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

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Abstract

We study optimal trade policy in a Krugman type model of trade. We conduct a general analysis allowing for three different instruments: tariffs on imports or taxes on exports and a production subsidy. For each instrument we consider the optimal policy under cooperation and non-cooperation.

Contrary to the existing literature on trade policy in the Krugman model, we find that optimal trade policy is not driven by a production relocation externality (home market effect). Instead, we show that when properly modeling general equilibrium effect of taxes/tariffs, policy makers' behavior is determined by a standard terms of trade effect and the desire to eliminate distortions arising from monopolistic competition.

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

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

JEL classification codes: F12, F13, F42

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1 Introduction

The aim of this paper is to study optimal trade policy in a version of the Krugman (1980) model of intra-industry trade due to monopolistic competition and increasing returns. We consider a generalized version of the Krugman model with two countries and 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 optimal non-cooperative and cooperative determination of import tariffs, export taxes as well as production subsidies.

While the standard result for optimal tariffs [1] implies that countries have incentives to impose a tariff on imports and/or exports in order to improve their terms of trade[2], a strand of literature from the 1980's[3], as well as some recent contributions[4] emphasize a second channel - a production relocation effect (home market effect).

The idea behind the production relocation effect is that in the presence of trade costs and increasing returns countries have an incentive to impose a tariff on imports or to subsidize production or exports in order to induce firms to relocate to the domestic economy. In this setup firms locate in the country where demand for their goods is relatively high in order to minimize shipping costs that cut into their profits. A tariff on imports shifts demand towards domestically produced goods, thereby increases the size of the home market relative to the foreign one and causes firms to relocate to the domestic economy. A production or export subsidy has a similar effect. This benefits domestic consumers since they pay lower prices on more varieties - as they need not pay transport costs on locally produced varieties. Foreign consumers however are worst off because less varieties are produced in their country.

We show that optimal trade policy does not imply any production relocation externality even in a setting where the potential for the home market effect to work is maximized. Instead, optimal trade policy is always driven by the standard terms of trade externality.

[1] See, for example, Helpman and Krugman (1989), Feenstra (2004).

[2] Through all the paper we define the terms of trade as the price of imports relative to the price of exports. Countries have an incentive to improve their terms of trade by making domestically produced goods more expensive in order to obtain more foreign produced goods in exchange for the same amount of exports.

[3] Venables (1987) and Helpman and Krugman (1989), Chapter 7.

[4] Melitz and Ottaviano (2008), Ossa (2008).

The explanation of the difference between our findings and those of the existing literature is twofold. On the one hand most of the previous results have been derived supposing that tariffs are pure waste[5]. As we clarify in more detail in section 5.4.3, while assuming that tariffs revenues are not rebated to consumers has been claimed to make the case for the home market effect even stronger, what it does is actually to make the model partial equilibrium. In the present paper we show how allowing for tariff redistribution generates wealth effects that are crucial for optimal trade policy. On the other hand the inefficiency due to monopolistic competition has always been overlooked. Indeed we demonstrate that the market equilibrium without any policy intervention implies an inefficiently low number of varieties due to the presence of monopolistic competition. As a consequence of of that uncoordinated policy makers try to increase the amount of domestic varieties by imposing, for instance, a tariff on imports. This result has been misinterpreted as a home market effect. Once the monopolistic distortion is eliminated by a lump sum financed subsidy to production of differentiated goods, optimal trade policy under non-coordination is driven exclusively by the terms of trade externality and domestic policy makers seek to externalize production of differentiated varieties.

The following conclusions can be drawn from our analysis. First, in the two-sector model analyzed, the market equilibrium allocation is inefficient due to monopolistic competition. If production subsidies are available, the first best allocation can be reached under coordination and there is no role for import tariffs or for export taxes. Contrary to the result of Venables (1987) we find that it does not pay to try to induce firms to locate in the domestic economy by over-subsidizing production. Conversely countries have an incentive to deviate from the cooperative solution lowering their subsidy in order to improve their terms of trade. Second, if import tariffs/subsidies (export taxes/subsidies) are the only instrument, the optimal policy under coordination is to subsidize imports (exports) in both countries but the first best allocation is not implementable anymore. Third, if the number of differentiated varieties is Pareto-optimal, the optimal non-cooperative trade policy consists of a positive import subsidy (export tax) that improves domestic terms of trade, instead of a tariff (subsidy). Finally, if the number of differentiated varieties is inefficiently low, the optimal non-cooperative trade policy is given by a positive import tariff (export subsidy). Such a trade policy is not motivated by a

[5]Venables (1987), Helpman and Krugman (1989), Ossa (2008).

production relocation externality but rather by the attempt to correct for the distortion arising from monopolistic competition.

The paper proceeds as follow: section 2 presents the related literature, section 3 the model, section 4 the equilibrium, section 5 the optimal trade policy problem and section 6 concludes.

2 Literature Review

Our paper builds on Krugman (1980)'s model of intra-industry trade. Krugman shows that in a two-sector model with increasing returns and transport costs, given the incentives to concentrate industries closer to the biggest market, each country is a net exporter of the goods produced in the sector for which it has a relatively larger domestic demand. This is what is usually referred to as the *home market effect*. As shown first in Krugman (1980) and discussed more in detail by Davis (1998), in a special case where one sector is characterized by monopolistic competition and transport costs while the other operates in a regime of perfect competition and no transport costs, if the two countries differ only in size, the bigger country is a net exporter of differentiated goods, while the smaller country exports the homogeneous good. As a consequence, consumers in the bigger country experience higher welfare because they save on transport costs. In such a context, Venables (1987) studies import tariffs and export and production subsidies. He concentrates on non-strategic interactions (i.e., unilateral changes in the policy instrument of one country with no retaliation) and shows that: first, a country's welfare is raised by a unilateral increase in its import tariffs when tariff revenues are not redistributed; second, a 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 extend Venables (1987) in several dimensions, which we believe to be crucial for a better understanding of the incentives that shape trade policies. The first extension is to the case when such inefficiency is taken care of in order to disentangle the different incentives behind trade policies. Second, we allow for redistribution of all tariff revenues. Finally, we consider not only the non-strategic interaction but also the cooperative solution and the Nash equilibrium for each policy instrument. We show that when tariff revenues are redistributed and allocations are optimal without tariffs, policy makers choose an import subsidy (they pay for increasing foreign demand) in order to

reduce the domestic number of firms and to improve the welfare relevant terms of trade. We also show that for Cobb-Douglas utility 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.

In their standard work on trade policy under imperfect competition Helpman and Krugman (1989) confirm Venables' results. They also discuss the "production efficiency effect" in a somewhat special model with a specific factor and factor price equalization for the mobile factor[6]. The difference between the price and the marginal cost of domestically produced varieties caused by monopolistic competition induces domestic consumers to consume too little of domestic goods. A tariff on imports can correct for this, even when relative factor prices and hence the relative price of individual varieties are not affected by a tariff. We find that this "production efficiency effect" is in fact also the explanation for the result that there is an optimal tariff in the two sector Krugman model, when monopolistic distortions are not eliminated by a subsidy.

Our paper is also related to a recent contribution by Ossa (2008). Using a version of Venables' model with a Cobb-Douglas utility function, he studies optimal import tariffs in a non-cooperative game. He finds that governments have incentives to unilaterally impose (infinite) import tariffs and interprets this as a production relocation externality. While the main results are derived under the assumption that tariff revenues are wasted, in the appendix he also considers a redistribution of tariff revenues and still finds an optimal finite tariff on imports. His interpretation (which coincides with Venables (1987) and Helpman and Krugman (1989)) is that the optimal tariff is now finite because a too large tariff implies lower tariff revenues. However, he does not eliminate the allocational distortion between the sectors due to monopolistic competition, which is in fact driving this result.

Finally, Melitz and Ottaviano (2008) study unilateral trade liberalization in a model with heterogeneous firms, variable markups and a freely traded outside good. They demonstrate

[6]Their analysis is based on Flam and Helpman (1987)

that in the long run (when entry and exit of firms is allowed for) a unilateral reduction of import tariffs (that are again assumed to be wasted) reduces domestic welfare. In their model, a reduction in tariffs causes some firms to leave the domestic market, which may reduce domestic welfare if the number of firms in the differentiated sector is too low because of monopoly distortions, which they do not correct. In addition, in their model a reduction in the number of firms in a market induces producers to charge higher markups thereby increasing monopoly distortions. Hence, it is in principle possible that optimal uncoordinated trade policy in their model involves a production relocation externality even when the number of differentiated firms is efficient with zero tariffs because there is the additional benefit of having more firms - increased competition leads to lower markups, which benefits domestic consumers. Whether this is in fact the case would require a formal investigation.

3 The Model

The world economy is composed by 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 perfect competition is assumed in the homogenous good sector. The two countries are identical in terms of preferences, production technology and market structure. The model is solved under the assumption of financial autarchy. In what follows foreign variables will be denoted by a (*).

3.1 Households

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

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

where C aggregates over the differentiated goods, Z represents the homogeneous good and α is the share of the differentiated goods in the aggregate consumption basket. While the homogenous good is identical across countries, each country produces a different subset of differentiated goods. In particular, N varieties are produced in the Home country (C_H) while

N^* are produced by Foreign (C_F). We allow for a general specification of the consumption aggregators with two different elasticity of substitutions, one between home and foreign goods (η) and one between goods produced in the same country (ε):

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

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

Foreign consumers face an analogous utility function. Let $p(h)$ ($p^*(h)$) be the price payed by home (foreign) consumers on domestically produced goods while $p(f)$ ($p^*(f)$) is the price payed by home (foreign) consumers on imported goods. In general, $p(h) \neq p^*(f)$ and $p^*(h) \neq p(f)$ because of transport costs and tariffs/subsidies on imports and exports. The solution to the expenditure minimization problem gives the following demand functions and price indices:

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

$$c(h) = \left[\frac{p(h)}{P_H} \right]^{-\varepsilon} C_H \qquad c^*(f) = \left[\frac{p^*(f)}{P_F^*} \right]^{-\varepsilon} C_F^* \tag{4}$$

$$C_H = \left[\frac{P_H}{P} \right]^{-\eta} C \qquad C_F^* = \left[\frac{P_F^*}{P^*} \right]^{-\eta} C^* \tag{5}$$

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

$$c(f) = \left[\frac{p(f)}{P_F} \right]^{-\varepsilon} C_F \qquad c^*(h) = \left[\frac{p^*(h)}{P_H^*} \right]^{-\varepsilon} C_H^* \tag{6}$$

$$C_F = \left[\frac{P_F}{P} \right]^{-\eta} C \qquad C_H^* = \left[\frac{P_H^*}{P^*} \right]^{-\eta} C^* \tag{7}$$

- Demand for the homogeneous good in Home and Foreign:

$$Z = \frac{1-\alpha}{\alpha} \frac{P}{p_Z} C \qquad Z^* = \frac{1-\alpha}{\alpha} \frac{P^*}{p_Z^*} C^* \tag{8}$$

- Domestic price indexes:

$$P = \left[P_H^{1-\eta} + P_F^{1-\eta}\right]^{\frac{1}{1-\eta}} \tag{9}$$

$$P_H = \left[\int_0^N p(h)^{1-\varepsilon} dh\right]^{\frac{1}{1-\varepsilon}} \qquad P_F = \left[\int_0^{N^*} p(f)^{1-\varepsilon} df\right]^{\frac{1}{1-\varepsilon}} \tag{10}$$

- Foreign price indexes:

$$P^* = \left[P_H^{*\,1-\eta} + P_F^{*\,1-\eta}\right]^{\frac{1}{1-\eta}} \tag{11}$$

$$P_H^* = \left[\int_0^{N^*} p^*(h)^{1-\varepsilon} dh\right]^{\frac{1}{1-\varepsilon}} \qquad P_F^* = \left[\int_0^N p^*(f)^{1-\varepsilon} df\right]^{\frac{1}{1-\varepsilon}} \tag{12}$$

Households inelastically supply L units of labor. The budget constraint of Home consumers reads as follows:

$$PC + p_Z Z = WL + T, \tag{13}$$

where W is the wage, p_Z is the price payed for the homogeneous good and T is a lump sum tax/transfer which will depend on the tariff/subsidy scheme adopted by the domestic government and which will be defined later.

3.2 Firms in the Differentiated Sector

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

$$Y(h) = L_C(h) - f, \tag{14}$$

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 subsidy on fixed and marginal costs (τ_C) and tariffs/subsidies on imports (τ_I) and exports (τ_X). 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 to the government. Solving the profit maximization problem, 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 $(1-\tau_C)W$ and optimal prices payed by foreign consumers equal domestic prices augmented by transport costs and tariffs:

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

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

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

Given that all firms use the same production technology, in equilibrium all firms in the same country will charge the same price and we have perfect symmetry within firms in the differentiated sector of each country.

3.3 Homogeneous good sector

Both countries produce a homogenous good which can be traded with no transport costs. The two countries share the same production technology:

$$Q_Z = L_Z^{\gamma} \qquad \gamma \leq 1, \tag{17}$$

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:

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

If $\gamma = 1$ (constant returns to scale) and as long as the homogeneous good is produced in both countries in equilibrium, there is factor price equalization:

$$p_Z = p_Z^* = W = W^* \tag{19}$$

3.4 Government

The government in each country disposes of 3 fiscal instruments. A production tax/subsidy (τ_C), tariffs/subsidies on imports (τ_I) and a tax/subsidy on exports (τ_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:

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

4 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:

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

$$P_F = \tau_I \tau_X^* \tau P_H^* \qquad P_F^* = \tau_I^* \tau_X \tau P_H \tag{22}$$

4.1 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:[7]

$$\Pi(h) = c(h)\left[p(h) - (1-\tau_C)W\right] + c^*(f)\left[\tau p(h) - \tau(1-\tau_C)W\right] - fW(1-\tau_C) = 0 \tag{23}$$

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

Using the optimal pricing rule into equation (23), we obtain:

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

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

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

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

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

4.2 Goods and Labor Markets Clearing Conditions

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

$$y(h) = c(h) + \tau c^*(f) \tag{27}$$

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:

$$y(h) = (\varepsilon - 1)f \qquad\qquad y^*(h) = (\varepsilon - 1)f \tag{28}$$

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

$$Q_Z + Q_Z^* = Z + Z^* \tag{29}$$

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

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

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:

$$L_C = N\varepsilon f \qquad\qquad Q_Z = [L - N\varepsilon f]^{\gamma} \tag{31}$$

and for Foreign:

$$Q_Z^* = [L^* - N^*\varepsilon f]^{\gamma} \tag{32}$$

4.3 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:

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

Hence, the balanced trade condition reads as follows[8]:

$$\tau\tau_X P_H C_F^* + p_Z\left(Z^X - Z^M\right) = \tau\tau_X^* P_H^* C_F \tag{34}$$

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

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

4.4 Price Indexes

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

$$\frac{P_H}{p_z} = \frac{\varepsilon}{\varepsilon-1}\gamma(1-\tau_C)N^{\frac{1}{1-\varepsilon}}Q_Z^{\frac{\gamma-1}{\gamma}} \qquad\qquad \frac{P_H^*}{p_z} = \frac{\varepsilon}{\varepsilon-1}\gamma(1-\tau_C^*)N^{*\frac{1}{1-\varepsilon}}Q_Z^{*\frac{\gamma-1}{\gamma}} \tag{36}$$

[8]Import and Export tariffs/subsidies are collected directly by the governments at the border so they do not enter into this condition.

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

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.

4.5 Terms of Trade

A crucial aspect in this model is the relevant definition of the terms of trade. In our model there are two relative prices that are of interest for domestic policy makers: P_F/P_H and P_F/p_z if Home is an exporter of the homogeneous good and p_z/P_H if Home is an importer of the homogeneous good. Using the definition of the price indices, we can write $P_F/P_H = \left(\frac{N}{N^*}\right)^{\frac{1}{\varepsilon-1}} \frac{p(f)}{p(h)}$. Hence, this relative price of the foreign bundle of differentiated goods in terms of the domestic bundle depends positively on the relative number of varieties produced domestically and on the relative price of individual varieties.

To gain intuition consider two extreme cases: constant returns to scale in the production of the homogeneous good ($\gamma = 1$); one sector economy ($\alpha = 1$).

If $\gamma = 1$ relative wages are one, so that $P_F/P_H = \left(\frac{N}{N^*}\right)^{\frac{1}{\varepsilon-1}} \frac{\tau_I \tau_X^* \tau(1-\tau_C^*)}{(1-\tau_C)}$. Hence, this measure of the terms of trade depends only on domestic tariffs, 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 (i.e P_F/P_H), since a larger number of domestic varieties has to be exchanged for the same number of foreign varieties. The other relevant relative prices become $p_z/P_H = \frac{N^{1/(\varepsilon-1)}}{\frac{\varepsilon}{\varepsilon-1}(1-\tau_C)}$ and $P_F/p_z = \tau_I \tau_X^* \tau (N^*)^{1/(1-\varepsilon)} \frac{\varepsilon}{\varepsilon-1}(1-\tau_C^*)$. Hence, the relative price of imports of homogeneous goods (p_z/P_H) is increasing in domestic varieties, while the relative price of exports of homogeneous goods (P_F/p_z) is increasing in the number of Foreign varieties. This implies that at least for the case of $\gamma = 1$, when we consider unilateral changes in domestic policy from a symmetric equilibrium we can focus only on P_F/P_H as a measure of the terms of trade because the other relevant measure (i.e. either p_z/P_H or P_F/p_z) moves in the same direction. Indeed,

suppose Home implements a policy to deviate from a symmetric equilibrium. If N increases, the domestic economy becomes a net importer of the homogeneous good and both its relevant terms of trade P_F/P_H and p_z/P_H. deteriorate. If instead N decreases, Home becomes a net exporter and its relevant terms of trade, P_F/P_H and P_F/p_z, improve simultaneously.

In the second extreme, if $\alpha = 1$, there is only one sector, so that the number of domestic and foreign varieties is fixed by equilibrium firm size and labor supply, $N = N^* = \frac{L}{\varepsilon f}$. In this case $P_F/P_H = \frac{p(f)}{p(h)} = \frac{\tau_I \tau_X^* \tau (1-\tau_C^*) W^*}{(1-\tau_C) W}$ is the only terms of trade and is affected by changes in relative wages.

In general, with $\gamma < 1$ and $\alpha \in (0, 1)$ both margins of adjustment - change in the relative numbers of varieties and changes in relative wages matter for the movements in the terms of trade.

5 Optimal Trade Policy

In this section we study optimal trade policy both from the perspective of single country policy makers[9] and from the perspective of a cooperative authority that maximizes average welfare of the world economy. We consider three possible trade policy instruments in turn: taxes/subsidies on the production of differentiated goods (τ_C, τ_C^*), import tariffs (τ_I, τ_I^*) and export taxes (τ_X, τ_X^*). In each case, we study only one strategic instrument at a time, so we do not allow, for example, policy makers to choose simultaneously and strategically import tariffs and export taxes[10]. The general set up of the two problems is specified in the next two sub-sections. We then analyze both the cooperative solution and the non-cooperative Nash solution for each policy instrument.

Since we want to compare our results with the existing literature, in what follows we will set $\gamma = 1$ (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). In section (?) we will study how the model behaves under a more general specification.

[9] In this case we study the Nash equilibrium of the game.

[10] So when policy makers choose import tariffs, τ_X and τ_X^* are always set equal to one.

5.1 Cooperative Policy Problem

Policy makers in the two countries choose fiscal instruments in order to maximize joined utility[11], taking the equilibrium conditions as a constraint:

$$\max_{C,C^*,N,N^*,\tau_i,\tau_i^*} \quad \left(\frac{P}{p_z}\right)^{1-\alpha} C + \left(\frac{P^*}{p_z}\right)^{1-\alpha} C^*$$

subject to (25), (26), (30)[12] and (35) and where $i \in \{C, I, X\}$ and Q_Z, Q_Z^* are defined according to (31) and (32) and the price indices are defined as in section 4.4.

5.2 Non-Cooperative Policy Problem

The policy maker of Home solves the following problem:

$$\max_{C,C^*,N,N^*,\tau_i} \quad \left(\frac{P}{p_z}\right)^{1-\alpha} C$$

subject to (25), (26), (30) and (35) taking τ_i^* as given and where $i \in \{C, I, X\}$ and Q_Z, Q_Z^* are defined according to (31) and (32) and the price indices are defined as in section 4.4. The policy maker of Foreign solves a symmetric problem. The solution of the game is the Nash equilibrium. In order to better understand the intuition behind the Nash equilibrium, we will also study the non-strategic behavior of the single country policy maker i.e., we will underline the mechanisms and the incentives which induce the policy maker to deviate from the cooperative solution.

5.3 Production Subsidies

5.3.1 The case of cooperation

For the time being we restrict the available policy instruments to a subsidy/tax on the production of the differentiated sector. Since we have two sectors - one with monopolistic competition

[11] Using (8) we can rewrite (1) as $U(C) = \left(\frac{1-\alpha}{\alpha}\right)^{\frac{1-\alpha}{\alpha}} \left(\frac{P}{p_z}\right)^{1-\alpha} C$. We neglect the constant in the maximization problem.

[12] Using equations (33) and (34) it is possible to rewrite the market clearing for the homogeneous good (30) in the following way: $Q_Z^* = \frac{(1-\alpha)}{\alpha}\frac{P^*}{p_z}C^* + \tau^{1-\eta}(\tau_I^*\tau_X)^{-\eta}\left(\frac{P_H}{p_z}\right)^{1-\eta}\left(\frac{P^*}{p_z}\right)^{\eta} C^* - \tau^{1-\eta}(\tau_I\tau_X^*)^{-\eta}\left(\frac{P_H^*}{p_z}\right)^{1-\eta}\left(\frac{P}{p_z}\right)^{\eta} C$. Using this expression instead of the original formulation of the homogeneous good market clearing condition makes the solution of the optimal problem simpler. We will do the same for the single country optimal policy problem.

and a competitive one - the monopolistic pricing decision distorts the competitive allocation towards having too few firms in the differentiated sector. Therefore, a the Pareto-efficient allocation chosen by a hypothetical world planner can be implemented by using a lump sum tax financed subsidy to production of differentiated goods.

If τ_C and τ_C^* are the only instruments, the optimal cooperative solution is to set[13] $\tau_C = \tau_C^* = \frac{1}{\varepsilon}$, i.e. to completely offset the distortion coming from the presence of monopolistic competition in the differentiated sector. Indeed, even if in a one-sector model the presence of monopolistic competition does not introduce any inefficiency in a model with endogenous number of varieties and fixed labor supply[14], 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.[15]

5.3.2 The case of non-cooperation

Non-strategic production subsidies

To gain intuition we look at changes in domestic policy, while holding foreign policy constant. We first study a unilateral deviation from a Pareto-efficient situation, where both countries set an optimal subsidy and Home unilaterally deviates by lowering the subsidy on production.

For our numerical example we consider the following calibration. We set $\varepsilon = 4$, a standard value in the literature. For convenience we choose transport costs $\tau = 1.7$ and an expenditure

[13] See appendix for the analytical derivation of the results discussed here and in the following sections.

[14] 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.

[15] The result that the market equilibrium leads to too little variety in the two sector Dixit-Stiglitz model has been proved by Dixit and Stiglitz (1977). For the case of $\gamma = 1$ our economy coincides with the example in section 6 of Benassy (1996). He shows that the unconstrained Pareto-optimal allocation involves an equilibrium number of varieties equal to $N = \alpha L/((\varepsilon + \alpha - 1)f)$, while the market solution is $N = \alpha L/(\varepsilon f)$, so the market provides too little variety. Note that a lump-sum financed production subsidy that corrects for the markup implements the first best solution.

share on the differentiated sector equal to $\alpha = 0.4$[16].

Looking at figure 1, which plots domestic and foreign variables against the level of the domestic production subsidy, while holding the foreign subsidy at the optimal level $\tau_C^* = 1/\varepsilon$, we see that a unilateral decrease in the domestic subsidy from the efficient level $1/\varepsilon = 0.25$ initially 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, reduces the domestic subsidy bill and improves domestic terms of trade (defined here as the relative price of imports of differentiated goods in terms of exports), while lowering the aggregate level of efficiency. There is no overexpansion of subsidies above the efficient level and consequently no home market effect - policy makers do not find it optimal to try to attract more firms to their economy if the aggregate amount of firms is efficient. Instead, they improve domestic terms of trade by reducing the number of varieties produced domestically. This implies that given fixed relative factor prices, a smaller amount of domestic varieties can be exchanged against the larger bundle of foreign varieties which also frees resources to produce more of the homogeneous good - which Home now exports at improved conditions, as the relative price of imports of the differentiated bundle in terms of homogeneous good also falls.

In a second scenario we consider a domestic deviation from an equilibrium where both countries initially set zero production subsidies, to a positive domestic subsidy. Again, figure 2 plots a number of domestic and foreign variables as functions of the domestic production subsidy. An increase in the domestic subsidy causes firms in the differentiated sector to enter the domestic market and leave the foreign one - so the subsidy to production causes agglomeration. The production in the homogeneous sector is reduced domestically to free resources for production in the differentiated sector. Consumption of differentiated goods at Home increases, even though the terms of trade move against Home. Domestic consumers substitute towards domestic differentiated goods, as the relative price of foreign differentiated goods and also the relative price of imports of homogeneous goods rises. Note that domestic utility is initially increasing in the subsidy and then starts to decrease and that the level of subsidy that maximizes domestic utility, is strictly smaller than the efficient subsidy, $1/\varepsilon = 0.25$. This implies that the presence of

[16]This calibration just exemplifies our results, which are robust for any $\eta = \varepsilon > 1$, $\tau > 1$, and $\alpha \in (0, 1)$.

monopolistic distortions gives an incentive to the domestic policy maker to subsidize production of differentiated goods in order to bring consumption of differentiated goods closer to the first best level. Since this subsidy comes at the cost of worsened terms of trade the domestic policy maker chooses a suboptimally low subsidy level. As a consequence, there is no home market effect in the sense that country policy makers do not have the incentive to over-subsidize production in order to expand the domestic number of firms by too much. Instead, policy makers trade off increased efficiency against worsened terms of trade.

Optimal production subsidy under non-cooperation

Having discussed the incentives of individual policy makers, we now take a look at the strategic interaction of policy makers. For simplicity, we study exclusively symmetric Nash equilibria of the policy game, where domestic and foreign policy makers simultaneously choose the optimal production subsidy. Since no analytical solutions of the equilibrium strategies can be obtained, we rely on numerical simulations. Again, we set $\alpha = 0.4$[17] and we plot the Nash-equilibrium subsidy and the subsidy of the cooperative solution against ε for various values of the transport cost τ. It is apparent from figure 8 that the subsidy in the noncooperative equilibrium is always strictly lower than the efficient subsidy. Domestic policy makers are willing to set some positive subsidy in order to get closer to efficiency, while on the other hand they try to obtain better terms of trade, inducing them to reduce the subsidy on production of differentiated goods. The equilibrium outcome is a positive, but inefficiently low subsidy of production. Thus, the equilibrium of the subsidy game does not feature any home market effect, since policy makers do not over-subsidize production of differentiated goods, corroborating the intuition from the non-strategic analysis. Instead, the standard terms of trade effect prevails.[18]

5.4 Tariff on Imports

In this section we assume that the only strategic policy instrument available to trade authorities is a tariff on imports. We discuss our findings for the case of cooperation and non-cooperation

[17]The solutions are not sensitive to the choice of α.

[18]Note that our interpretation differs from Venables (1987), who shows in a non-strategic setting that a deviation from a zero to a small positive subsidy on production is always profitable from the viewpoint of domestic policy makers. The true reason why this is the case is the inefficiency of the market solution and not a Home Market Effect.

under two alternative assumptions. Under the first hypothesis the monopolistic distortion of the differentiated sector is offset by an appropriate production subsidy (i.e. $\tau_C = \tau_C^* = 1/\varepsilon$); under the second, the monopolistic distortion is not corrected (i.e. $\tau_C = \tau_C^* = 0$). This distinction is key to clarify what drives the incentives of non-coordinated governments.

5.4.1 The case of cooperation

The solution of the cooperative problem with respect to the choice of the optimal $\tau_I = \tau_I^*$ is given by[19]:

$$\frac{1+\tau_I^{1-\varepsilon}\tau^{1-\varepsilon}}{1+\tau_I^{-\varepsilon}\tau^{1-\varepsilon}}\left[1+\tau_I^{-\varepsilon}\tau^{1-\varepsilon}-\frac{\tau_I-1}{\tau_I}\right]=\frac{1}{1-\tau_C}\frac{\varepsilon-1}{\varepsilon}\left[1+\tau_I^{-\varepsilon}\tau^{1-\varepsilon}-\frac{\varepsilon}{1-\alpha}\frac{\tau_I-1}{\tau_I}\right] \tag{38}$$

When $\tau_C = \tau_C^* = 1/\varepsilon$ the cooperative solution is $\tau_I = \tau_I^* = 1$. This can be seen also by looking at figure 3[20] which plots the endogenous responses of welfare and equilibrium variables to a simultaneous shift in home and foreign tariffs. The intuition behind this result is pretty straightforward: when the distortions due to monopolistic competition are removed by means of production subsidies the economy is already at the first best allocation therefore, utility of Home and Foreign is maximized in absence of tariffs.

When $\tau_C = \tau_C^* = 0$ we have already seen in section 5.3 that the number of varieties produced in the economy is inefficiently low. Hence, the cooperative authority seeks to correct this distortion by subsidizing imports. Figure 4 plots the endogenous responses of welfare and equilibrium variables to a simultaneous shift in home and foreign tariffs for this case. Subsidizing imports in both countries reduces the relative price of imported differentiated varieties (both relatively to the domestic varieties and the homogeneous good). This will increase N and N^* while reducing the demand for the homogeneous good Z (whose production is above efficiency when $\tau_I = \tau_I^* = 1$). A positive tariff on the contrary would bring the economy further away from the efficient allocation. This is why household's utility is maximized for $\tau_I = \tau_I^* < 1$. Notice however that not surprisingly, the inefficiency due to monopolistic competition cannot be completely offset through tariffs: welfare is lower in figure 4 when $\tau_C = 0$ than in figure 3

[19] See appendix for the derivation.

[20] As for the production subsidy, all the exercises in this section are carried out under the baseline calibration $\varepsilon = 4$, $\alpha = 0.4$ and $\tau = 1.7$ but results are robust for any $\varepsilon > 1$, $\tau > 1$, and $\alpha \in (0, 1)$.

when $\tau_C = 1/\varepsilon$. In order to show that the optimality of an import subsidy is not limited to the specific calibration used for figure 4, figure 5 reports the optimal import subsidy for the cooperative solution against ε for different values of the transport cost τ.

5.4.2 The case of non-cooperation

As for production subsidies, before discussing the Nash equilibrium, we study the effects of a unilateral change. The exercise makes clear why single country policy makers may want to deviate from the cooperative policy. As clarified below, uncoordinated policies aim to improve the terms of trade and not to render domestic good cheaper by agglomerating firms in the domestic economy.

Non-strategic tariffs

Figure 6 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. Suppose that domestic authorities decides unilaterally to provide a small subsidy to imports[21]. 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 makes households increase their demand for foreign goods. As a result firms agglomerate in the foreign economy and domestic varieties are reduced while foreign ones are boosted. If the number of firms diminishes, governments can cut production subsidies and tax bills. This causes a positive wealth effect which more than compensates that due to the subsidy to imports. Indeed, the demand of the homogenous good rises as does its consumption. At the same time the price of the differentiated goods augments and the terms of trade improve allowing to import more goods for each unit of exports. As a consequence, domestic households can increase also the overall consumption of the differentiated goods C, even if some of the domestic varieties have been destroyed.

The figure also clarifies why we can interpret our results in the light of the standard terms of trade externality. The incentives of uncoordinated authorities to deviate from the efficient allocation are explained as the attempt to exert the monopoly power on the production of domestic varieties. As a monopolist, these policy makers seek to reduce home output to render

[21] In a neighborhood of $\tau_I = \tau_I^* = 1$.

local goods relatively more expensive. Hence contrary to Venables (1987) and Ossa (2008), raising import tariffs would decrease domestic welfare.

Figure 7 plots the effects of a unilateral change of the domestic tariff when the number of varieties is inefficiently low (i.e. $\tau_C = \tau_C^* = 0$). In this scenario a positive tariff improves domestic welfare. This outcome is in line with the above analysis when the instrument available to policy makers was a production subsidy. These results are also consistent with Venables (1987) and Ossa (2008) but the analysis just conducted highlights a quite different interpretation. Uncoordinated authorities face a trade off between correcting the monopolistic distortion and improving the terms of trade. In equilibrium however the first incentive prevails. Indeed a tax on imports renders domestic differentiated goods cheaper and pushes firms to relocate in the domestic economy. But differently from the case when $\tau_C = \tau_C^* = 1/\varepsilon$ the consumption of differentiated goods at Home is boosted. Indeed, the increase in consumption of domestic differentiated varieties that have no transport cost brings prices closer to marginal cost, allows for a more efficient use of resources and reduces the domestic dead weight loss due to firm monopoly power. This is exactly why single country policy makers accepts the cost of terms of trade worsening. Notice that also the consumption of the homogenous good can augment thanks to the increase in the foreign production and the positive wealth effect due to tariff revenue redistribution.

Our conclusion is then that in this model the incentive to tax imports has to be interpreted as a "production efficiency effect" and not as the attempt to exploit the home market effect in order to minimize transportation costs. Overall, we do not find any incentive to use import tariffs or production subsidies to push the number of domestically produced varieties above the efficient level. Rather the contrary.

Optimal tariffs under non-cooperation

After having clarified in the previous section the incentives that move policy makers away from the cooperative solution, we now analyze the equilibrium outcomes of the non-cooperative game. As for the case of the production subsidy, we restrict ourselves to the symmetric Nash equilibria of the game. Once again, we have to rely on numerical simulation. We calibrate $\alpha = 0.4$ and then study the Nash solution for $\varepsilon \in [1, 7]$ and $\tau = (1.1; 1.5; 1.9)$. We consider two

cases: $\tau_C = \tau_C^* = 1/\varepsilon$ and $\tau_C = \tau_C^* = 0$.

Figure 9 reports the optimal import tariff for the case where the monopolistic distortion has been eliminated by means of the production subsidy. The first thing to be noticed is that no Nash equilibrium exists for $\varepsilon < 2$. More importantly, for all other values of ε and for all values of τ, the Nash equilibrium entails a subsidy to imports[22]. When the production subsidies eliminate the monopolistic competition distortions, single country policy makers' choices are driven solely by the incentive to manipulate the terms of trade in their favor. This incentive is stronger the higher their market power i.e., the lower the elasticity of substitution between varieties ε[23]. Coherently, the lower the elasticity the more the two countries are subsidizing their imports (τ_I moves closer and closer to zero).

Figure 10 shows the Nash solution for the case when the monopolistic distortion has not been eliminated. Because of the assumption $\eta = \varepsilon$, a higher ε means at the same time lower monopolistic distortion (i.e. less inefficiency in the economy to be taken care of) and lower market power of each country (i.e. lower incentive to manipulate the terms of trade). As we saw in the previous analysis, domestic policy makers are willing to accept a worsening in the terms of trade in order to increase domestic production of the differentiated good to move closer to the efficient level. The optimal import tariff approaches one as the elasticity increases. Indeed, the higher the elasticity the lower the inefficiency in the economy but also the lower the incentive to manipulate the terms of trade. For relatively low values of ε instead the trade off faced by the policy maker becomes stronger. On the one hand, the lower the elasticity the higher the distortion due to monopolistic competition and the stronger the incentive to impose a positive import tariff to increase the number of domestic varieties towards efficiency. On the other hand, lower elasticity gives higher market power to each country therefore making a stronger case for trying to improve the terms of trade in their favor by means of an import subsidy. While the incentive to correct for the monopolistic distortion prevails for values of ε above 1.5, the terms of trade incentive kicks in strongly for low values of the elasticity, thus the

[22]For relatively high values of transport costs there are multiple equilibria but all of them imply $\tau_I < 1$.

[23]Recall that for the moment we are following the practice common in the related literature of assuming $\eta = \varepsilon$. The elasticity which is relevant for the term of trade externality is η. Considering different values for the two elasticities would allow us to disentangle the inefficiency due to monopolistic competition from the incentives to manipulate the terms of trade.

hump shaped form of the optimal import tariff.

5.4.3 The wealth effect

As emphasized in the introduction, the redistribution of tariff revenues is key to explain the difference between our results and those of the previous literature. Neglecting this redistribution means neglecting wealth effects that are crucial for the open policy makers' optimal decisions. To see why consider that in our model[24]:

$$Z = (1 - \alpha)m$$

namely the expenditure for the homogenous good is a constant share of consumers' wealth m. If, as in Venables (1987) and Ossa (2008), tariffs are pure waste (i.e $m = wL$) in equilibrium $Z = (1 - \alpha)L$. This outcome follows directly from the assumptions that preferences are Cobb-Douglas, there is free trade and the homogenous sector is perfectly competitive with a constant return to scale technology[25]. Intuitively, the substitution and the income effects due to a change in the relative price always compensate exactly. Then the equilibrium level of the homogenous good is exogenously determined and independent of trade policies. In this set up single country policy makers will find it optimal to tax imports as much as possible[26]. A positive tariff shifts local demand towards home produced goods and induces firms of the differentiated sector to agglomerate in the domestic economy. This relocation benefits home consumers. Indeed the higher is the number of varieties locally produced, the lower are transport costs and the price of the differentiated goods and the more households can buy of them. At the same time, even if the homogeneous good becomes relatively more expensive, in equilibrium it is always consumed in the same amount exactly because labor income is fixed and tariffs are a pure waste.

However, once tariff revenues are redistributed, uncoordinated policy maker optimal behavior is driven by the incentive to improve the terms of trade. In order to clarify our argument we analyzed two cases: 1) the lump sum transfers rebated to consumers consist of just the tariffs on imports of differentiated goods (i.e $m = L + T_{\tau_I}$ and $Z = (1 - \alpha)(L + T_{\tau_I})$); 2) these transfers include the tariffs on imports and the taxes collected by governments to finance the

[24]For the sake of simplicity in this paragraph we set $p_z = 1$ and $\tau_X = 1$.

[25]These last assumptions imply $w = p_z = 1$.

[26]In other words an unilateral increase of import tariffs increases always domestic welfare. See Ossa (2008).

correction of the monopolistic distortion in the differentiated sector (i.e $m = L + T_{\tau_I} - T_{\tau_C}$ and $Z = (1-\alpha)(L + T_{\tau_I} - T_{\tau_C})$). In both these cases the demand of the homogenous good is not invariant to policy decisions. Still, in response to a change in the relative price (and in tariffs) income and substitution effects cancel out. Nevertheless in equilibrium the demand of the homogenous goods is shifted by the wealth effect due to the transfers. Which impact a tariff produces on the homogenous good then depends on the sign of this wealth effect.

Tariff revenue is hump shaped because of the Laffer curve argument. Hence, when there are no taxes to subsidize production, the optimal tariff is positive but finite[27]. Increasing a tariff always boosts consumption of differentiated goods. But a too high tariff reduces that of the homogenous good because it cuts tariff revenues and thus consumers' income (i.e. the wealth effect is negative). Then raising tariffs unilaterally generates a tradeoff for single country trade authorities: in order to consume more differentiated goods, domestic households have to consume less of the homogenous good.

When governments tax consumers to eliminate the monopolistic distortion, the wealth effect on the demand of the homogenous good associated with a tariff is negative even for low values of τ_I (more precisely in sufficiently small neighborhood of $\tau_I = 1$). Indeed, such kind of policy augments the production of the differentiated goods increasing then the taxes paid by consumers to finance production subsidies. This effect more than compensates that on tariff revenues. As a result, transfers decrease thereby reducing total household income. Thus, in equilibrium domestic demand for the homogenous good is reduced too and the domestic policy maker faces a trade off between increasing C and reducing Z[28].

[27] See Venables (1987) and Ossa (2008) in the appendix.

[28] One may wonder if these findings hold even with a more general utility function. Venables (1987) for instance considers the class of weakly separable preferences. Within this class our results would not change as long as the homogenous and the differentiated goods are gross-substitutes. In that case the Walrasian demand of the homogenous good $Z(P_C, m)$ is such that $\frac{\partial Z(P_C,m)}{\partial P_C} > 0$. Hence under this assumption a policy that renders the differentiated goods cheaper and reduces the demand for the homogenous good, would shrink that demand even more than when preferences are Cobb-Douglas. Notice that both quasi-linear and CES utility functions may satisfy the property of gross substitutability. In particular for CES it is sufficient that the elasticity between Z and C is greater than 1.

5.5 Export Subsidies

5.5.1 The case of cooperation

Export subsidies/taxes have a very similar effect as import tariffs, so we will be rather brief in this section, as intuitions are basically the same as in the case of tariffs. Consider first the case where monopolistic distortions have been eliminated ($\tau_C = \tau_C^* = 1/\varepsilon$). From figure 11 we see that any simultaneous move of export taxes away from zero ($\tau_X = \tau_X^* = 1$) lowers welfare in both countries. A positive export tax reduces the equilibrium number of differentiated varieties below the Pareto-optimal level, because it reduces equilibrium demand for exports by distorting relative prices and the other way round for a subsidy on exports.

When monopolistic distortions are not corrected ($\tau_C = \tau_C^* = 0$), a coordinated move to a small positive subsidy on exports ($\tau_X = \tau_X^* < 1$) is welfare improving, as can be seen from figure 12. The subsidy increases production and consumption of differentiated varieties which are not sufficiently provided by the market outcome. Note that this is only a second best solution: while an export subsidy can correct price distortions on exports, there is no instrument to influence the price of varieties that are produced and consumed in the same country.

5.5.2 The case of non-cooperation

Non-strategic export subsidy

Here, we study again unilateral deviations from an initially symmetric situation without export taxes or subsidies. Again, we consider first the case where are distortions are eliminated by a production subsidy. From 13 it is apparent that a unilateral deviation to a positive tax on exports, that reduces the number of differentiated varieties, is welfare improving in this case. A tax on exports improves domestic terms of trade and also increases domestic wealth through a reduced subsidy bill on production.

In the second scenario monopolistic distortions have not been eliminated. Then - as can be seen in 14 - a deviation to a positive subsidy on exports that attracts more firms to the domestic economy improves domestic welfare. Domestic terms of trade worsen and the subsidy bill is increased causing negative wealth effects. Still, Home is better-off because domestic consumption of differentiated varieties that was too low in the market equilibrium is driven closer to the Pareto-optimal level. Again, this mechanism should not be interpreted as a Home

Market effect.

Optimal export subsidies under non-cooperation

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6 Conclusion

In a two sector variant of the Krugman (1980) intra-industry model we study optimal trade policy of uncoordinated and coordinated authorities for different policy instruments: a production subsidy, a tariff on imports and a tax on exports. According to all our findings, in this type of framework uncoordinated policy makers' behavior is explained by two opposite incentives: the willingness to exploit their monopoly power to improve the terms of trade (the standard terms of trade externality) and the need of correcting the distortion due to monopolistic competition (known as production efficiency effect). This result is clearly in contrast with some contributions of the trade literature (see in particular Venables (1987), Ossa (2008) and Helpman and Krugman (1989)) which, within the same type of set up have claimed that single country policies aim at inefficiently agglomerating firms in the domestic economy, in order to minimize transportation costs (the so called home market effect). What explains the difference between our conclusions and those of the existing analysis is the following. On the one hand, we relax one simplifying assumption common to the literature, which is to model tariffs as a pure waste. Neglecting the redistribution of tariff revenues implies eliminating wealth effects that are key for optimal policy choices. On the other hand, we show that in this kind of framework the equilibrium allocation is not Pareto-efficient. Indeed, given that there are two sectors and endogenous firm entry, the production of differentiated goods is not fixed by labor supply and a proper production subsidy improves consumers' welfare.

Overlooking these features of the model is what has led to a misinterpretation of the underlying mechanism driving uncoordinated policy decisions. In fact, once the monopolistic distortion is offset by an appropriate subsidy and tariff revenues are redistributed, it is clear that single country policy makers' behavior can be explained only in the light of the standard terms of trade externality: they find it optimal to subsidize imports(!); they want to induce firm exit from the domestic market in order to render domestic goods more expensive than foreign ones. Conversely, if there are no production subsidies, we do find - like Venables (1987) and Ossa

(2008) - that a positive tariff is optimal from the uncoordinated authority viewpoint. However, this result should not be interpreted as an attempt to induce firms to relocate in the domestic economy in order to render differentiated goods cheaper, but as a way to push the economy towards a more efficient use of resources.

7 Appendix

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References

Benassy, Jean-Pascal, "Taste for Variety and Optimum Production Patterns in Monopolistic Competition," *Economics Letters*, 1996, *52*, 41–47.

Davis, Donald R., "The Home Market, Trade, and Industrial Structure," *American Economic Review*, 1998, *88* (5), 1264–1276.

Dixit, Avinash K. and Joseph E. Stiglitz, "Monopolistic Competition and Optimum Product Diversity," *American Economic Review*, 1977, *67* (3), 297–308.

Feenstra, Robert C., *Advanced International Trade: Theory and Evidence*, Princeton University Press, 2004.

Flam, Harry and Elhanan Helpman, "Industrial Policy under Monopolistic Competition," *Journal of International Economics*, 1987, *22* (1-2), 79–102.

Gros, Daniel, "A Note on the Optimal Tariff Retaliation and the Welfare Loss from Tariff Wars in a Framework with Intra-Industry Trade," *Journal of International Economics*, 1987, *23* (3-4), 357–367.

Helpman, Elhanan and Paul Krugman, *Trade Policy and Market Structure*, MIT Press, 1989.

Krugman, Paul, "Scale Economics, Product Differentiation, and Pattern of Trade," *American Economic Review*, 1980, *70* (5), 950–959.

Melitz, Marc J and Giancarlo I.P. Ottaviano, "Market Size, Trade, and Productivity," *Review of Economic Studies*, 2008, *75*, 295–316.

Ossa, Ralph, "A "New Trade" Theory of GATT/WTO Negotiations," *mimeo, University of Chicago Booth School of Business*, 2008.

Venables, Anthony, "Trade and Trade Policy with Differentiated Products: A Chamberlinian-Ricardian Model," *The Economic Journal*, 1987, *97* (387), 700–717.

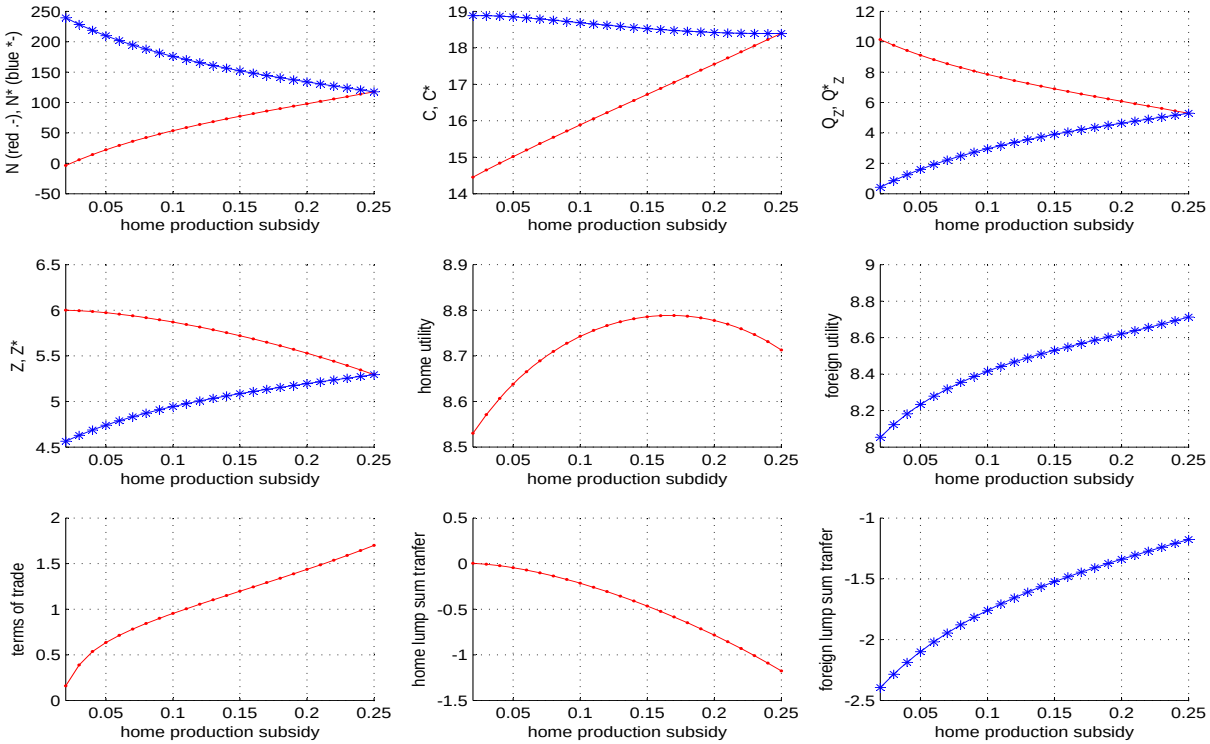


Figure 1: Effects of an unilateral shift of the domestic production subsidy when $\tau_C^* = 1/\varepsilon$.

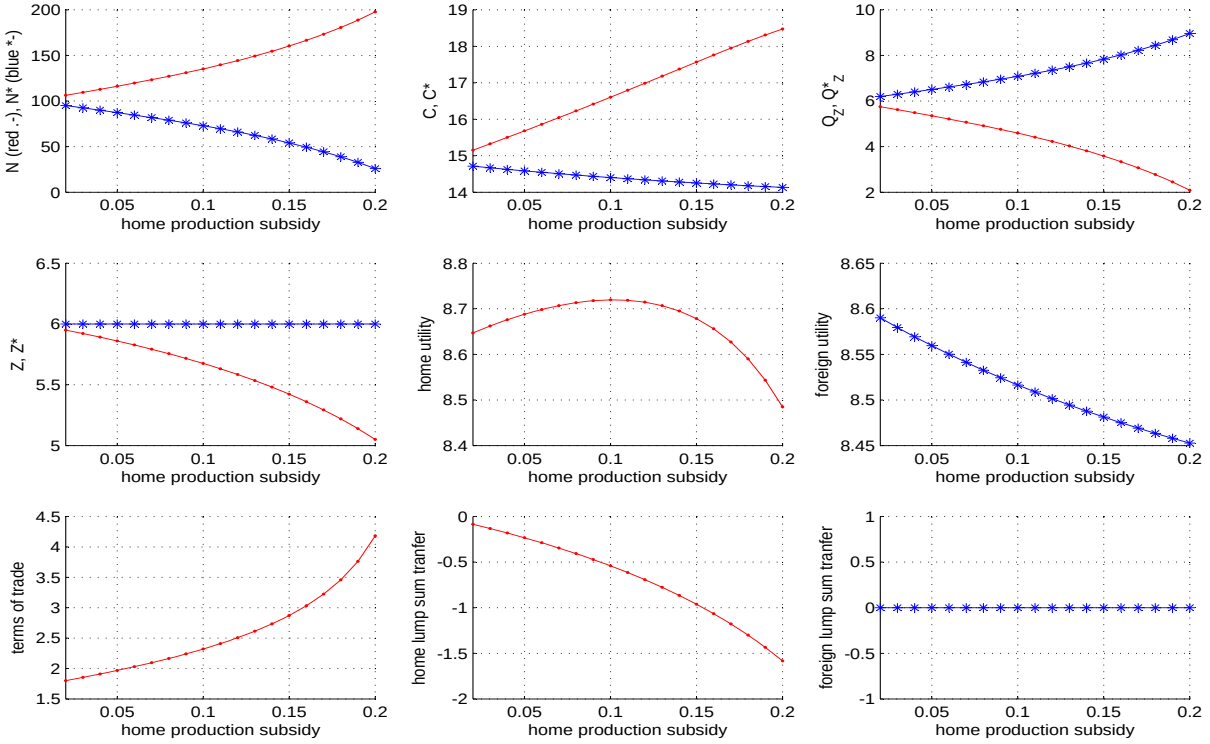


Figure 2: Effects of an unilateral shift of the domestic production subsidy when $\tau_C^* = 0$.

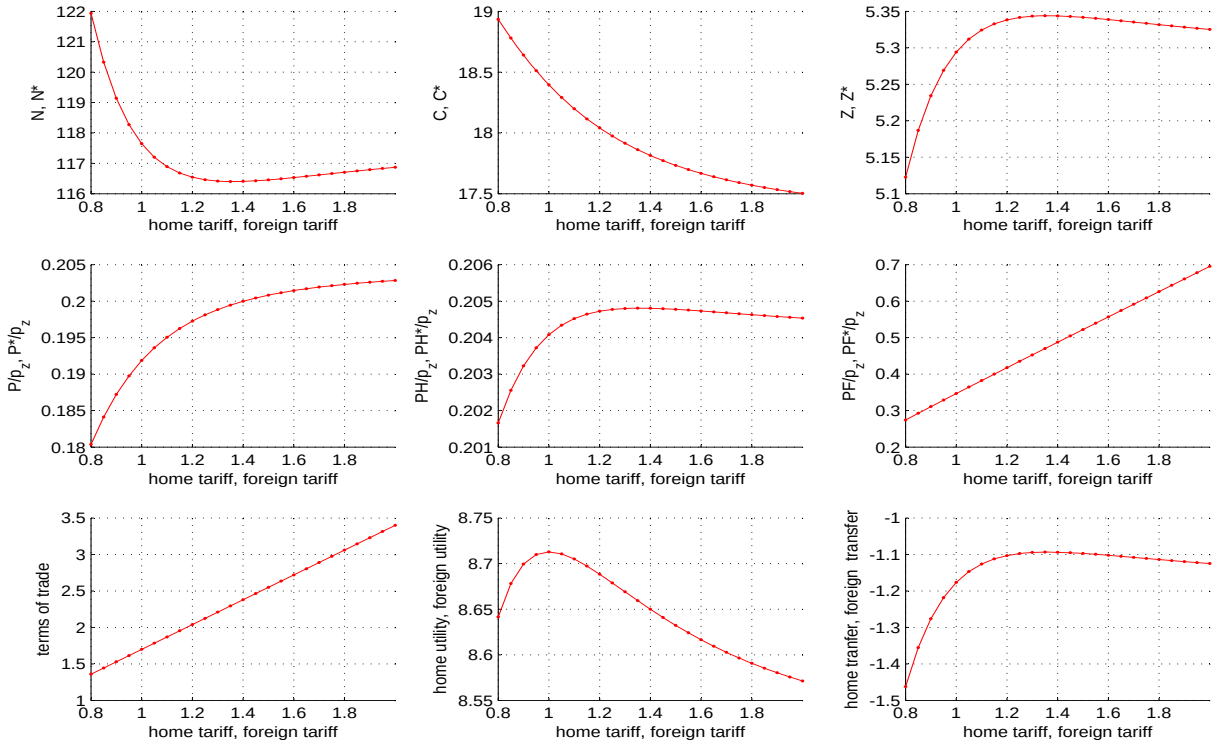


Figure 3: Effects of a simultaneous shift in home and foreign tariffs when $\tau_C = \tau_C^* = 1/\varepsilon$.

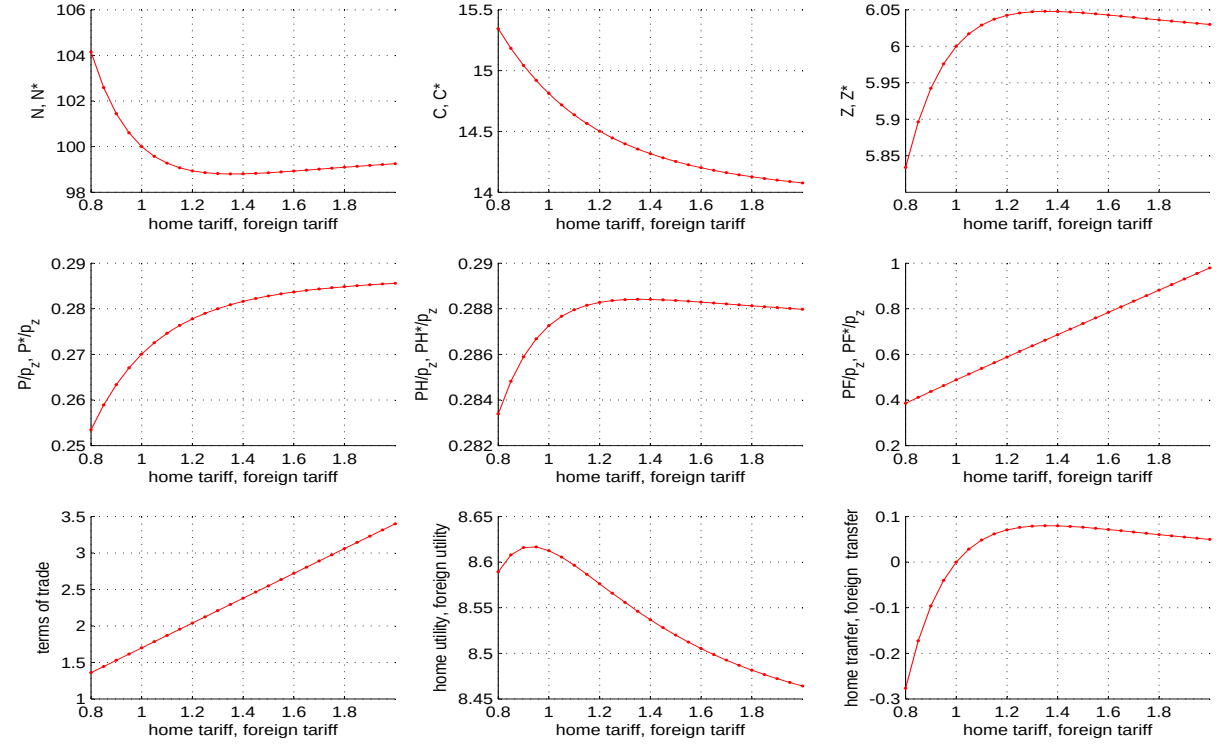


Figure 4: Effects of a simultaneous shift in home and foreign tariffs when $\tau_C = \tau_C^* = 0$.

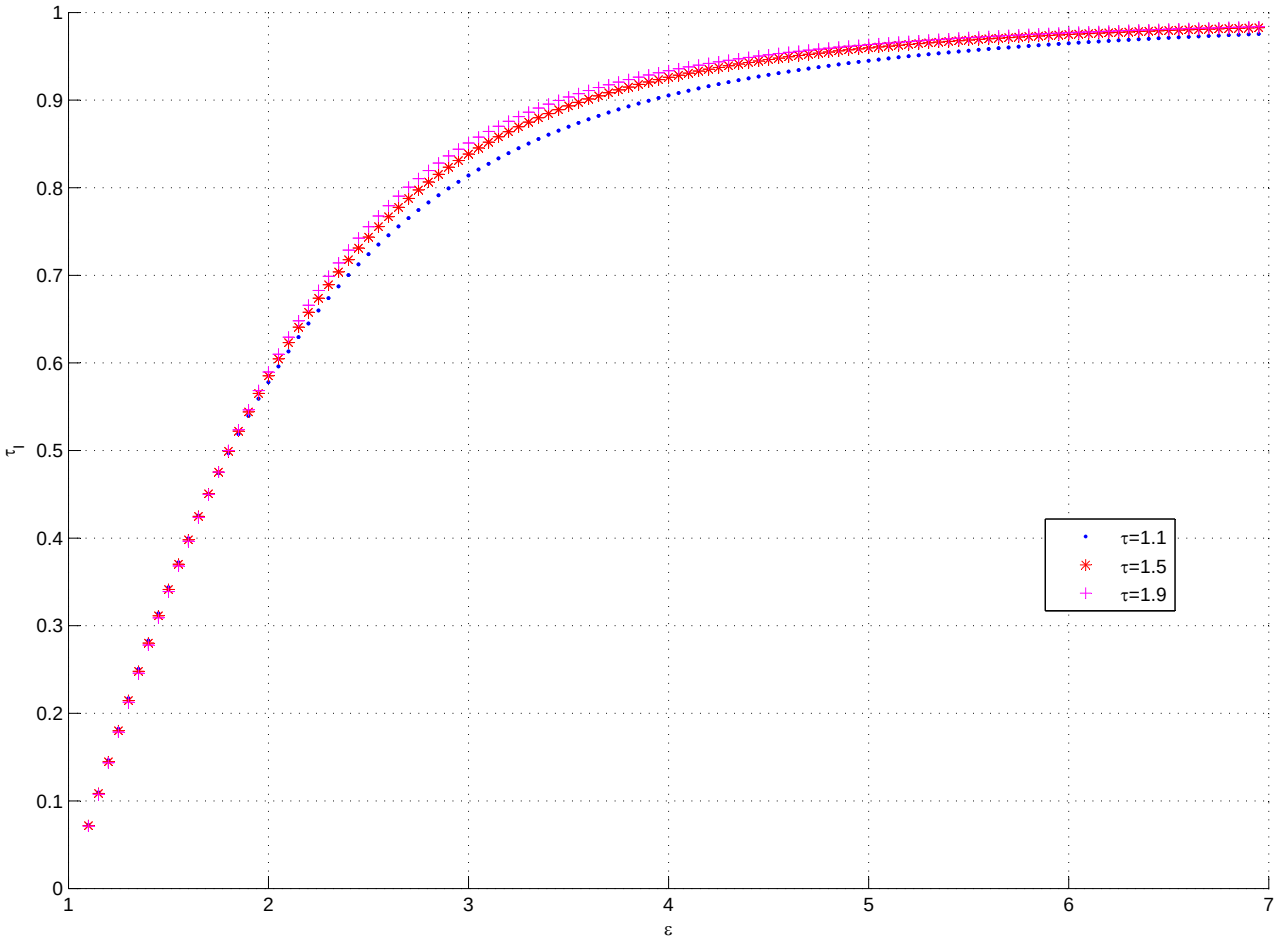


Figure 5: Cooperative solution for import tariffs when $\tau_C = \tau_C^* = 0$.

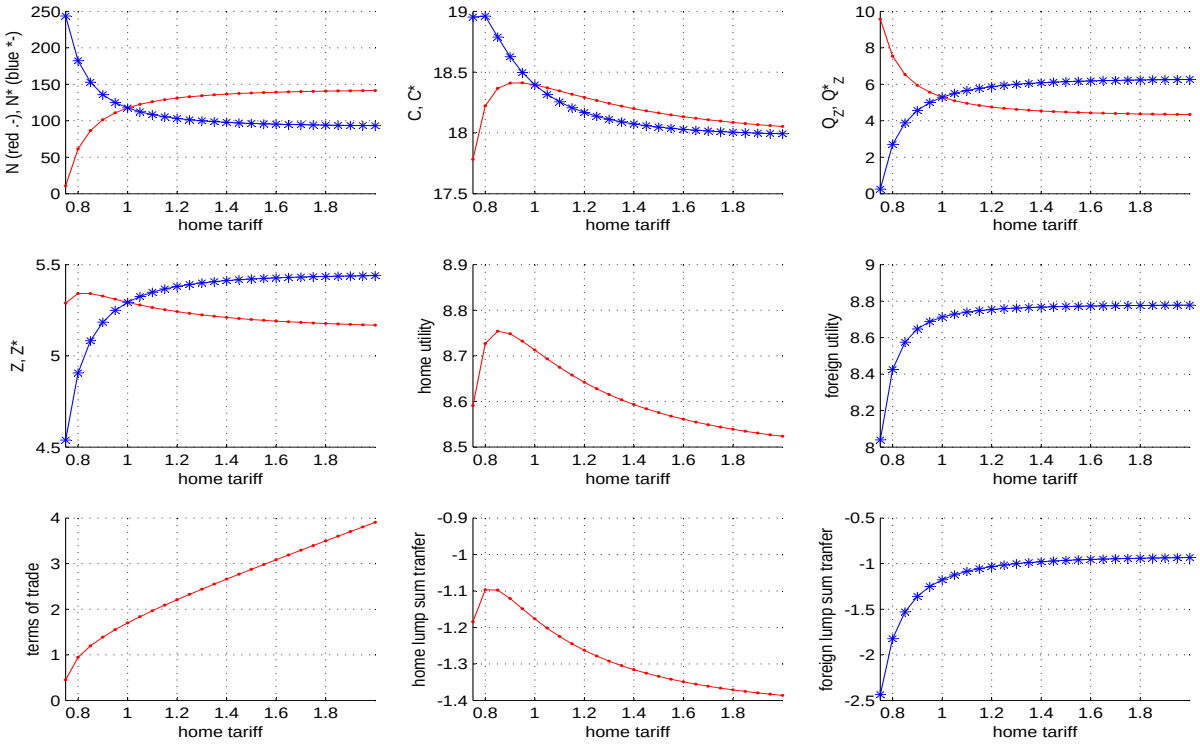


Figure 6: Effects of an unilateral shift of the domestic tariff when $\tau_C = \tau_C^* = 1/\varepsilon$.

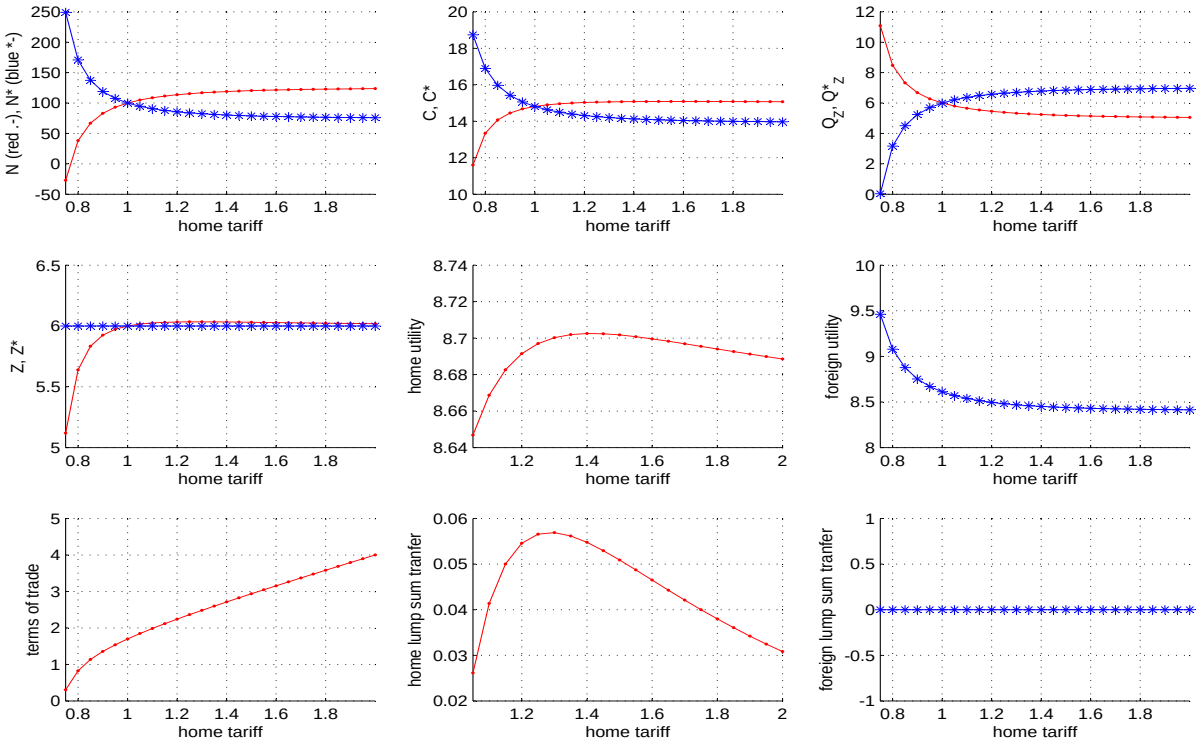


Figure 7: Effects of an unilateral shift of the domestic tariff when $\tau_C = \tau_C^* = 0$.

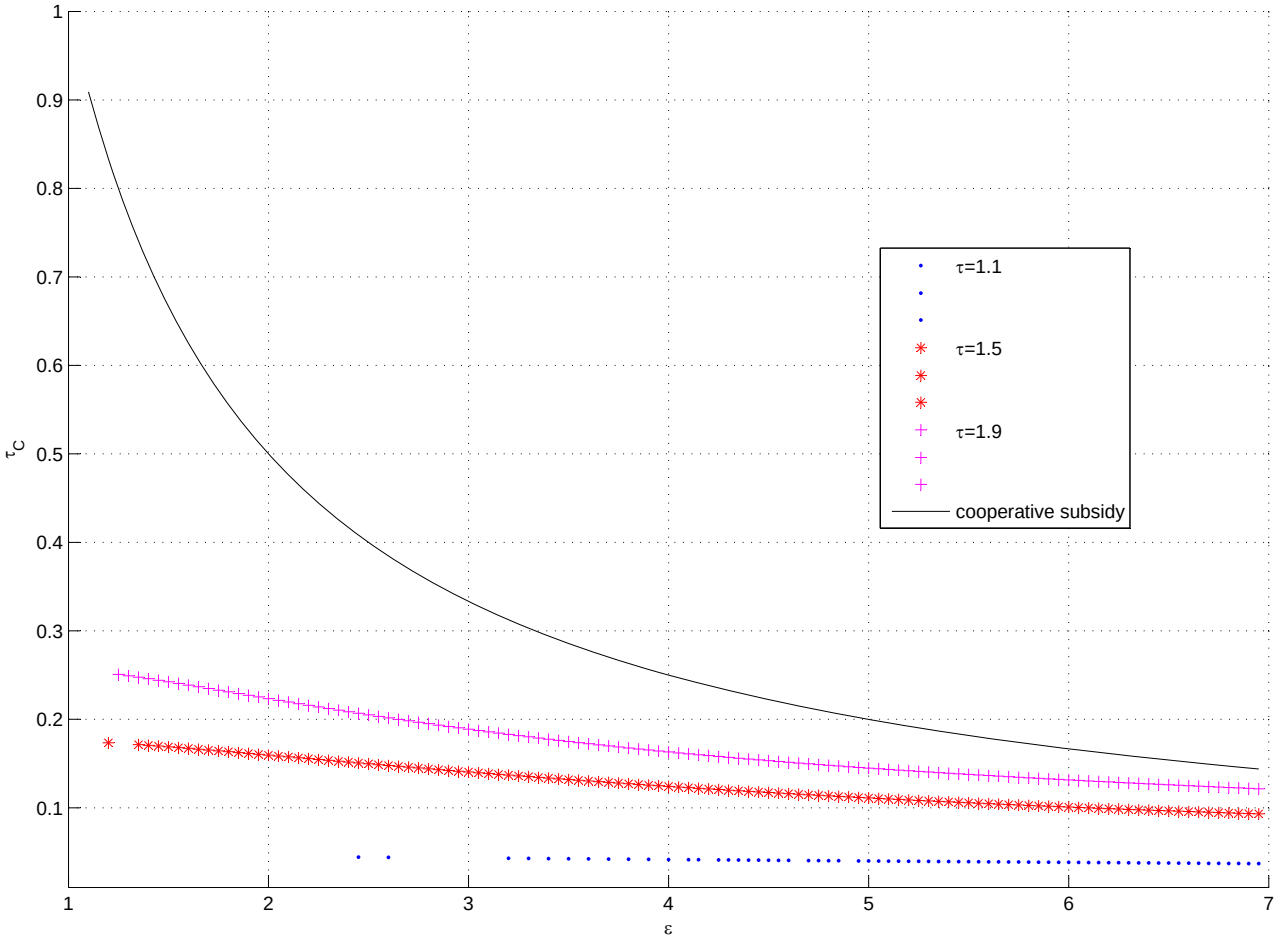


Figure 8: Nash solution for a production subsidy.

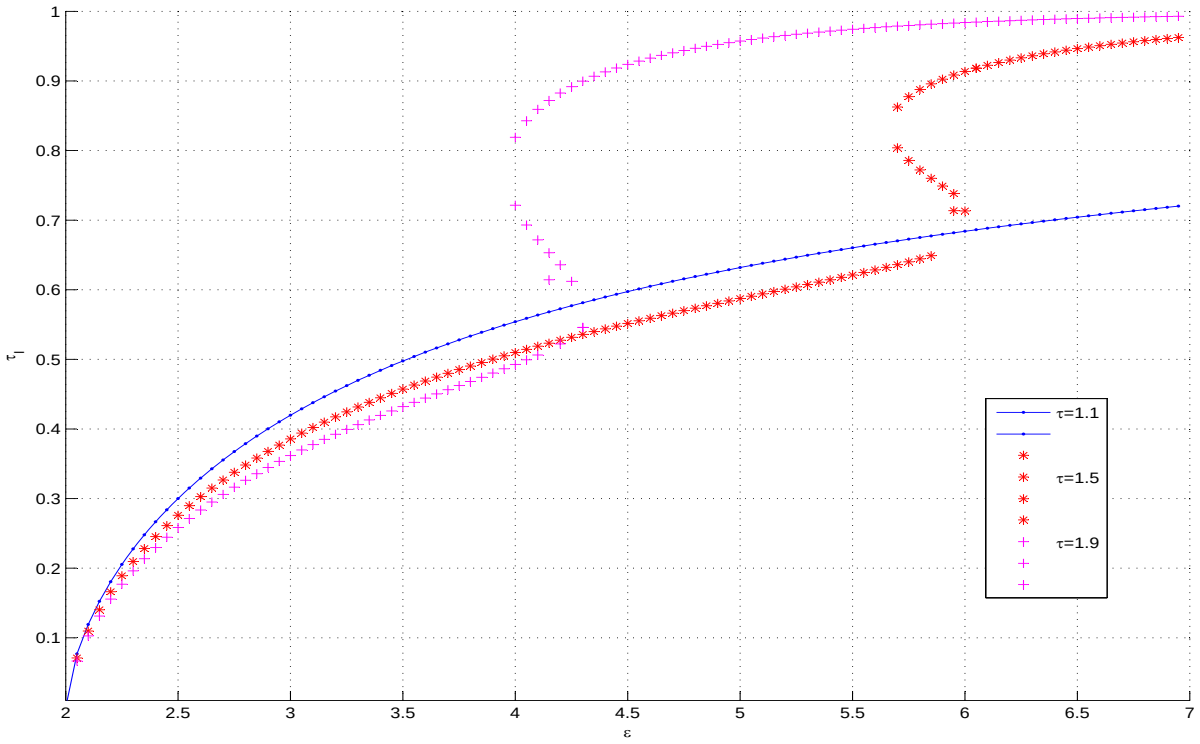


Figure 9: Nash solution for import tariff when $\tau_C = \tau_C^* = 1/\varepsilon$.

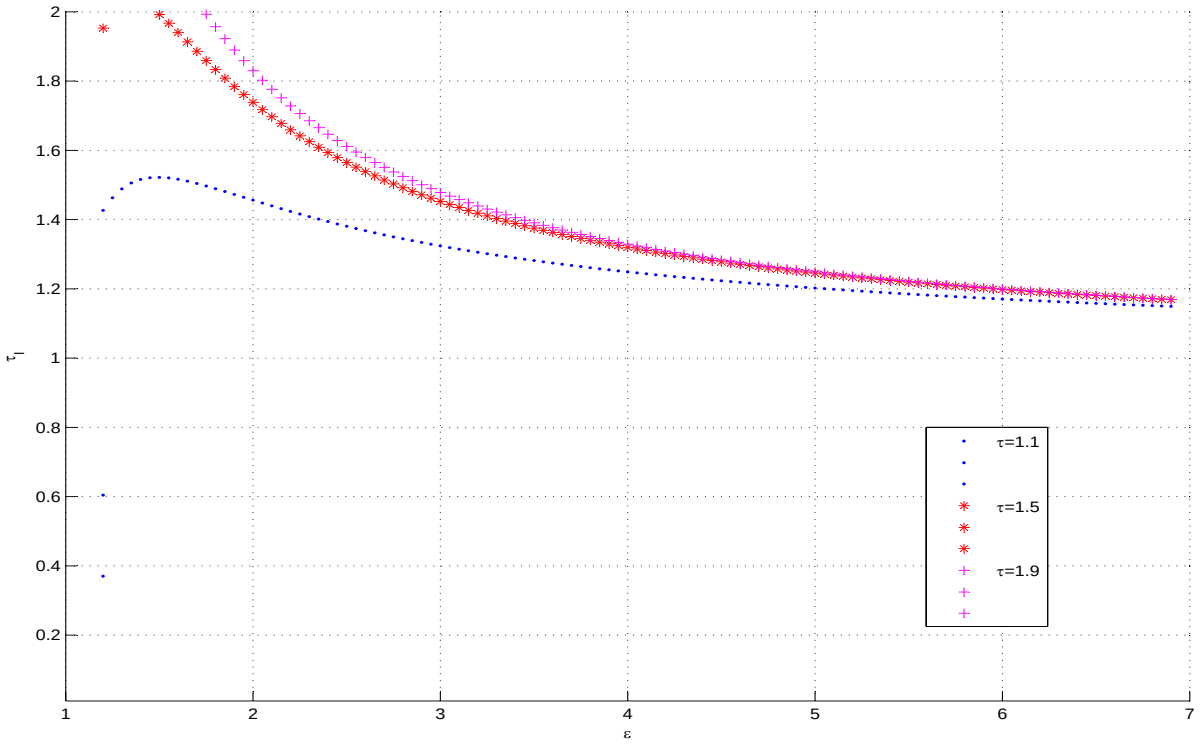


Figure 10: Nash solution for import tariff when $\tau_C = \tau_C^* = 0$.

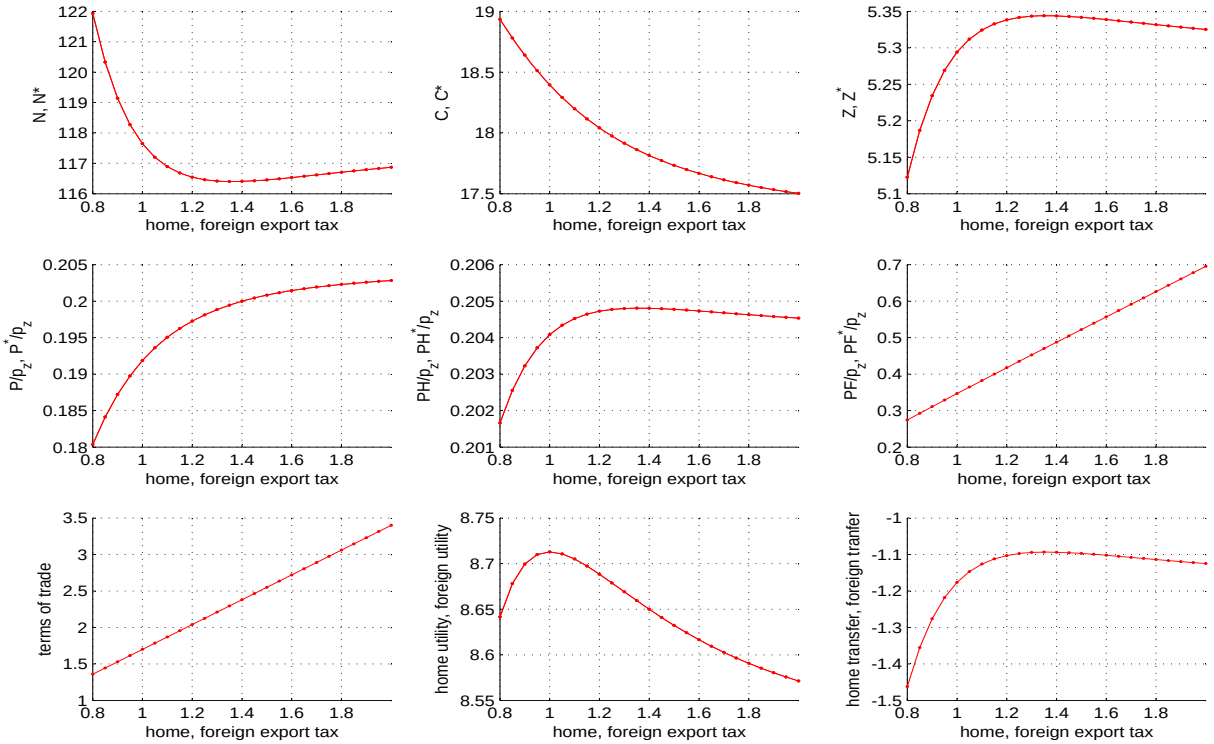


Figure 11: Effects of a simultaneous shift in home and foreign export taxes when $\tau_C = \tau_C^* = 1/\varepsilon$.

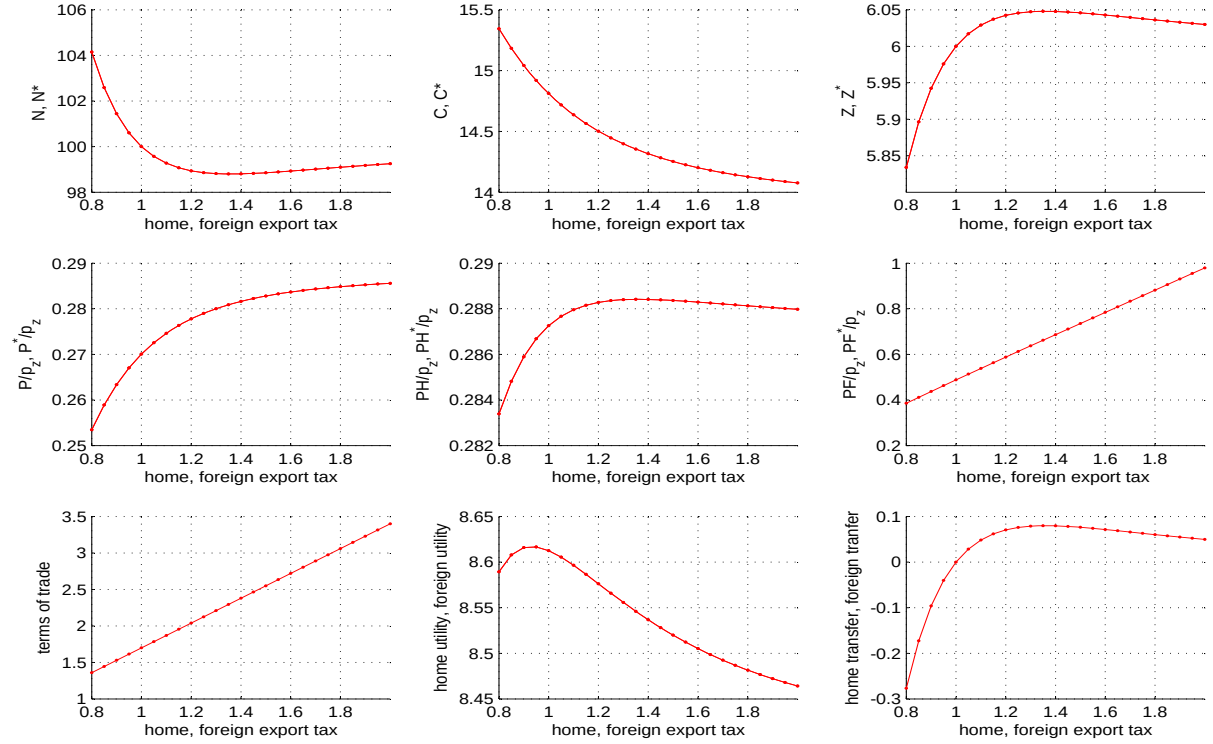


Figure 12: Effects of a simultaneous shift in home and foreign export taxes when $\tau_C = \tau_C^* = 0$.

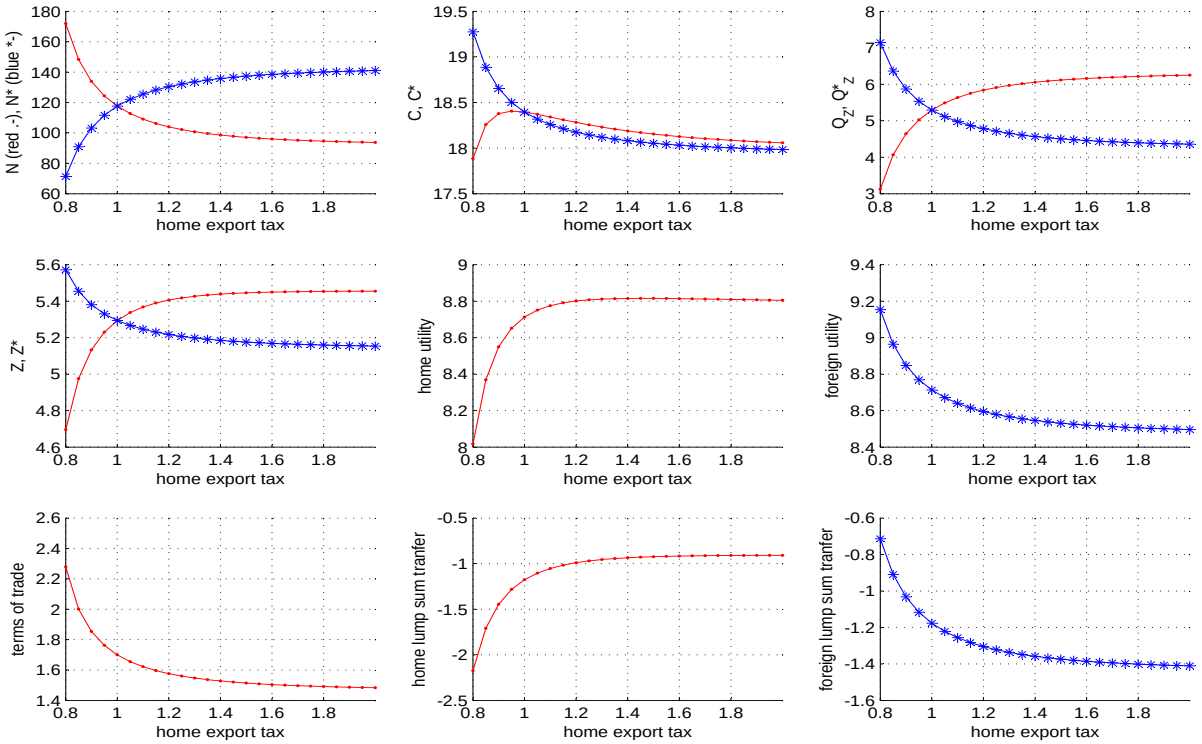


Figure 13: Effects of an unilateral shift of the domestic export tax when $\tau_C = \tau_C^* = 1/\varepsilon$.

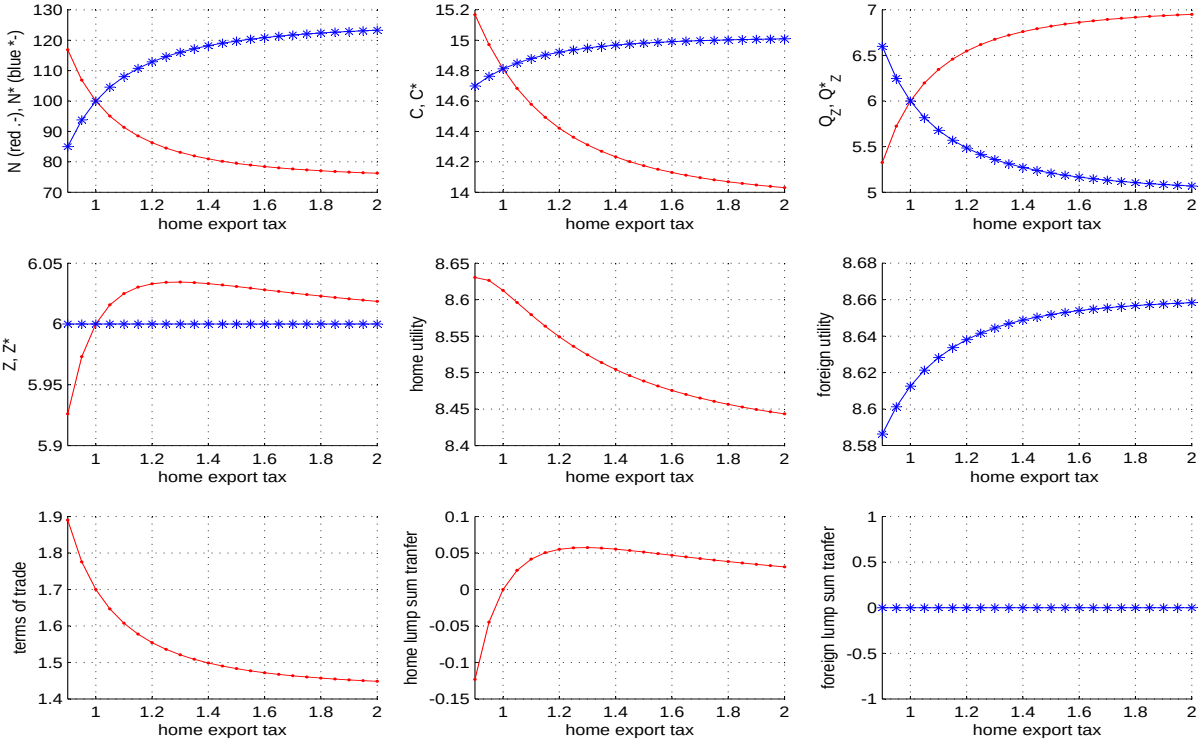


Figure 14: Effects of an unilateral shift of the domestic export tax when $\tau_C = \tau_C^* = 0$.