquad (15)$$

In the same way, Foreign firms' optimal pricing decisions lead to:

$$p^*(h) = \tau_C^* \frac{\varepsilon}{\varepsilon - 1} W^* \qquad p(f) = \tau_I \tau_X^* \tau p^*(h) \qquad (16)$$

### 2.3 Homogeneous good sector

Both countries can produce a homogenous good using the same production technology:

$$Q_Z = L_Z^\gamma \qquad \gamma \leq 1, \qquad (17)$$

where  $L_Z$  is the amount of labor allocated to producing the homogeneous good. The good is sold in a perfectly competitive market without trade costs. Consequently, the price equals marginal cost and is the same across the two countries:

$$p_Z = \frac{1}{\gamma} L_Z^{1-\gamma} W \qquad p_Z = p_Z^* \qquad (18)$$

If  $\gamma = 1$  (constant returns to scale) and as long as the homogeneous good is produced in both countries in equilibrium, which we will assume for the rest of the paper, there is factor price equalization:

$$p_Z = p_Z^* = W = W^* \qquad (19)$$

### 2.4 Government

The government of each country disposes of 3 fiscal instruments. A production tax/subsidy ( $\tau_C$ ), tariffs/subsidies on imports ( $\tau_I$ ) and a tax/subsidy on exports ( $\tau_X$ ). All government revenues are redistributed to consumers through a lump sum transfer  $T$ . The government is assumed to run a balanced budget. Hence, the government's budget constraint is:

$$(\tau_I - 1)\tau_X^* \tau P_H^* C_F + (\tau_X - 1)\tau P_H C_F^* + (\tau_C - 1)W \int_0^N (y(h) + f)dh = T \qquad (20)$$

Total government income consists of import revenues charged on imports of differentiated goods including transport costs and foreign export taxes, export taxes charged on exports including transport costs and the production tax revenues.

### 3 Equilibrium

Given that firms share the same production technology, the equilibrium is symmetric - firms in the differentiated sector of one country charge the same price and produce the same quantity. This implies that in equilibrium price indices can be written as:

$$\frac{p(h)}{P_H} = N^{\frac{1}{\varepsilon-1}} \qquad \frac{p^*(h)}{P_H^*} = N^{*\frac{1}{\varepsilon-1}} \qquad (21)$$

$$P_F = \tau_I \tau_X^* \tau P_H^* \qquad P_F^* = \tau_I^* \tau_X \tau P_H \qquad (22)$$

#### 3.1 Free Entry in the Differentiated Sector

The assumption of free entry in the differentiated sector implies that monopolistic producers in the differentiated sector make zero profits in equilibrium:<sup>4</sup>

$$\Pi(h) = c(h) [p(h) - \tau_C W] + c^*(f) [\tau p(h) - \tau \tau_C W] - f \tau_C W = 0 \qquad (23)$$

Combining the optimal pricing rule with equation (23), we obtain:

$$c(h) + \tau c^*(f) = (\varepsilon - 1) f \qquad (24)$$

Substituting the demand functions into (24) and using (21) and (22), the zero profit condition for firms in the domestic differentiated sector can be rewritten as:

$$(\varepsilon - 1) f = N^{\frac{\varepsilon}{1-\varepsilon}} \left( \frac{P_H}{p_z} \right)^{-\eta} \left[ \left( \frac{P}{p_z} \right)^\eta C + \tau^{1-\eta} (\tau_I^* \tau_X)^{-\eta} \left( \frac{P^*}{p_z} \right)^\eta C^* \right] \qquad (25)$$

An analogous condition can be derived for firms located in the foreign country:

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<sup>4</sup>Remember that firms pay (receive) taxes (subsidies) to (from) the government. Taking this into account, firms' revenues from exporting are given by  $c^*(f) \frac{p^*(f)}{\tau_I^* \tau_X} = c^*(f) \tau p(h)$ .

$$(\varepsilon - 1)f = N^* \frac{\varepsilon}{1-\varepsilon} \left( \frac{P_H^*}{p_z} \right)^{-\eta} \left[ \left( \frac{P^*}{p_z} \right)^\eta C^* + \tau_I^{-\eta} \tau_X^*{}^{-\eta} \tau^{-1-\eta} \left( \frac{P}{p_z} \right)^\eta C \right] \quad (26)$$

### 3.2 Goods and Labor Market Clearing Conditions

For each differentiated variety produced by Home the following market clearing condition must be satisfied:

$$y(h) = c(h) + \tau c^*(f) \quad (27)$$

Therefore, the zero profit condition (24) and market clearing (27) imply that the production of each variety is fixed and the same is true for the varieties produced by Foreign:

$$y(h) = (\varepsilon - 1)f \qquad y^*(h) = (\varepsilon - 1)f \quad (28)$$

The market clearing condition for the homogeneous good is given by:

$$Q_Z + Q_Z^* = Z + Z^* \quad (29)$$

which, using the demand functions, can be written as:

$$Q_Z + Q_Z^* = \frac{(1 - \alpha)}{\alpha} \left[ \frac{P}{p_z} C + \frac{P^*}{p_z} C^* \right] \quad (30)$$

Finally, equilibrium in the labor market implies that  $L = L_C + L_Z$  with  $L_C = N L_C(h)$  in the symmetric equilibrium. Making use of (14) and (28), we have:

$$L_C = N \varepsilon f \qquad Q_Z = [L - N \varepsilon f]^\gamma \quad (31)$$

and for Foreign:

$$L_C^* = N^* \varepsilon f \qquad Q_Z^* = [L^* - N^* \varepsilon f]^\gamma \quad (32)$$

### 3.3 Balanced Trade Condition

The model is solved under the assumption of financial autarky, so trade is balanced. The net-export of the homogenous good by Home is defined as:

$$Z^X - Z^M \equiv Q_Z - \frac{1 - \alpha}{\alpha} \frac{P}{p_Z} C \quad (33)$$

Hence, the balanced trade condition reads as follows:<sup>5</sup>

$$\tau \tau_X P_H C_F^* + p_Z (Z^X - Z^M) = \tau \tau_X^* P_H^* C_F \quad (34)$$

The left hand side of the above expression is the sum of net export value of the homogeneous goods and the value of exports of differentiated varieties, while the right hand side is the value of imports of differentiated varieties.

Combining (33) with (34), (22) and the demand functions, we can rewrite the balanced trade condition as follows:

$$Q_Z = \frac{(1 - \alpha) P}{\alpha} \frac{P}{p_Z} C + \tau_I^{-\eta} (\tau_X^* \tau)^{1-\eta} \left( \frac{P_H^*}{p_Z} \right)^{1-\eta} \left( \frac{P}{p_Z} \right)^\eta C - \tau_I^{*\eta} (\tau_X \tau)^{1-\eta} \left( \frac{P_H}{p_Z} \right)^{1-\eta} \left( \frac{P^*}{p_Z} \right)^\eta C^* \quad (35)$$

### 3.4 Price Indices

Using the optimal pricing rules (15) and (18) together with equations (17) and (21) (and the corresponding ones for Foreign), relative prices can be written as follows:

$$\frac{P_H}{p_Z} = \frac{\varepsilon}{\varepsilon - 1} \gamma \tau_C N^{\frac{1}{1-\varepsilon}} Q_Z^{\frac{\gamma-1}{\gamma}} \quad \frac{P_H^*}{p_Z} = \frac{\varepsilon}{\varepsilon - 1} \gamma \tau_C^* N^{*\frac{1}{1-\varepsilon}} Q_Z^{*\frac{\gamma-1}{\gamma}} \quad (36)$$

$$\frac{P}{p_Z} = \left[ \left( \frac{P_H}{p_Z} \right)^{1-\eta} + (\tau_I \tau_X^* \tau)^{1-\eta} \left( \frac{P_H^*}{p_Z} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}} \quad \frac{P^*}{p_Z} = \left[ \left( \frac{P_H^*}{p_Z} \right)^{1-\eta} + (\tau_I^* \tau_X \tau)^{1-\eta} \left( \frac{P_H}{p_Z} \right)^{1-\eta} \right]^{\frac{1}{1-\eta}} \quad (37)$$

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<sup>5</sup>Import tariffs/subsidies are collected directly by the governments at the border so they do not enter into this condition.

The free entry conditions for the two countries (25) and (26), the market clearing for the homogeneous good (30) and the balanced trade condition (35) together with the expressions for price indices just derived and (31) and (32) fully characterize the equilibrium of the economy.

## 4 Terms of Trade

Before going into the details of trade policy choices under different instruments we need to clarify two main points. The first one is the relevant definition of the terms of trade. The second point, that we will investigate in the following section, is to highlight the different economic incentives that determine unilateral trade policies.

A crucial aspect of our study of policy makers' incentives to set trade policy is to define the terms of trade in the relevant way. All other contributions (Venables (1987), Helpman and Krugman (1989), Ossa (2008), Bagwell and Staiger (2009)) have defined the terms of trade as the relative prices of individual varieties in international markets,  $\frac{\tau_X^* p^*(h)}{\tau_X \tau_C} = \frac{W^* \tau_X^* \tau_C^*}{W \tau_X \tau_C}$ . Since these works all consider a linear outside good, relative wages are one. Consequently, only export and production taxes can affect these relative prices.

However, these are not the relative prices in international markets that domestic policy makers care about. Domestic policy makers - like domestic consumers - are interested in how many units of foreign goods they can buy for a given amount of domestic goods. This relation is reflected in the trade balance condition (34).

Dividing (34) by  $(\tau \tau_X P_H)$  we obtain  $C_F^* + \left(\frac{p_z}{\tau \tau_X P_H}\right) (Z^X - Z^M) = \left(\frac{\tau_X^* P_H^*}{\tau_X P_H}\right) C_F$ , where the left hand side is the value of domestic exports and the right hand side is the value of domestic imports. Consider the case in which Home imports the homogeneous good ( $Z^X = 0$ ). In this case an increase in the relative world market price (before tariffs are applied) of the foreign differentiated bundle in terms of the domestic bundle  $\left(\frac{\tau_X^* P_H^*}{\tau_X P_H}\right)$  hurts domestic consumers because the amount of foreign differentiated goods they can buy for a given amount of domestic goods decreases. Similarly, an increase of the relative price of homogeneous goods in international markets  $p_z/(\tau \tau_X P_H)$  in terms of domestic exports also lowers the purchasing power of domestic exports in terms of foreign goods.

As a consequence, the two relative world market prices that are of interest for domestic policy makers, and hence the welfare relevant definition of the terms of trade, are  $(\tau_X^* P_H^*)/(\tau_X P_H)$  and

$p_z/(\tau\tau_X P_H)$  if Home is an importer of the homogeneous good and  $(\tau\tau_X^* P_H^*)/p_z$  if Home is an exporter of the homogeneous good.<sup>6</sup>

Using the definition of the price indices, we can write the relevant terms of trade as  $\left(\frac{\tau_X^* P_H^*}{\tau_X P_H}\right) = \left(\frac{N}{N^*}\right)^{\frac{1}{\varepsilon-1}} \frac{W^* \tau_X^* \tau_C^*}{W \tau_X \tau_C}$ . Hence, the relative international price of imports of differentiated goods in terms of exports depends positively on the relative number of varieties produced domestically and negatively on the relative domestic wages. It also depends directly on domestic and foreign production subsidies  $\tau_C, \tau_C^*$  and export taxes  $\tau_X, \tau_X^*$ . Note that the previous literature has only considered the second part of the above expression as the terms of trade, omitting the part that depends on the relative number of domestic varieties,  $\left(\frac{N}{N^*}\right)^{\frac{1}{\varepsilon-1}}$ .

To gain some more intuition consider first the case of constant returns to scale in the production of the homogeneous good ( $\gamma = 1$ ). If  $\gamma = 1$  relative wages are one, so that  $\left(\frac{\tau_X^* P_H^*}{\tau_X P_H}\right) = \left(\frac{N}{N^*}\right)^{\frac{1}{\varepsilon-1}} \frac{\tau_X^* \tau_C^*}{\tau_X \tau_C}$ . Hence, this measure of the terms of trade depends only on domestic and foreign export taxes, production subsidies and on the relative number of domestic varieties. An increase in the relative number of varieties produced at home increases the relative price of imports of differentiated varieties, since a larger number of domestic varieties has to be exchanged for the same number of foreign varieties. The other relevant relative prices become  $p_z/(\tau\tau_X P_H) = \frac{N^{1/(\varepsilon-1)}}{\tau\tau_X \tau_C^{\frac{\varepsilon}{\varepsilon-1}}}$  and  $(\tau\tau_X^* P_H^*)/p_z = \tau\tau_X^* \tau_C^* (N^*)^{1/(1-\varepsilon)} \frac{\varepsilon}{\varepsilon-1}$ . Hence, the relative price of imports of homogeneous goods is increasing in the number of domestic varieties, while the relative price of exports of homogeneous goods is increasing in the number of foreign varieties.

Note that with these definitions of the terms of trade, all policy instruments (production subsidies, tariffs and export taxes) may affect the terms of trade indirectly, by changing the distribution of firms located in the domestic and the foreign economy.

In the general case with  $\gamma < 1$  terms of trade are also affected by changes in relative wages.

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<sup>6</sup>Below we show that domestic policy makers manipulate these prices in their favor even when there is a linear outside good (which fixes relative wages), there are no transport costs (and hence there is no home market externality) and the only policy instrument available are tariffs (which do not influence prices of individual varieties in world markets).

## 5 Single-country Policy Makers' Incentives

When policy makers set trade policy unilaterally in order to maximize the welfare of their citizens, their choices are driven by the following motives.

First, there is a terms of trade externality. Uncoordinated policy makers try to render the relative prices of imported bundles cheaper in order to maximize the total purchasing power of domestically produced goods in international markets. As mentioned in the previous section, they do this by outsourcing production of differentiated goods to the foreign economy. This may affect foreign consumers whose purchasing power of domestic goods in international markets is reduced.

Second, in the presence of positive transport costs there is a home market (production relocation) externality that works in the opposite direction. Domestic policy makers try to induce firms to relocate to the domestic economy, so that domestic consumers can benefit from lower prices, since they save on transport costs. This can hurt foreign consumers, who now have to pay transport costs on more varieties. It is clear that there is an inherent trade-off between the terms of trade effect and the home market externality, since the first implies a reduction in the number of domestically produced varieties while the second one calls for an increase.

Third, without trade policy intervention, the number of differentiated varieties at the world level is too low relative to the amount of production of the homogeneous good. This is due to monopolistic price setting in the differentiated sector.

While in the one-sector Krugman model with Dixit-Stiglitz preferences and endogenous entry the presence of monopolistic competition does not introduce any inefficiency,<sup>7</sup> this is no longer true in a two-sector model. In particular, if not corrected by the production subsidy, the price markup charged by firms in the differentiated sector leads to an equilibrium with an inefficiently low number of varieties and an inefficiently high level of production of the homogeneous good because the marginal rate of substitution between the two sectors does not equal the marginal rate of transformation. To correct for such an inefficiency policy makers have an incentive to

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<sup>7</sup>This result is proved in Gros (1987). The basic intuition is that firm size is optimal in the market solution of any model with Dixit-Stiglitz utility (see Dixit and Stiglitz (1977)) and with one sector and homogeneous firms markups do not distort any decision of consumers because all relative goods prices equal one, so that also the number of varieties is chosen optimally.



subsidize production. By doing so they can either completely (production subsidy) or partially (import and export subsidy) eliminate the price markup in the differentiated sector, thus increasing the world number of varieties.

Finally, in some cases there is an additional revenue externality. We sometimes consider a production subsidy that is set non-strategically in order to eliminate the monopolistic distortion. Then there is the incentive to outsource production of differentiated goods in order to save on subsidy expenditures at the expense of the other country.

## 6 Trade Policy

We can now turn to the main objective of the paper, which is to clarify the role played by the different inefficiencies/externalities discussed above in affecting a country's decision over its policy instruments. In particular, we are interested in the interactions between the different inefficiencies/externalities and the specific policy instrument used. We do so by studying non-strategic trade policies - unilateral changes in trade policy by Home with no retaliation from Foreign. This exercise is sufficient to clarify the role played in each case by the desire to correct for the monopolistic distortion, the attempt to improve the terms of trade, the home market externality and the revenue externality.

We consider three possible trade policy instruments in turn: taxes/subsidies on the production of differentiated goods ( $\tau_C, \tau_C^*$ ), import tariffs ( $\tau_I, \tau_I^*$ ) and export taxes ( $\tau_X, \tau_X^*$ ). In each case, we study only the choice of one instrument at a time, so we do not allow, for example, policy makers to set simultaneously import tariffs and export taxes.<sup>8</sup> A detailed analysis of both the cooperative solution and strategic trade policy interaction for each instrument is provided in Campolmi et al. (2009).<sup>9</sup>

In order to better understand the results for the different policy instruments, it is however useful to have as a benchmark the allocation that the two countries could achieve under coop-

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<sup>8</sup>So when policy makers choose import tariffs,  $\tau_X$  and  $\tau_X^*$  are always set equal to one. This is an important difference with respect to the analysis in Bagwell and Staiger (2009).

<sup>9</sup>In that paper we study optimal trade policies both from the perspective of single country policy makers, studying the Nash equilibrium of the game, and from the perspective of a cooperative authority that maximizes average welfare of the world economy.

eration. While for a formal derivation of such policies we refer to Campolmi et al. (2009), here it is enough to summarize the main results. The actions of the cooperative policy maker are exclusively driven by the desire to eliminate the inefficiency induced by monopolistic competition in the differentiated sector. The first best allocation can be reached by setting the production subsidy in each country at the level needed to completely eliminate the price markup in the differentiated sector ( $\tau_C = \tau_C^* = \frac{\varepsilon-1}{\varepsilon}$ ,  $\tau_I = \tau_I^* = \tau_X = \tau_X^* = 1$ ). If such an instrument is not available, the policymaker subsidizes production using import or export subsidies, implementing the constrained efficient allocation.<sup>10</sup>

For each of the policy instruments we investigate two cases. Under the first hypothesis the monopolistic distortion in the differentiated sector is not corrected (i.e.  $\tau_C = \tau_C^* = 1$ ), while under the second it is offset by an appropriate production subsidy (i.e.  $\tau_C = \tau_C^* = (\varepsilon-1)/\varepsilon$ ). We consider these two scenarios because we want to disentangle the consequences of the inefficiency caused by monopolistic pricing in the differentiated sector from the other effects.

Since we want to compare our results with the existing literature, the first set of results is derived under the assumptions of  $\gamma = 1$  (constant returns in the homogeneous sector, which - together with costless trade in this sector - guarantees factor price equalization) and  $\eta = \varepsilon$  (elasticity of substitution between the domestic and the foreign bundle equal to the elasticity of substitution between varieties). Far from being realistic, the assumption of  $\eta = \varepsilon$  is commonly used for tractability. We will show how crucial that assumption is and how many useful insight can be gained by relaxing it. For completeness we will also compare those outcomes with the ones that would arise under the assumption of decreasing returns in the homogeneous sector ( $\gamma < 1$ ).

Because our model is relatively general, analytical results cannot be obtained. Instead, we rely on numerical simulations.

## 6.1 Production Subsidies

In this section we consider the case of a production subsidy/tax being the only policy instrument available, i.e.  $\tau_I = \tau_I^* = \tau_X = \tau_X^* = 1$  always.

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<sup>10</sup>Using import and/or export subsidies the first best allocation cannot be implemented due to the lack of an instrument that eliminates the distortion for the good produced and consumed in the same country.

### 6.1.1 Benchmark case: $\eta = \varepsilon$ and $\gamma = 1$

We first start from a situation where neither of the two countries is using the production subsidy (i.e.  $\tau_C = \tau_C^* = 1$ ) and ask the question of what the optimal choice of  $\tau_C$  for Home would be assuming that Foreign keeps  $\tau_C^* = 1$ . For our numerical example we consider  $\varepsilon = 4$ , a standard value in the literature, transport costs  $\tau = 1.4$ <sup>11</sup> and an expenditure share on the differentiated sector  $\alpha = 0.4$ , as in Fujita, Krugman and Venables (1999). The same calibration will also be used for the benchmark case of the other two instruments. In the next section we show how the results are affected by different values of  $\varepsilon$  and  $\tau$ .

Figure 1 shows the behavior of key variables for both countries as functions of the domestic production subsidy. In particular, for each country we plot the number of varieties produced, consumption of the differentiated bundle, production and consumption of the homogeneous good and utility. We also report the terms of trade from the perspective of Home and the net transfers to Home.<sup>12</sup> An increase in the domestic subsidy increases demand for domestic differentiated goods and thus, other things equal, generates positive profits in the domestic country. This causes firms in the differentiated sector to enter the domestic market and leave the foreign one until zero profits are reached. Hence, the subsidy to production causes agglomeration. Overall, the increase in  $N$  more than compensates the decrease in  $N^*$  and pushes the number of varieties available at the world level closer to efficiency. Domestic production in the homogeneous sector is reduced to free resources for production in the differentiated sector. Consumption of differentiated goods at Home increases, even though the terms of trade depreciate and there are net transfers from Home to Foreign,<sup>13</sup> thanks to the increase in the world number of varieties (lower monopolistic distortion) and the reduced transport costs (home mar-

<sup>11</sup>As an upper bound Anderson and Wincoop (2004) estimate an international trade cost excluding policy barriers of around 60% for industrialized countries. This splits into a transport cost of 21% and a 32% international trade costs excluding policy barriers, such as language and information costs ( $0.6=1.21*1.32-1$ ). We view this as rather high but our results are perfectly robust to choosing this number for trade costs.

<sup>12</sup>Net transfers are computed as:

$$NT = (\tau_I - 1)\tau_X^* \tau P_H^* C_F + (\tau_X - 1)\tau P_H C_F^* - (\tau_C - 1)W\tau C_F^* - (\tau_I^* - 1)\tau_X \tau P_H C_F^* - (\tau_X^* - 1)\tau P_H C_F^* + (\tau_C^* - 1)W^* \tau C_F \quad (38)$$

and represent net transfer of taxes from Foreign to Home when positive.

<sup>13</sup>This is because home consumers pay taxes to subsidize all domestically produced goods, including the one sold abroad.

ket effect). The home market externality and the inefficiency due to monopolistic competition call for a production subsidy while the terms of trade externality requires a production tax, thus the hump-shaped behavior of domestic utility w.r.t. the subsidy. Overall, the terms of trade externality predominates and utility is maximized at a level of domestic subsidy strictly smaller than the efficient one ( $\tau_C = 0.75$ ). Interestingly, even though now production is more efficient at the world level, the foreign country is worse off. Why is this the case? Since their nominal income is unaffected, foreign consumers keep consuming the same amount of the homogeneous good while experiencing a reduction in the consumption of the differentiated goods. This is because of the higher transportation costs they have to pay after the relocation of firms to Home. Hence, the home market effect seems to be crucial in explaining the lower utility experienced by foreign consumers.

To abstract from the role played by the desire to correct for the inefficiency caused by monopolistic competition, we run a second experiment starting from the cooperative allocation i.e.  $\tau_C = \tau_C^* = \frac{\varepsilon-1}{\varepsilon}$ . This is done in Figure 2. A unilateral decrease in the domestic subsidy from the efficient level  $\tau_C = 0.75$  increases domestic utility, even though it lowers domestic consumption of differentiated goods. Hence, the optimal strategy given that the other country chooses an efficient subsidy, is to deviate to a smaller subsidy, that causes exit of firms in Home and entry in Foreign (going against the home market externality), reduces the domestic subsidy bill (revenue externality due to both the reduction of the subsidy and also to the relocation of some firms in the foreign country<sup>14</sup>) and improves domestic terms of trade, while lowering the aggregate level of efficiency (indeed  $N + N^*$  is now decreasing). The bottom line of these two experiments is that in none of the cases the home market externality drives the policy actions in the sense that there is no over-subsidizing of production in order to expand domestic number of firms above the efficient level. Policy makers trade off increased efficiency against worsened terms of trade.

### 6.1.2 Implications of $\eta \neq \varepsilon$

The previous results have been derived for a specific calibration, so one may wonder how robust they are. In particular, given the role played by the presence of monopolistic distortion, it is

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<sup>14</sup>In fact, now we have a positive net transfer form Foreign to Home.

interesting to study what happens when we lower or increase the inefficiency in the economy. The advantage of having a model with two different elasticities is that we can study how the results are affected by a change in  $\varepsilon$  (the higher its value, the lower the distortion due to monopolistic competition) while keeping constant  $\eta$  (the trade elasticity, crucial in determining the strength of the terms of trade externality). We consider only the case of  $\varepsilon \geq \eta$ , which guarantees that demand for varieties is increasing in the sectoral price index. Another crucial parameter is  $\tau$  which determines the level of transport cost and thus the strength of the home market effect. Setting  $\varepsilon > \eta$  allows to study the case without transport cost which is not well defined in the model with  $\varepsilon = \eta$  because it implies an infinite elasticity of the number of varieties with respect to policy instruments.<sup>15</sup>

In Figure 3 we report both the cooperative production subsidy (top) and the optimal domestic subsidy (bottom) for the case when  $\tau_C^*$  is set to zero. We allow  $\tau$  to vary between one (no transport cost, thus no home market externality) and two and consider  $\varepsilon$  in  $[2, 8]$ .<sup>16</sup> Several things are worth noticing. First, the optimal cooperative production subsidy does not depend on the level of transport cost and is decreasing in the level of  $\varepsilon$ . Second, in the case of unilateral change, the domestic country always chooses a production subsidy lower than the optimal one, independently of both the level of the monopolistic distortion and the level of the transport costs. Thus, interestingly enough, even when making the home market externality stronger by changing the transport costs, it never induces the home country to over-subsidize production, as one might have expected. Third, the difference between the cooperative subsidy and the optimal one under the unilateral change is decreasing in  $\tau$ . The intuition is the following. When  $\tau$  increases, the strength of the home market effect increases and so does the incentive to set a subsidy and the the incentives to exploit the terms of trade effect is reduced. Results are the qualitatively the same when considering the case  $\tau_C = \frac{\varepsilon-1}{\varepsilon}$ .<sup>17</sup>

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<sup>15</sup>The intuition is that in that case consumers do not care about the location of production, so that a positive production subsidy set by one country induces the whole differentiated sector to locate in that country and the outcome of an infinitesimal subsidy is specialization.

<sup>16</sup>Given that  $\eta \leq \varepsilon$ , for this exercise we set  $\eta = 2$  in order to study also cases with very strong inefficiency due to monopolistic distortion.

<sup>17</sup>The figure is not reported to save space but is available on request.

### 6.1.3 Implications of $\gamma < 1$

In the case of  $\gamma < 1$  relative wages increase in the number of domestic differentiated varieties, so there is an additional effect on the terms of trade. Nonetheless, results are robust to the introduction of decreasing returns in the homogeneous sector. Unilateral production subsidies are always smaller than the optimal ones.

## 6.2 Tariffs

In this section we study what drives the incentives of single country policy makers when the only instrument available is a tariff on imports. As for the case of production subsidies, we analyze the endogenous effects due to a unilateral change in the domestic tariff in the absence of foreign policy intervention, i.e. setting  $\tau_I^* = 1$ .

### 6.2.1 Benchmark case: $\eta = \varepsilon$ and $\gamma = 1$

Figure 4 plots the effects of a unilateral change of the domestic tariff on a number of endogenous variables for our baseline calibration<sup>18</sup> when the number of varieties is inefficiently low (i.e.  $\tau_C = \tau_C^* = 1$ ). In this scenario a positive tariff improves domestic welfare. This result is consistent with Venables (1987) and Ossa (2008) and can be explained as follows.

When unilaterally setting a tariff/subsidy on imports, independent trade authorities face a trade off between different effects. On the one hand, a tax on imports pushes firms to relocate in the domestic economy. The effect works through an increase in Home's demand for domestically produced goods induced by the tariff, which increases the profits of domestic firms and causes entry. Domestic consumers may benefit from this agglomeration because it reduces the burden of transport costs and renders the differentiated bundle cheaper. On the other hand, this same tax on imports worsens the terms of trade and exacerbates the inefficiency due to monopolistic competition by reducing  $N + N^*$ , the total number of the varieties produced in the differentiated sector. Under the benchmark calibration the home market effect prevails: a tariff on imports increases welfare by boosting domestic consumption in the differentiated and in the homogenous sectors. This result is not that surprising in the light of Figure 4. The impact of an unilateral

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<sup>18</sup>As for the production subsidy, all the exercises in this section are carried out under the baseline calibration  $\varepsilon = \eta = 4$ ,  $\alpha = 0.4$  and  $\tau = 1.4$ .

change in the domestic tariff on the terms of trade is weaker than in the case of the other policy instruments. Differently from both the production and export subsidies, tariffs affect the relevant terms of trade only through the indirect effect on the relative number of varieties ( $\frac{N}{N^*}$ ). At the same time the potential efficiency gain through an increase in the overall production of the differentiated sector induced by a domestic subsidy to imports would be very small relative to the rise in transport costs associated with the relocation of domestic monopolistic firms in the foreign economy. On top of that, tariff revenues imply a positive net transfer from Foreign to Home.

Moving to the second experiment, Figure 5 plots some endogenous domestic and foreign variables as function of the home tariff under the assumption that the distortion due to monopolistic competition is removed by a subsidy to production. Suppose that the domestic policy maker decides unilaterally to provide a small subsidy to imports. Such a policy improves domestic welfare at the expense of the foreign country. A subsidy to imports renders local differentiated goods relatively more expensive and induces households to increase their demand for foreign goods. As a consequence, firms agglomerate in the foreign economy and the number of domestic varieties is reduced while the foreign one is boosted. If the number of firms diminishes, governments can cut production subsidies and tax bills. This causes a positive wealth effect (and a negative revenue externality on foreign consumers, who now have to subsidize the production of more varieties), which more than compensates the negative one due to the import subsidy, generating a positive net transfer from Foreign. As a consequence of that, the consumption of homogeneous goods rises. At the same time the price of the differentiated goods augments and the terms of trade improve allowing to import more differentiated goods for each unit of exports. Hence, domestic households can increase also the overall consumption of the differentiated bundle  $C$ , even if some of the domestic varieties have been destroyed. In other words, when the monopolistic distortion is removed by an appropriate production subsidy, the terms of trade externality and the revenue effect more that compensate the rise in transport cost generated by a subsidy on imports. This explains why in this environment, contrary to Venables (1987) and Ossa (2008), raising import tariffs would decrease domestic welfare.

We can draw at least two conclusions from these last exercises. First, in the benchmark case without correction of the monopolistic distortion and differently from the case of the production subsidy the only externality that can explain the incentive of domestic policy makers to tax

imports is the home market effect. However, notice that this incentive does not lead to an over-expansion (i.e. above the first best level) of home varieties. Second, the home market effect is dominated by the revenue effect and the terms of trade externality when the monopolistic distortion is offset by appropriate production subsidies.

### 6.2.2 Implications of $\eta \neq \varepsilon$

Here we check if the results under our baseline calibration are robust once we allow  $\varepsilon$  being different from  $\eta$ .

Again, we consider first the case where the production subsidies  $\tau_C$  and  $\tau_C^*$  are set equal to one. Figures 6 and 7 plot the optimal tariff/subsidies on imports as functions of the elasticity of substitution among varieties  $\varepsilon$  and the iceberg cost  $\tau$  with  $\eta$  being equal to 2. The only difference across these two figures is the range of variation of  $\varepsilon$ .<sup>19</sup> In Figure 6  $\varepsilon \in (2, 2.6]$ , while in 7  $\varepsilon \in [2.6, 8]$ . The following conclusions can be drawn from these figures.

Consider first the case of  $\tau = 1$ . In this case the home market effect is absent and the only incentives for policy makers are terms of trade effects and the elimination of monopolistic distortions. Consequently, the optimal policy is an import subsidy (i.e.  $\tau_I < 1$ ). As  $\varepsilon$  becomes larger and larger, policy makers are less willing to subsidize imports (i.e. the optimal subsidy on imports tends to 1). In fact, as  $\varepsilon$  increases, the differentiated sector converges to a competitive sector which produces a single variety and the elasticity of  $N$  with respect to tariffs becomes zero. As a consequence both motives (the correction the monopolistic distortion and the incentive to improve the terms of trade) for subsidizing imports vanish.

Moving next to positive but sufficiently low levels of transport costs, single country policy makers still find it optimal to subsidize imports while for high transport costs the optimal policy is a tariff. The intuition is straightforward: while terms of trade effects and monopolistic distortions determine policy choices for low transport costs the home market effect prevails for high transport costs. Note however that if  $\varepsilon$  is sufficiently bigger than  $\eta$ , the optimal policy is an import subsidy even for transport costs of around 40%.

Note also that for  $\varepsilon$  close to  $\eta$  optimal tariffs are a non-monotonic function of transport costs. For a given  $\varepsilon$  the strength of the home market effect depends on two effects. On the one hand,

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<sup>19</sup>The figure is split in two parts in order to depict the different effects more clearly.



a low value of  $\tau$  implies a high elasticity of  $N$  with respect to the tariff.<sup>20</sup> On the other hand, a low  $\tau$  implies small savings in terms of transport costs for a given change in  $N$ . The strength of the home market externality is determined by combining these two effects. The hump shape disappears as  $\varepsilon$  increases. The reason is that the elasticity of  $N$  with respect to  $\tau_I$  decreases in  $\varepsilon$ , because a higher  $\varepsilon$  implies less love for variety and larger firms. Therefore, the transport cost saving motive becomes the dominant determinant of the home market effect.

We can then conclude that the results of Venables (1987) and Ossa (2008) are not robust in a plausible world in which the elasticity among varieties is greater than the trade elasticity.<sup>21</sup>

### 6.2.3 Implications of $\gamma < 1$

In Figure 8 we repeat the same exercise as in Figure 4. We consider again a unilateral deviation from a situation without trade policy but now allowing for decreasing returns in the homogeneous sector ( $\gamma = 0.65$ ). In this case the optimal choice is still a positive tariff but now this does not only induce relocation, it also improves domestic terms of trade thanks to an improvement in the relative wage. Indeed, labor at home is relocated from the homogeneous to the differentiated sector, thus marginal productivity in the domestic homogeneous sector goes up, while the opposite happens in Foreign. As a consequence, the domestic relative wage increases. Note that, as decreasing returns become stronger, the model behaves very much like a one sector model and the terms of trade externality becomes the predominant motive for setting an import tariff.

## 6.3 Export Taxes

Finally, we analyze the incentives behind the unilateral choice of the export instrument when  $\tau_I = \tau_I^* = \tau_X^* = 1$ .

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<sup>20</sup>Indeed, in the extreme case of no transport cost an infinitely small tariff would cause relocation of all firms!

<sup>21</sup>Our finding that a positive import subsidy is optimal if the monopolistic inefficiency is corrected remains valid independently of the values of  $\tau$  and  $\varepsilon$ . The figure is omitted to save space but is available from the authors on request.

### 6.3.1 Benchmark case: $\eta = \varepsilon$ and $\gamma = 1$

We study the case of unilateral deviations from an initially symmetric situation without export taxes or subsidies in two scenarios.

In the first one, the monopolistic distortion has not been eliminated. Figure 9 shows how a deviation to a positive subsidy on exports that attracts more firms to the domestic economy and increases the overall number of varieties available at the word level improves domestic welfare. Domestic terms of trade worsen and the subsidy bill is increased causing negative wealth effects. Still, Home is better off for two reasons: domestic consumption of differentiated varieties, that was too low in the market equilibrium, is driven closer to the Pareto-optimal level; in addition, domestic consumers can save on transport costs. The intuition is similar to the one provided for the unilateral deviation from zero production subsidy. The terms of trade would call for an export tax while the home market externality and the monopolistic distortion call for an export subsidy. When starting from an inefficient allocation, the monopolistic distortion and the home market externality prevail, thus inducing the home country to set a subsidy.

Under the benchmark calibration the subsidy is below the optimal cooperative one due to the terms of trade externality. However, for higher levels of transport cost this need not be the case.

The second scenario (Figure 10) considers the case where the monopolistic distortion has been eliminated by production subsidies ( $\tau_C = \tau_C^* = \frac{\varepsilon-1}{\varepsilon}$ ). Now a unilateral deviation to a positive tax on exports, that relocates firms in the foreign economy and induces an overall reduction in the number of differentiated varieties, is welfare improving for two reasons. First, it improves domestic terms of trade and second, it increases domestic wealth through a reduced subsidy bill on production. When starting from an efficient allocation those two incentives are strong enough to make domestic policymakers favor a relocation of firms from the domestic to the foreign economy - exactly the opposite of what the home market effect would induce.

### 6.3.2 Implications of $\eta \neq \varepsilon$

In Figure 11 we report the optimal domestic export tax/subsidy for the case  $\tau_C = \tau_C^* = 1$  and  $\tau_X^* = 1$  for different values of  $\varepsilon$  and  $\tau$ . In the benchmark case we said that while the home market effect and the monopolistic distortion call for a subsidy, the terms of trade externality

would require a tax and that the first two effects predominate. Figure 11 shows that this result does not go through in a more general setup where we allow for the intra-industry elasticity  $\varepsilon$  to exceed the trade elasticity  $\eta$ . On the one hand, one might consider this result as not so surprising given that, by increasing  $\varepsilon$ , we are reducing the monopolistic distortion and also, as explained earlier, the home market externality. On the other hand,  $\varepsilon$  needs to be only marginally bigger than  $\eta$  for the optimal strategy to be an export tax, thus underlining the weakness of the previous result. When considering the case  $\tau_C = \tau_C^* = \frac{\varepsilon-1}{\varepsilon}$ , it is always optimal to set an export tax, independently on the level of  $\tau$  and  $\varepsilon$ , thus the terms of trade and revenue externalities always predominate in this context.<sup>22</sup>

### 6.3.3 Implications of $\gamma < 1$

In Figure 12 we study the incentives to deviate from  $\tau_X = 1$  when  $\tau_C = \tau_C^* = 1$  under decreasing returns in the homogeneous sector ( $\gamma = 0.65$ ). We can see from the picture that the optimality of an export subsidy is not robust to the introduction of decreasing returns. The terms of trade externality now dominates over the home market effect even when the monopolistic distortion has not been taken care of with an adequate production subsidy. As a consequence the optimal unilateral deviation is to set an export tax.

With decreasing returns the home market effect is weakened due to an increase in the relative domestic wage that is caused by the reduction in the production of the homogeneous sector. Consequently, it does not pay off to try to agglomerate firms in the domestic economy. Instead, the direct effect (through the effect of  $\tau_X$  on the international prices of varieties) and the indirect effect (through a reduction in the relative number of domestic varieties) on the terms of trade together with the tax revenues induce the domestic policy maker to set a positive tax on exports. This comes at the cost of paying larger transport costs and a deterioration in the relative price of imports of differentiated goods in terms of the homogeneous good caused by a decrease in the relative domestic wage.

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<sup>22</sup>To save space we do not include this figure. The relevant figure is available on request.

## 7 Conclusion

In this paper we have studied unilateral trade policy in a two-sector variant of the Krugman (1980) model of intra-industry trade. We have isolated the different incentives that drive policy makers' choices. They are determined by three main effects: a terms of trade effect, the home market externality and a distortion in the aggregate allocation due to monopolistic pricing. In addition, our analysis has revealed what the welfare relevant terms of trade in this model are. Contrary to the view point of the previous literature, which has considered the prices of individual varieties in international markets as the terms of trade, we have shown that policy makers care about aggregate relative price indices of importables and not only about the prices of varieties. This implies that terms of trade effects and the home market externality coexist even when considering tariffs and a homogeneous good produced with constant returns that fixes relative factor prices.

We have studied three different policy instruments: production taxes, tariffs and export taxes. Contrary to Venables (1987), we find that unilaterally set production subsidies are always inefficiently low due to a terms of trade externality. Over-subsidizing production in order to attract firms to the domestic economy (home market effect) is never an optimal unilateral policy choice. When considering tariffs and export taxes we demonstrate that the home market effect is sometimes the driving force for trade policy. However, for a wide range of parameter combinations the terms of trade effect and the desire to eliminate monopolistic distortions are the dominant effects. In addition, home market effects never dominate when we correct the monopolistic distortion with an appropriately set production subsidy. This shows that the results of Venables (1987), Ossa (2008) and Helpman and Krugman (1989), who found that setting positive tariffs in order to attract firms to the domestic economy is optimal, are not robust.

The analysis in this paper sets the foundations for studying strategic trade policy in this set-up. Now that policy makers' incentives have been clarified, Nash equilibrium policy outcomes, where many of the incentives that determine policies are obscured by strategic interaction, can be investigated. We relegate this analysis to our companion paper Campolmi et al. (2009), where we also derive results on cooperative trade policy and discuss the relations of our findings with WTO rules on trade policy.

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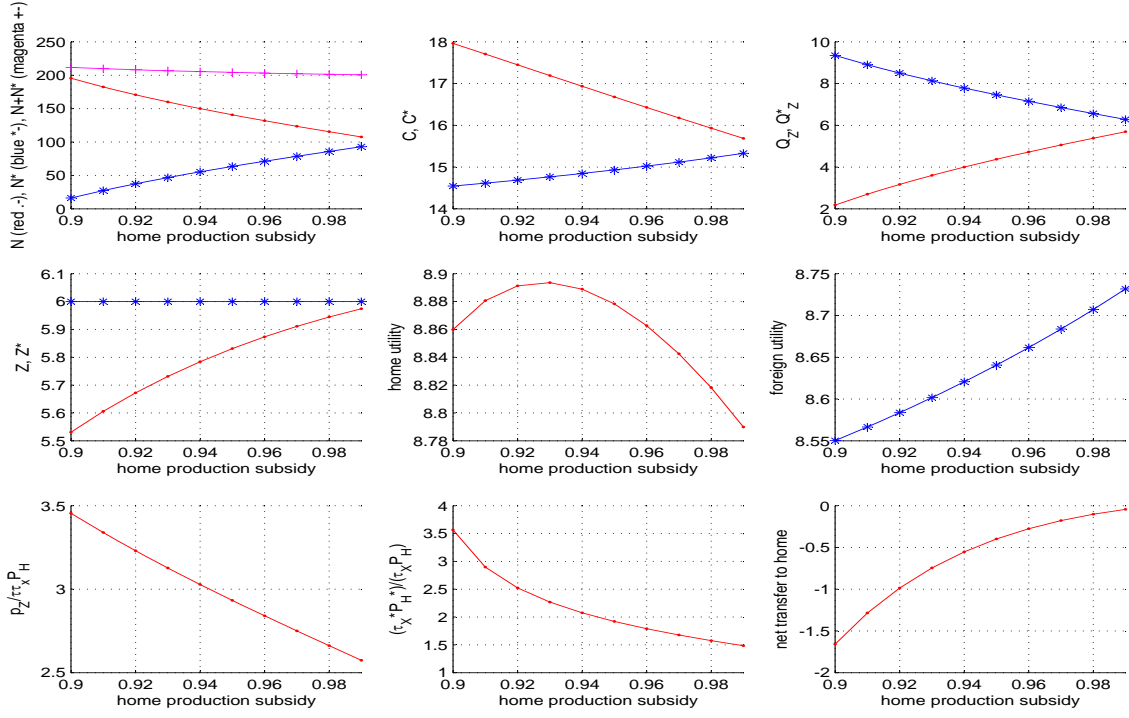


Figure 1: Effects of an unilateral shift of the domestic production subsidy when  $\tau_C^* = 1$ .

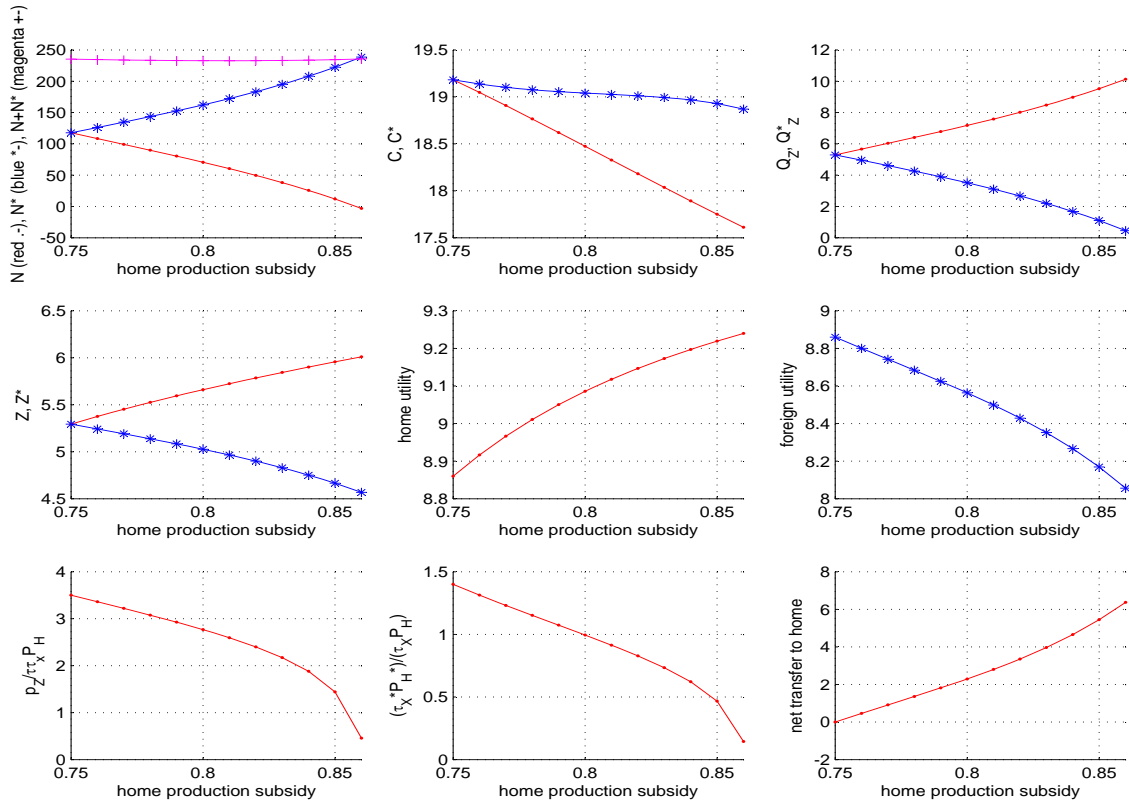


Figure 2: Effects of an unilateral shift of the domestic production subsidy when  $\tau_C^* = \frac{\epsilon-1}{\epsilon}$ .

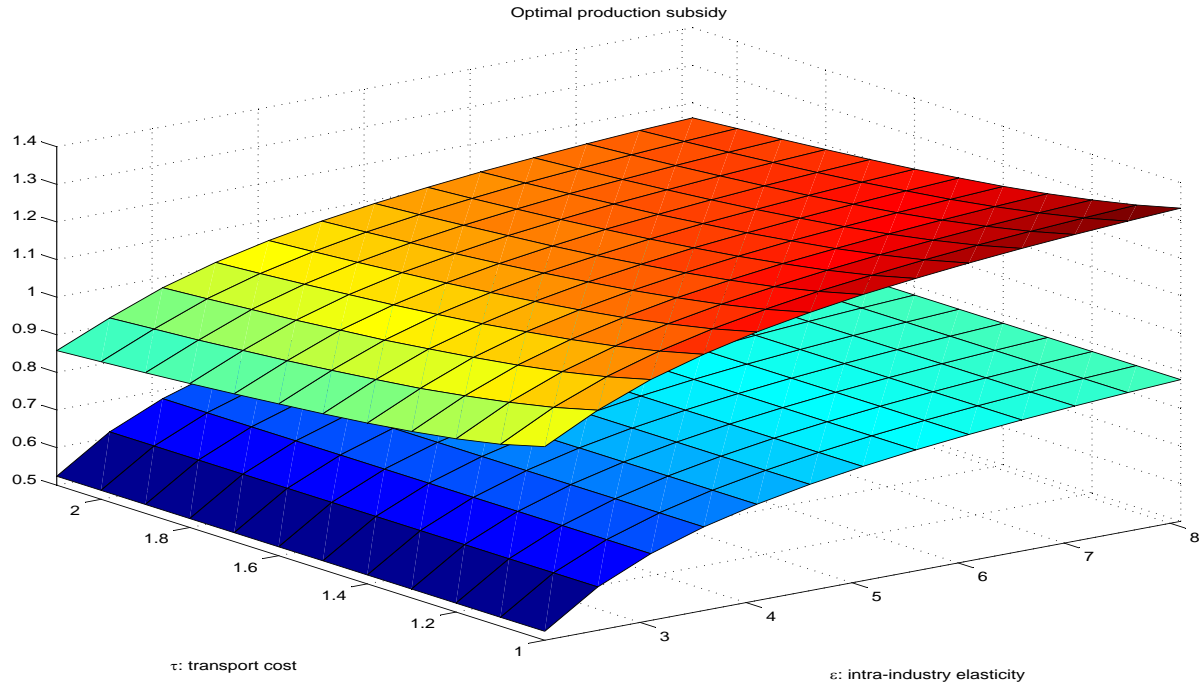


Figure 3: Optimal cooperative (bottom) and domestic (top) production subsidy when  $\tau_C^* = 1$ .

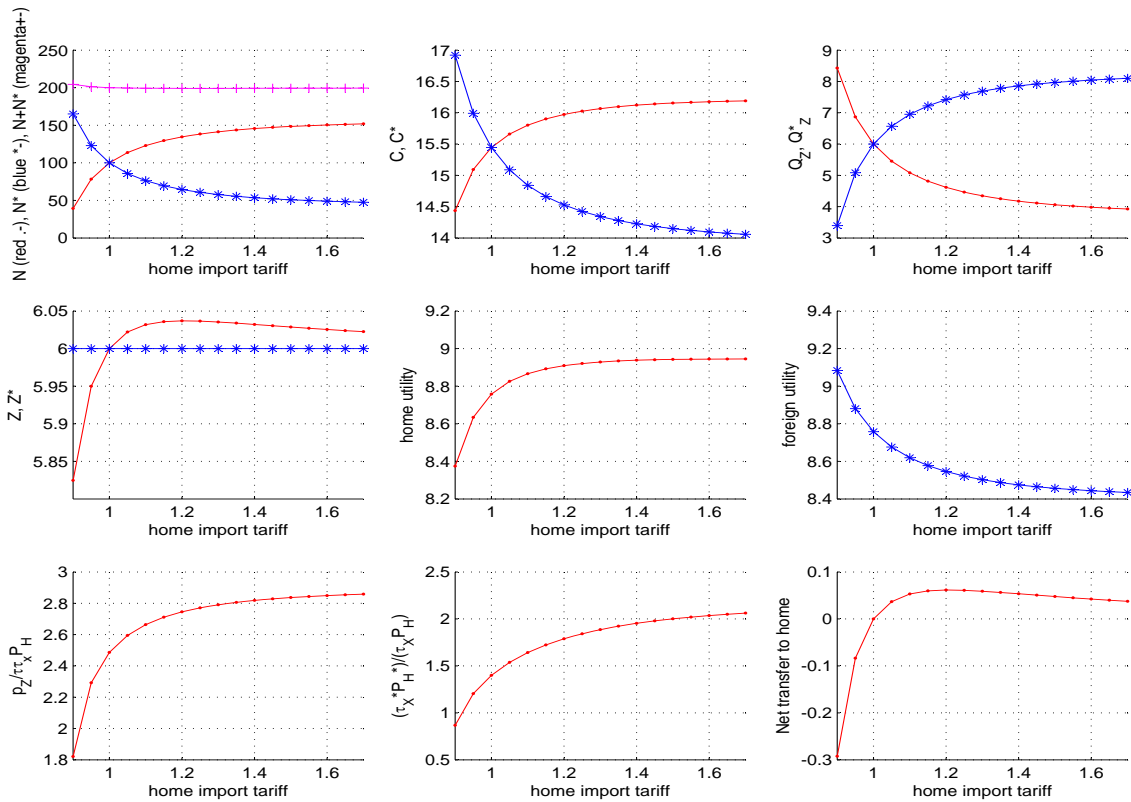


Figure 4: Effects of an unilateral shift of the domestic tariff when  $\tau_C = \tau_C^* = 1$ .

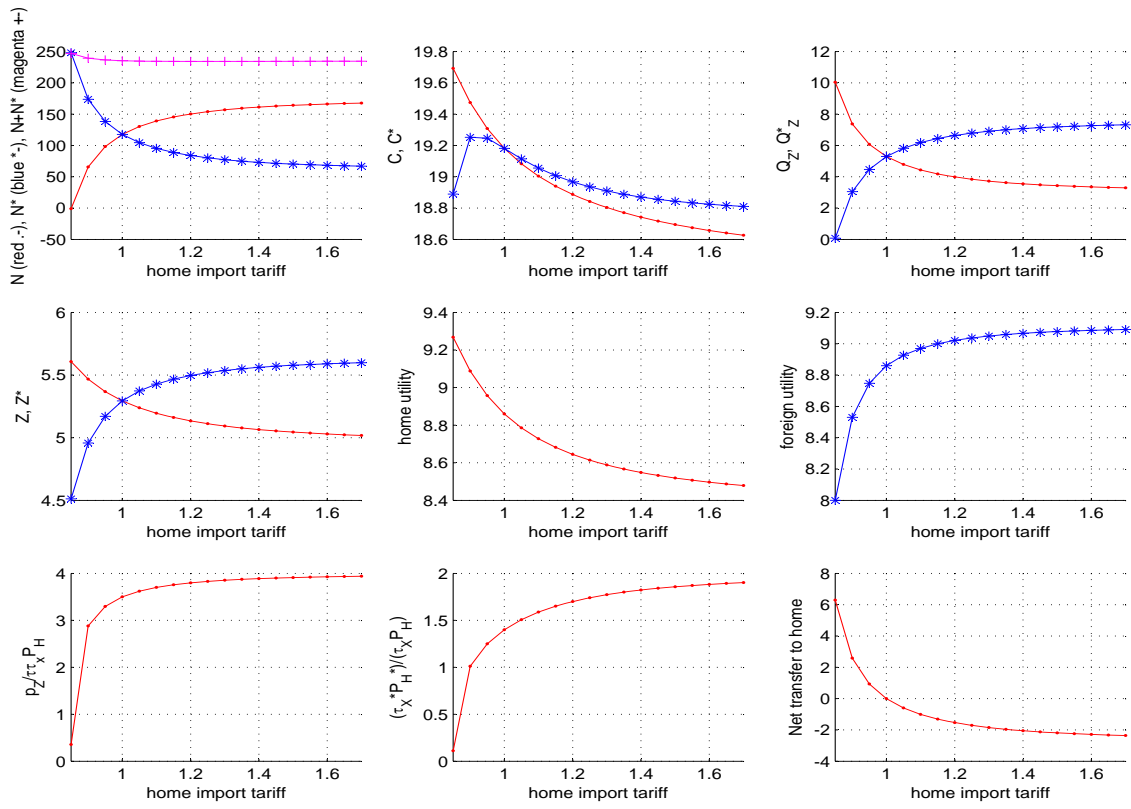


Figure 5: Effects of an unilateral shift of the domestic tariff when  $\tau_C = \tau_C^* = (\varepsilon - 1)/\varepsilon$ .

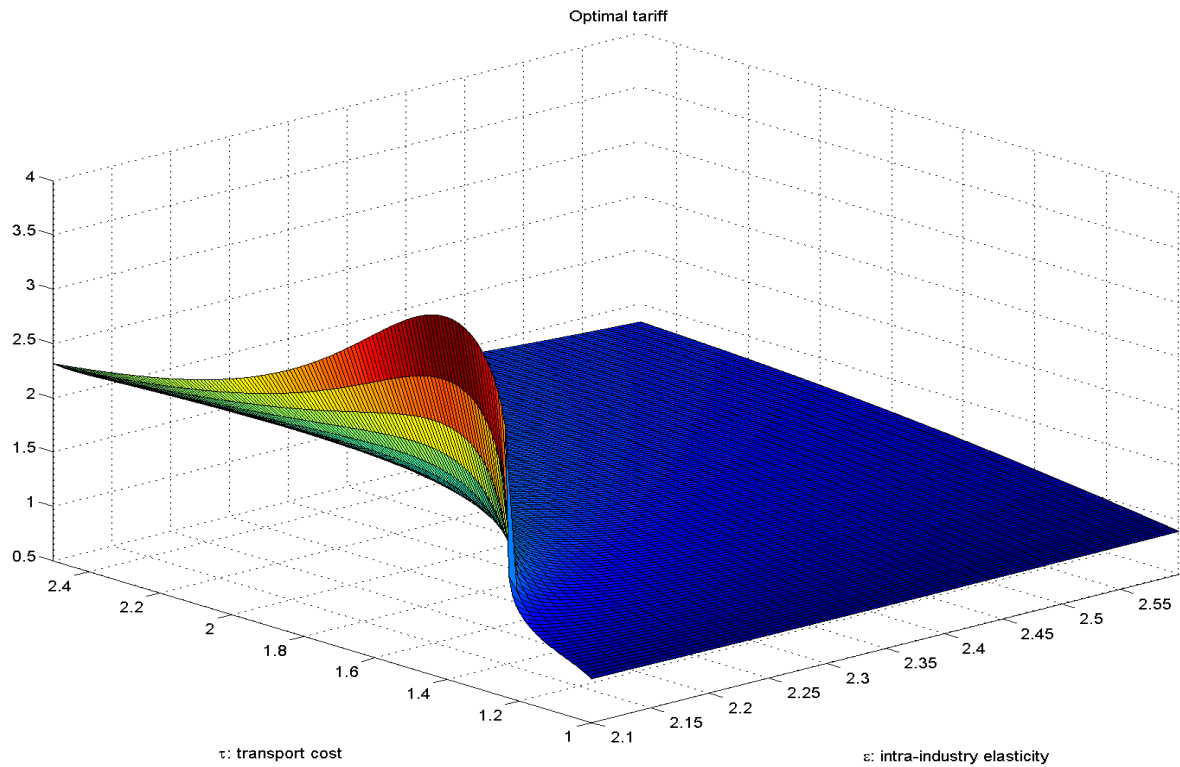


Figure 6: Domestic tariff/ subsidy on imports when  $\tau_C = \tau_C^* = \tau_I^* = 1$ .



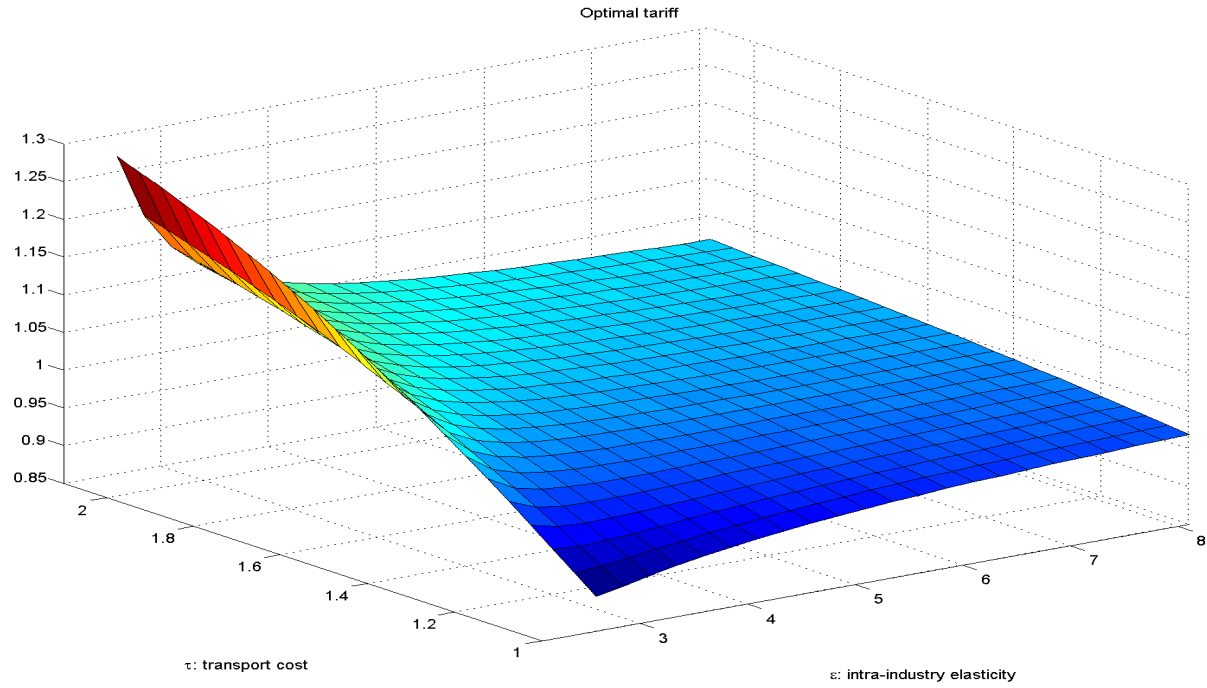


Figure 7: Domestic tariff/ subsidy on imports when  $\tau_C = \tau_C^* = \tau_I^* = 1$ .

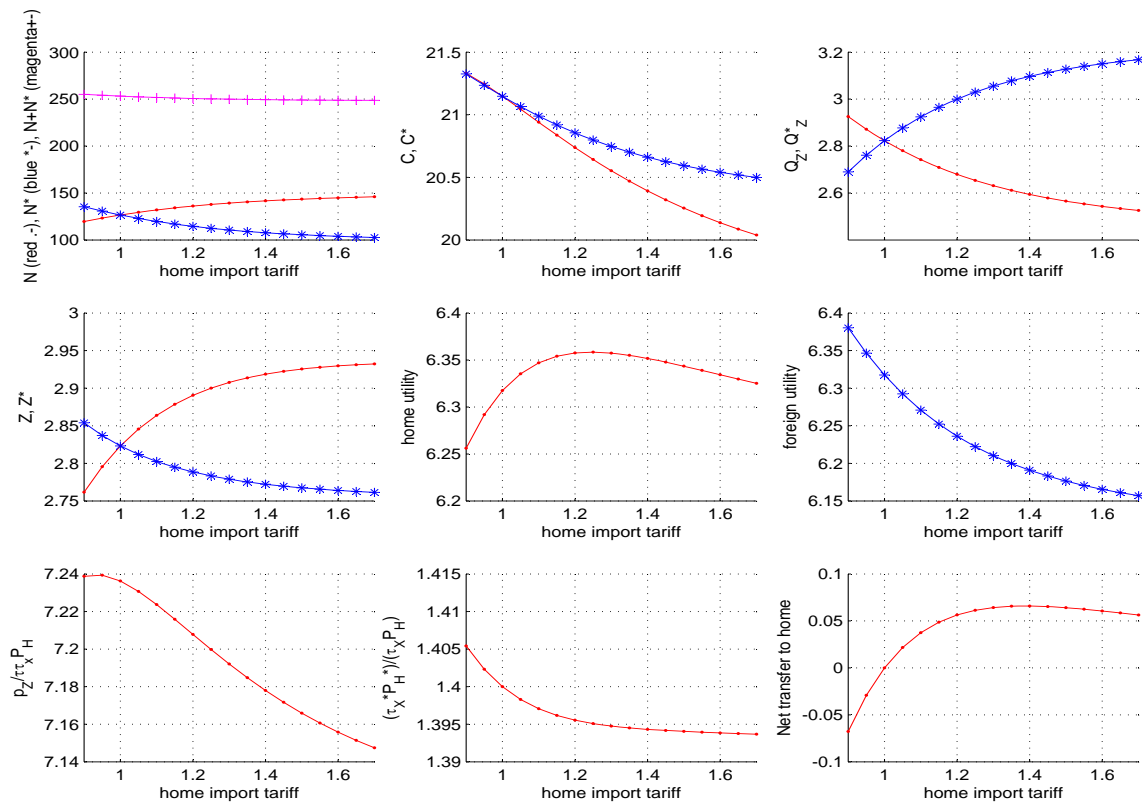


Figure 8: Domestic tariff on imports when  $\tau_C = \tau_C^* = \tau_I^* = 1$  and  $\gamma = 0.65$ .

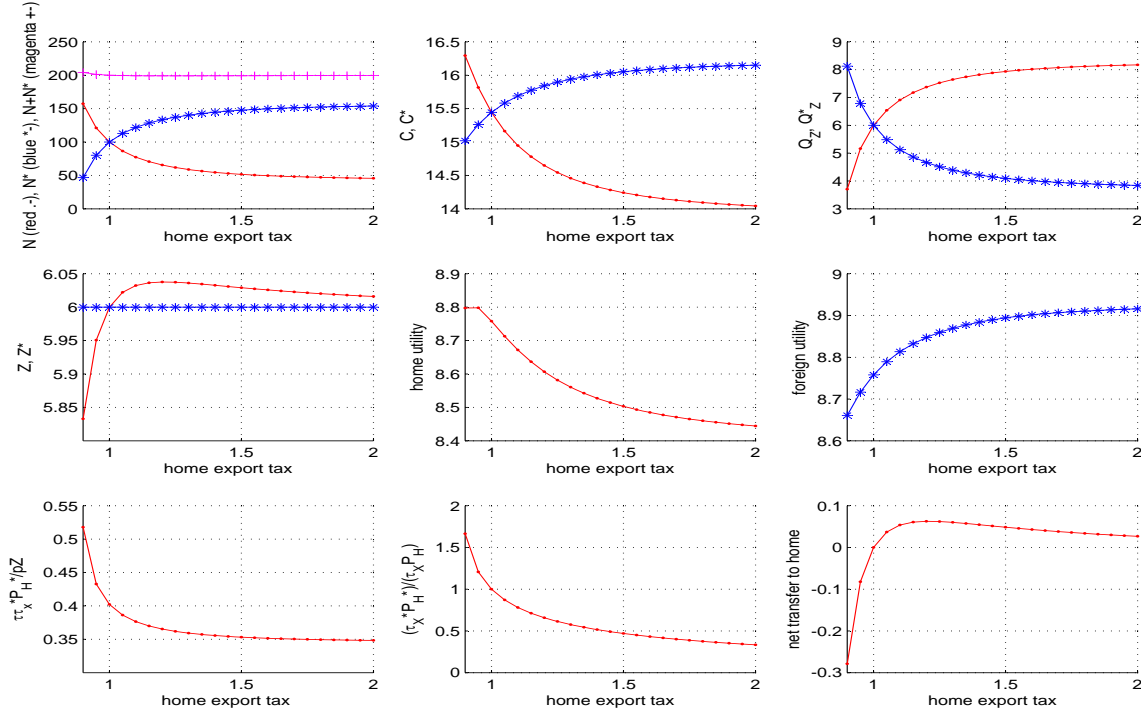


Figure 9: Effects of an unilateral shift of the domestic export tax when  $\tau_C = \tau_C^* = \tau_X^* = 1$ .

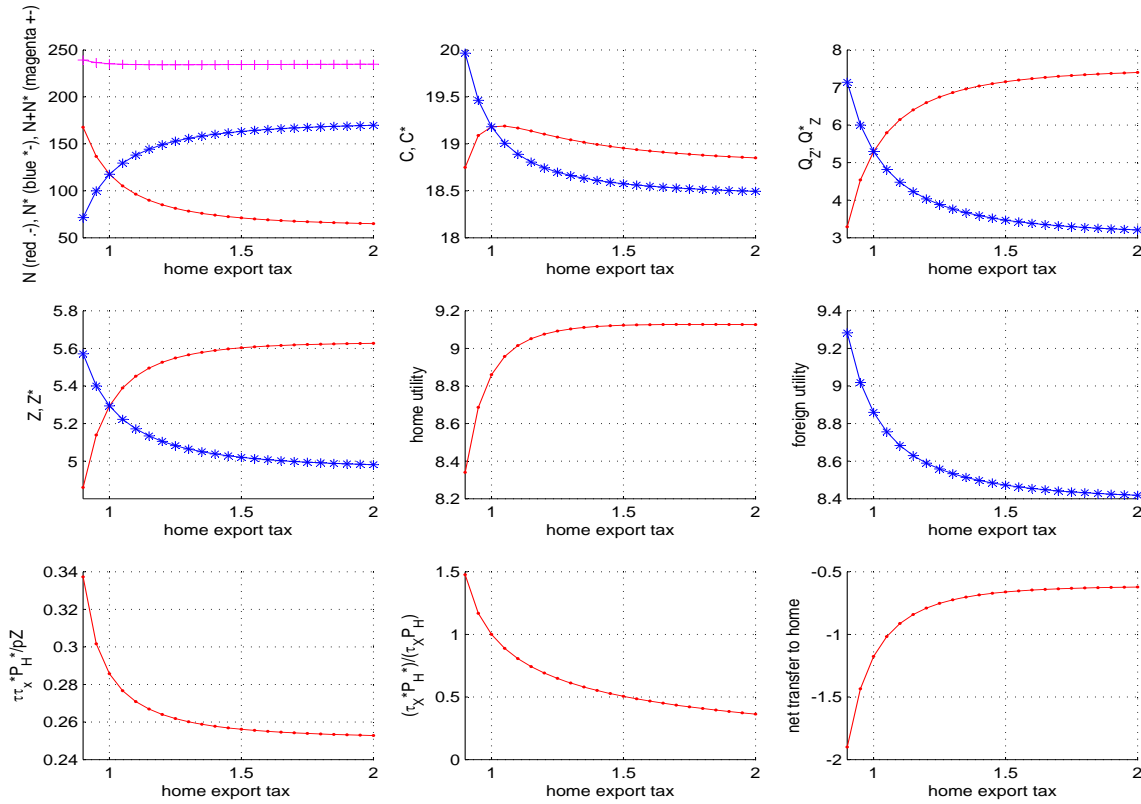


Figure 10: Effects of an unilateral shift of domestic export tax when  $\tau_C = \tau_C^* = \frac{\epsilon-1}{\epsilon}$  and  $\tau_X^* = 1$ .

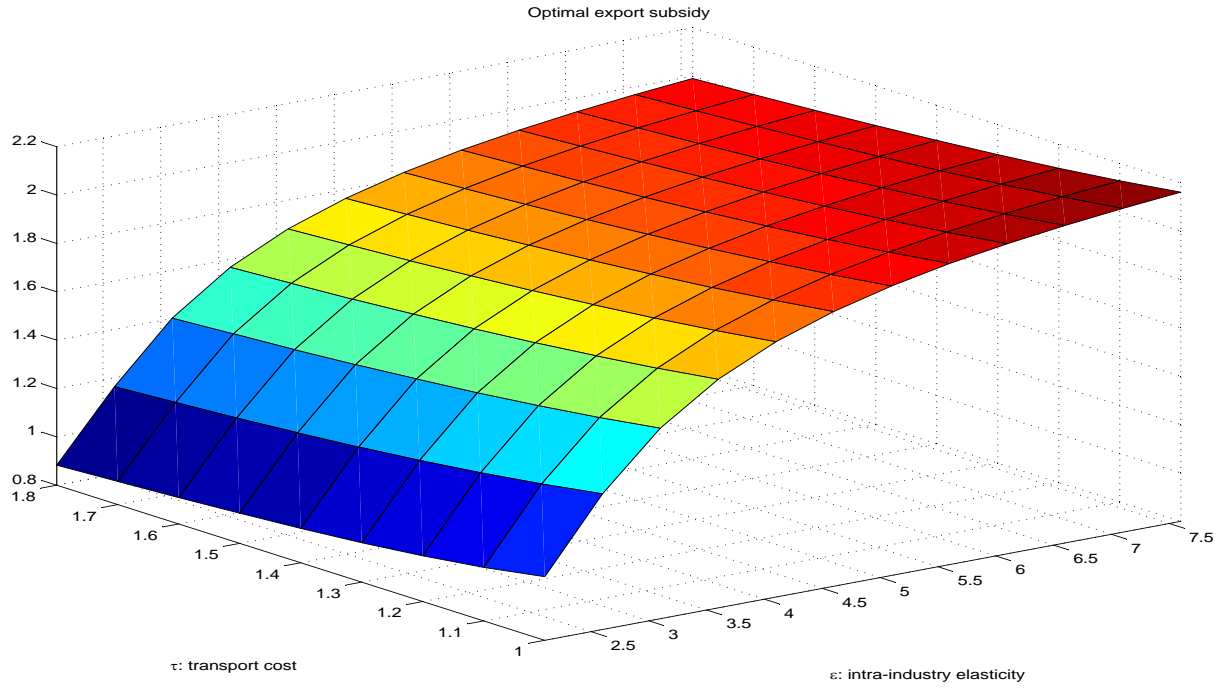


Figure 11: Optimal Export tax/subsidy when  $\tau_C = \tau_C^* = 1$  and  $\tau_X^* = 1$ .

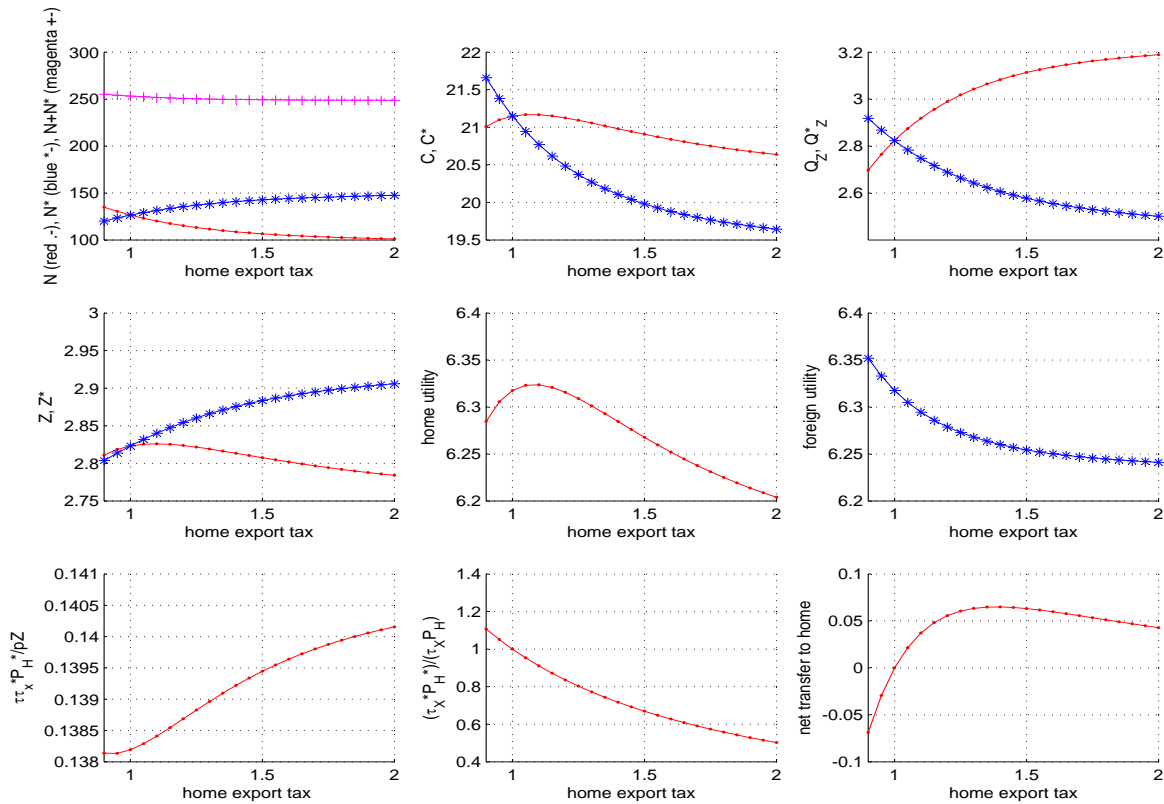


Figure 12: Domestic tax on exports when  $\tau_C = \tau_C^* = \tau_X^* = 1$  and  $\gamma = 0.65$ .