KATHOLIEKE
UNIVERSITEIT
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DEPARTEMENT TOEGEPASTE ECONOMISCHE WETENSCHAPPEN

RESEARCH REPORT 0117

DOES PROTECTION HARDEN BUDGET CONSTRAINTS?

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D/2001/2376/17

Does Protection Harden Budget Constraints?

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March 2001

Abstract

In this paper we analyse the effects of soft budget constraints in an international context. Firstly, we show that soft budget constraints in an exporting country lead to higher levels of trade protection in the recipient country. Secondly, the model predicts that protectionist trade policy helps to harden budget softness in the exporting country. We therefore argue that, when industrial policy fails to enforce financial discipline, trade policy can take over this role. Finally, we discuss potential implications of our model for EU-policy with respect to Central and Eastern European Countries.

JEL-classification: F13, L13, P34

Keywords: Soft Budget Constraints, Transition, Trade Policy, Oligopoly

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*Financial support provided by the Fund for Scientific Research (FWO) under research grant G.0267.01 is gratefully acknowledged by the authors. The authors also wish to thank Joep Konings, Nancy Huyghebaert, Bas Van Aarle, Alain de Crombrugghe, Frederic Warzynski, Marvin Jackson, Jarko Fidrmuc, Linda Van De Gucht and all LICOS-seminar participants for useful suggestions. The usual disclaimer applies.

1 Introduction

Soft budget constraints (SBCs) refer to the fact that loss-making firms are being bailed out, either because of paternalistic reasons (Kornai, 1980), because of politicians' influence on enterprise behaviour (Shleifer and Vishny, 1994) or because SBCs give rise to a commitment problem in the presence of irreversible investment (Dewatripont and Maskin, 1995). SBCs were characteristic of economic life under socialism[1] and implied giving direct subsidies to enterprises. Consequently, with the transition towards market-type economies, the hardening of budget constraints is one of the major challenges transition countries are facing at present. Despite the drastic cut in direct subsidies, there is evidence to suggest that SBCs continue to exist, be it under a different form. Schaffer (1998) argues that tax arrears in the private sector importantly substitute for these direct subsidies[2]. Alternatively, SBCs exist under the form of the non-collection of bills by state utility suppliers (e.g. gas, electricity, water - EBRD, 1999, p. 137; Pinto et al., 2000) or under the form of soft credit to state enterprises (Perotti and Carare, 1996, Majumdar, 1998).

Attention in the literature has typically concentrated on how to promote the hardening of budget constraints through institutional reform (Roland, 2000) and on the effects of SBCs on firm performance. For example, Kornai (1980) finds a relation between SBCs and excessive demand for inputs. Qian and Xu (1998) analyse the link between SBCs and the lack of innovation in socialist countries. Huang and Xu (1999) demonstrate how SBCs can negatively influence R&D and economic growth. Konings and Vandenbussche (2000) show that SBCs lead to inferior firm performance[3]. However, the effects of SBCs in an international context have been overlooked so far. In this paper, we contribute to the literature by looking at how SBCs in exporting countries affect and are affected by trade protection in the recipient country.

Since the opening of Central and Eastern Europe, the exports of these

[1] SBCs are also present in market economies. However, incentive distortions in a market economy are usually less serious. Everaert (2000) discusses general applications of SBCs in market economies.

[2] Schaffer (1998) argues that governments in transition countries typically fail to collect overdue taxes. Consequently, these tax arrears are one of the major channels through which the governement continues to subsidise the economy, be it that this is much less visible than in the case of direct state subsidies.

[3] A more comprehensive overview of existing theoretical and empirical work on SBCs is found in Everaert (2000).

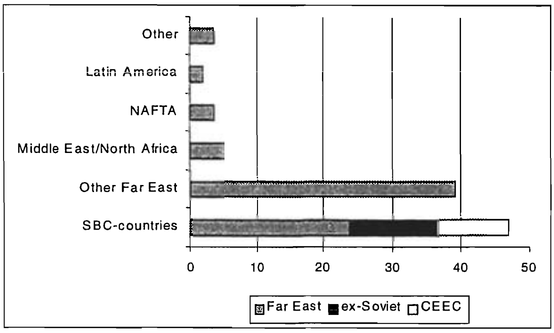

Figure 1: Frequency AD/CVD-cases, 1992-99, (European Commission, 1996, 2000).

countries to the EU have increased dramatically. At the same time, a substantial number of protectionist actions have been taken by the recipient countries. In particular, anti-dumping measures and countervailing duties against Central and Eastern European Countries (CEECs) have frequently been used. Figure 1 shows the high relative number of EU anti-dumping and countervailing duty cases against countries where SBCs can reasonably be expected[4].

Since SBCs can lead to prices below cost, this practice could - in an international context - classify under 'dumping'[5]. In turn, this could be an explanation of the anti-dumping measures, taken by many countries against CEEC-imports, the EU in particular. Alternatively, SBCs can be considered as subsidies against which WTO-regulation allows for countervailing duties to be put in place[6].

[4] Amongst the SBC-countries of the Far East, we only included China, Vietnam and India. For these countries, direct empirical evidence of SBCs exists. One could argue that countries like e.g. Korea, Indonesia or Thailand equally suffer from SBCs. They are however included in the category 'other Far East'. In this way, our graph presents lower-bound evidence of a high proportion of AD/CVD-cases against SBC-countries. The category 'other' consists of Australia, South Africa and Norway.

[5] Notice that dumping can also prevail without below-cost pricing and that the legal definition of dumping can considerably differ from its economic interpretation. A discussion of the concept and its practical implementation is given in Vandenbussche (1995).

[6] However, the difficulty in explicitly demonstrating the existence of a subsidy often

In this paper, we analyse the interaction between SBCs and countervailing tariffs by setting up a three-stage model with two countries. The foreign government moves first by deciding on the degree of budget softness, modelled in the form of a subsidy. In the second stage, the home government responds by setting a countervailing tariff to protect its domestic firms against these SBC-imports. Finally, the home and the foreign firm compete for profits in the home market.

The aim of this paper is twofold. We first show that SBCs in the exporting country lead to higher levels of trade protection in the partner country. Secondly, we address the question of whether these countervailing tariffs eliminate the incentives to subsidise production in the foreign country. We demonstrate that protection by the recipient country leads to the hardening of budget constraints in the exporting country. Hence, we show that, when industrial policy fails to impose financial discipline, trade policy can take over this role. In particular, we show that, while the subsidy level is strictly positive in the absence of countervailing protection, the optimal export subsidy in the presence of a retaliative import tariff is negative.

The analysis in this paper is by definition an analysis of the second best. SBCs persist due to the malfunctioning of domestic competition policies and the malfunctioning of bankruptcy laws in transition countries. A solution closer to the first best would be the enforcement of a common competition policy with e.g. the EU in these countries. However, at present competition policy still very much remains a national issue. This implies that other countries, notably trade partners, are left with second-best tools - such as import tariffs - to offset the negative spillovers of SBCs in an international context. This is what we discuss in this paper.

The paper is organised as follows. In section 2 we develop a simple theoretical model which demonstrates that SBCs lead to higher protection in the recipient country and that protection is a device to harden budget softness in the exporting country. A discussion of the results is presented in section 3. A final section comments and concludes.

leads countries to rely on anti-dumping legislation instead. In the latter case, it often suffices to demonstrate injury.

2 Theoretical model

To analyse the effects of SBCs in the presence of a countervailing tariff, we develop a simple three-stage model with two countries. The presence of a countervailing tariff already suggests the timing in the model: SBCs, being a subsidy in disguise, are set before protectionist action is taken. More specifically, consider an international Cournot duopoly where two firms, a home firm and a foreign firm, are each located in their own country. Both firms provide the home market with an identical product, i.e. the home firm is producing only for the local market while the foreign firm is exporting to the home market. We assume the foreign firm is located in a transition country and benefits from a SBC. Thus, in the first stage of the game the foreign government decides on the subsidy level so as to maximise foreign welfare. The home country in the second stage responds by levying a countervailing tariff on the imports from the foreign producer. In the final stage of the game, both producers compete in quantities. In particular, to see whether protection hardens budget constraints, we compare the optimal level of the foreign subsidy under the protectionist regime with the optimal level of subsidisation under 'free-trade', i.e. when the home government unilaterally opts for a zero tariff rate. Our results support the hypothesis of hardening budget constraints under protectionism.

Demand in the home market is given by the following inverse demand function:

$$P = P(\overset{-}{x}, \overset{-}{x}^{f}), \tag{1}$$

where x and x^f refer to home and foreign output respectively and where P refers to the price of the homogeneous product in the home market. Demand is symmetric with respect to home and foreign output and downward sloping in both quantities. The signs on top in expression (1) indicate the direction of the effects of output on the price. Profits of the home and foreign producer respectively equal

$$\begin{aligned} \Pi(x, x^f) &= (P - c)x & (2) \\ \Pi^f(x^f, x, t, s) &= (P - c + s - t)x^f, & (3) \end{aligned}$$

where s stands for the SBC and t represents the level of protection imposed by the home government on imports x^f. Subsidies decrease and tariffs increase the marginal cost of production c[7]. We assume that the marginal cost of production is equal for both firms[8], i.e. $c = c^f$.

When imposing a countervailing tariff, we assume that the home government is mainly concerned with duty revenue and with protecting home producers' interests. Hence the home government's welfare objective function is given by the sum of these two components[9]:

$$G(x, x^f, t) = \Pi(x, x^f) + tx^f. \tag{4}$$

Analogously, the foreign government's welfare depends on the interest of foreign producers[10] minus outlays for SBCs:

$$G^f(x^f, x, t, s) = \Pi^f(x, x^f, t, s) - sx^f. \tag{5}$$

Throughout the paper, we assume no asymmetric information, such that we can solve the model via backward induction. Hence, the equilibrium concept we use is subgame perfection. The next section solves the model under 'free trade', i.e. when there is no countervailing protection. Section 2.2 derives the results when an optimally chosen tariff is in place.

[7]Subsidies could also be aimed at reducing fixed costs. However, in this case s will no longer affect equilibrium quantities and will drop from expression (5). Hence, in this case there are no international spillovers of subsidisation.

[8]It could be argued that $c > c^f$ would be the more intuitive assumption, given the fact that transition economies typically have a comparative labour cost advantage. However, productivity differences or additional transportation costs could offset this cost advantage. Moreover, our results go through under $c > c^f$. For a discussion, see section 3.

[9]In the anti-dumping literature it is commonly argued that consumer interests are ignored by the government when the latter sets a protectionist tariff (e.g. Krueger, 1996). Moreover a similar objective function could be obtained from political economy models of trade policy where consumers are not very well organised. Therefore, we leave consumer surplus out of the analysis. An additional advantage of this assumption is that it simplifies our analysis. A further discussion of this assumption is given in section 3. We could further include relative weights in expression (4), where the social cost of public funds exceeds unity as in Neary (1994). However, given the partial equilibrium nature of the model and to simplify the analysis, we opt for equal weights.

[10]The government in transition countries could arguably have a different objective function, related to a preference for more employment. This would suggest maximisation of sales instead of profits. However, in the long run survival of a firm tends to coincide with profit maximisation. In this respect, our objective function represents a lower bound. Using sales instead of profit maximisation would only strenghten our results.

2.1 'Free trade'

In this section, we solve the model when countervailing protection is absent. This corresponds to the case of 'free trade'[11]. The results derived in this part thus serve as a benchmark against which the results under protectionism will be compared.

Solving the game by backward induction implies that we start by solving the problem of setting quantities. The first order conditions (FOCs) for profit maximization of (2) and (3) are

$$\Pi_x = (P - c) + xP' = 0 \tag{6}$$
$$\Pi^f_{x^f} = (P - c + s) + x^f P' = 0. \tag{7}$$

Equations (6) and (7) define the reaction functions RF and RF^f that are illustrated in Figure 2 for the case of linear demand. The equilibrium quantities[12] for the home and foreign producer in the home market are given by:

$$x^* = x(\overset{-}{s}) \tag{8}$$
$$x^{f\,*} = x^f(\overset{+}{s}). \tag{9}$$

In Figure 2 this corresponds to the intersection point A. We assume that the second order conditions (SOCs) for a profit maximum are satisfied, i.e. demand functions are not too convex:

$$\Pi_{xx} = 2P' + xP'' < 0 \tag{10}$$
$$\Pi^f_{x^f x^f} = 2P' + x^f P'' < 0. \tag{11}$$

The properties imposed on the demand functions further imply that the reaction functions are downward sloping, i.e.

$$\Pi_{xx^f} = P' + xP'' < 0 \tag{12}$$
$$\Pi^f_{x^f x} = P' + x^f P'' < 0. \tag{13}$$

[11] Notice that setting the tariff $t = 0$ reduces the three-stage model in fact to a two-stage model. Notice also that by setting $t = 0$ expressions (3), (4) and (5) are changed accordingly.

[12] Equilibrium values are denoted with a star*.

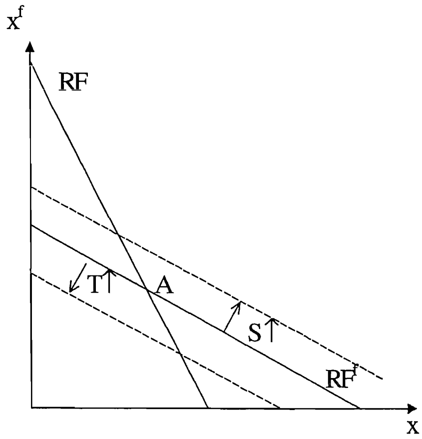

Figure 2: Cournot reaction curves

In the expressions for the equilibrium quantities (8) and (9) we have indicated that SBCs have a positive effect on foreign output in equilibrium $x^{f\,*}$, whereas they lower equilibrium output of the home producer x^*. Moreover, the effect of s is stronger on the foreign output level than on the home producer's output. A rigorous proof is presented in the Appendix, but these properties can equally be understood by looking at Figure 2. Graphically, RF^f is shifted up by a subsidy - for a same level of home output, the foreign producer produces more - such that it leads to a fall of the home output and an increase of foreign output in equilibrium. It is also clear from Figure 2 that the effect on foreign output is larger, given that the home reaction function is steeper than the foreign reaction function.

Having solved for the optimal levels of output, we now allow the foreign government to choose the degree of budget softness as countervailing protection is absent, i.e. $t = 0$. Finding the optimal level of the SBC requires that we maximise foreign welfare G^f with respect to s,

$$G^f(x^f(s), x(s), s) = \Pi^f(x(s), x^f(s), s) - sx^f(s).$$

Taking the FOC and using the envelope theorem, as shown in the Appendix, implies[13]

$$G_s^f = \frac{d\Pi^f}{dx}\frac{dx}{ds} - s\frac{dx^f}{ds} = 0. \tag{14}$$

From this equation, we solve for the optimal level of SBC, as set in the first stage of the game. In the appendix we show that

$$G_s^f \mid_{s=0} > 0 \Longrightarrow s^* > 0, \tag{15}$$

i.e. the optimal subsidy s^* is positive[14]. This suggests that, under 'free trade', SBCs generate positive welfare effects for transition economies.

Proposition 1 *Without countervailing protection, the optimal level of the SBC is strictly positive.*

Intuitively, the outcome of a positive subsidy relates to the profit-shifting argument, as in Brander and Spencer (1985)[15].

2.2 Countervailing tariff

In this section, we allow the home government to respond to the foreign subsidy by setting a countervailing tariff that maximises the home government's welfare.

The first order conditions (FOCs) for profit maximization of (2) and (3) are now

$$\begin{aligned} \Pi_x &= (P - c) + xP' = 0 & (16)\\ \Pi^f_{x^f} &= (P - c + s - t) + x^f P' = 0, & (17) \end{aligned}$$

and determine the associated reaction functions RF respectively RF^f. The SOCs as in (10) and (11) continue to apply, and so do the conditions (12) and

[13] SOCs are dealt with in the appendix.

[14] The properties of the demand functions ensure that the foreign welfare function is single peaked.

[15] Notice that $\frac{d\Pi^f}{ds} > 0$ as shown in the appendix. Graphically, the shift in the reaction function through the subsidy enables the foreign producer to reach a higher isoprofit function. This means that subsidy seeking is rational from the point of view of the foreign producer. From a global welfare point of view, subsidising practices are also efficient, in this model where countervailing duties are absent.

(13) which ensure the reaction functions are negatively sloped. Equilibrium quantities for the home and foreign producer in the home market are now a function of s and t:

$$
\begin{aligned}
x^* &= x(\overset{+}{t}, \overset{-}{s}) && (18)\\
x^{f\,*} &= x^f(\overset{-}{t}, \overset{+}{s}). && (19)
\end{aligned}
$$

The home tariff has a positive effect on the home output in equilibrium x^*, but a negative effect on foreign output in equilibrium $x^{f\,*}$. Graphically, this can be understood since the home tariff shifts the foreign reaction function down, as illustrated in figure 2. Again, the effect of t is stronger on the foreign output than on the home producer's output. The steeper slope of the home reaction function continues to be responsible for this. For a rigorous proof, we refer the reader to the Appendix.

After having solved for the optimal quantities, we now allow the home government to determine the optimal tariff rate. This corresponds to solving stage two of the game. Maximising the home welfare function (4) implies taking the FOC with respect to t. Using the envelope theorem, we get[16]

$$G_t = \frac{d\Pi}{dx^f}\frac{dx^f}{dt} + x^f + t\frac{dx^f}{dt} = 0. \tag{20}$$

Solving for t^* gives the optimal tariff. In the Appendix, we show that t^* is strictly positive, i.e.

$$t^* > 0, \ \forall s. \tag{21}$$

Irrespective of the level or sign of the SBC, the optimal countervailing tariff is strictly positive. Proposition 2 summarizes.

Proposition 2 *When the exporting country has a SBC-policy, a strictly positive countervailing tariff will always increase the welfare of the importing country.*

Through the implicit function rule we further show (see Appendix) that t^* is increasing in the level of the SBC,

[16] SOCs are dealt with in the appendix.

$$\frac{dt(s)}{ds} = \frac{-G_{ts}}{G_{tt}} > 0. \tag{22}$$

This implies that SBCs in the exporting country lead to higher levels of international trade protection by the partner country. Proposition three summarizes this result.

Proposition 3 *Soft budget constraints lead to higher levels of international trade protection.*

We can further prove (see Appendix) that an increase in s leads to a less than proportional increase in t^*, implying

$$0 < \frac{dt(s)}{ds} < 1. \tag{23}$$

In other words, SBCs will not be fully offset by the countervailing import tariff. Proposition four summarizes.

Proposition 4 *Countervailing tariffs are not fully countervailing.*

The final step in solving the model requires that we find the optimal level for the SBC, given the presence of an optimal countervailing tariff. To do so, the foreign government sets the SBC-level that optimizes foreign welfare, given in (5). Taking the FOC and using the envelope theorem implies[17]

$$G_s^f = (P - c - t)\frac{dx^f}{ds} + x^f(\frac{dP}{ds} + (\frac{dP}{dt} - 1)\frac{dt}{ds}) = 0. \tag{24}$$

From this equation, we solve for the optimal level of the SBC. We show in the Appendix that

$$G_s^f \mid_{s=0} < 0 \Longrightarrow s^* < 0, \tag{25}$$

i.e. the optimal subsidy s^* is negative[18]. This suggests that the optimal policy for the exporting country when a countervailing tariff is in place, requires levying a tax on exports, instead of giving a subsidy. Thus, the negative optimal subsidy is in fact an optimal tax. Proposition five summarises.

[17]SOCs are dealt with in the appendix.

[18]The properties of the demand functions ensure that the foreign welfare function is single peaked.

Proposition 5 *Under countervailing protection, the optimal level of subsidisation is strictly negative.*

Our results thus suggest that, with optimal countervailing protection, the incentive for allowing SBCs ceases to exist. Recall that the outcome for s^* was strictly positive when the countervailing tariff was absent. Hence, comparing the optimal subsidy levels leads to the following ranking:

$$s^*_{t=0} > 0 > s^*_{t=t^*}. \tag{26}$$

This suggests that countervailing protection hardens budget constraints in the exporting country. For transition countries, this implies that, when industrial policy fails to impose financial discipline, trade policy can take over this role. This is what proposition six states.

Proposition 6 *Protection hardens budget constraints.*

3 Discussion of the results

So far, we have solved for the optimal values of the decision variables in each of the three stages of the model and have given some intuitive explanation for the outcomes. Two main conclusions arose from the theoretical analysis. Firstly, SBCs lead to higher levels of trade protection. Secondly, trade protection leads to lower levels of SBCs; in other words, trade protection hardens budget constraints.

So far, we have also refrained from concretizing the 'home' and 'foreign' transition country. However, an immediate application of the analysis relates to the relation between the EU and the CEECs.

Our model predicts that EU anti-dumping or countervailing duties against CEEC-imports can impose the necessary financial discipline to which the governments in these transition countries cannot credibly commit themselves. EU-policy may thus be a way of helping these countries in establishing hard budget discipline[19]. Given the political difficulties transition countries face

[19] An additional benefit from having a protectionist EU trade policy ($t^* > 0$) in place, consists of the fact that transition countries are now forced to tax exports - instead of to subsidise them. This gives them an extra source of liquidity.

Notice that the hardening of budget constraints is (only) an externality effect, implied by the model: it arises when all agents act in their own interest, maximising their own welfare.

in enforcing hard budget constraints (Schleifer and Vishny, 1994), external constraints - in this case EU countervailing protection - may be particularly effective. In an empirical study for Italy, Bertero and Rondi (2000) show how the requirements for participating in the European Single Market programme and for entering the European Monetary Union at the time created powerful incentives for disciplining Italian state-owned enterprises in respecting hard budget constraints. Similar external constraints for transition countries, like an EU protectionist trade policy, might be equally effective in constraining firms' behaviour to limit budget softness[20].

Our results should not be abused by those favouring protectionism. Rather, it is due to the deficiency of national competition and bankruptcy policies that second-best responses, like trade policy, ought to secure the hardening of budget constraints. An alternative way to impose harder budget constraints in CEECs would be to enforce a common competition policy with e.g. the EU[21]. However, as long as the CEECs are not fully integrated into the EU, EU competition law does not fully apply[22]. In the absence of a common competition policy, trade policy measures, like anti-dumping or countervailing duties, can be used by the EU to counter any practices, stemming from the malfunctioning of bankruptcy and competition laws in transition countries.

Next, we discuss the robustness of our results.

The home welfare function in our model, does not include consumer surplus. Including it would not change our results qualitatively, but would make the analysis much more tedious[23].

[20] A related issue is that the EU might also be directly preoccupied with fighting SBCs in the CEECs in the light of their integration into the EU, since under EU-law practices such as SBC-subsidisation are strictly ruled out. The latter feature, however, is not incorporated into the model.

[21] Australia and New Zealand adopted a common competition policy when founding a free trade area. Remarkebly, as soon as this common competition policy was in place, anti-dumping measures were abolished. This suggests that common competition policy enforcement and anti-dumping measures could be substitutional devices. For a discussion, see Hoekman, (1998).

[22] From this perspective, and to the extent that common competition policy enforcement is a more effective way to fight SBCs, the immediate integration of the CEECs into the EU would be the more appropriate option. A related issue is that CEECs are not easily willing to give up preferential policies before entering the EU if they cannot yet fully reap all the benefits associated with EU-membership. However, compliance with EU-regulations is exactly one of the preconditions for EU-membership.

[23] Including consumer surplus (CS) would result in a lower value for t^*, as $\frac{dP}{dt} > 0$ and

Another assumption we make is that of equal marginal costs for both countries. In the more intuitive case where the transition country has a comparative cost advantage, i.e. $c > c^f$, all our results go through. The assumption that $c > c^f$ would simply bring about an additional cost asymmetry between the two countries on top of the subsidy. The higher this cost asymmetry, the higher the countervailing tariff, and the more our results are being reinforced.

Finally, our results are robust with respect to the type of competition assumed. The result stated in Proposition 6, namely that protection hardens budget constraints, equally holds for Bertrand competition with differentiated goods. The latter case is fully integrated in the Appendix.

The analysis in section 2 clearly sets out empirically testable predictions. A promising route for future empirical research is to verify, on the basis of firm-level data, whether firms in transition countries that are subject to EU anti-dumping or countervailing duties, show evidence of reduced levels of SBCs over time. The measurement of SBCs could then occur along the lines recently proposed by Schaffer (1998).

4 Conclusion

Despite the many attempts, over the past decade, to reform and to establish a market-based economy, important incentive distortions have continued to exist in many of the transition countries. Hard financial discipline in particular has been difficult to enforce such that SBCs remain an important and widespread problem. Using a three-stage two-country model we analyse how SBCs in an exporting country affect and are affected by an import tariff from the recipient country. This framework allows us to study SBCs in the context of an international duopoly. Two cases are considered: one where import protection is absent and one where the government of the importing country optimally sets a countervailing tariff. Our paper suggests that EU protectionist policy against SBC-imports from transition countries can help to impose financial discipline in these countries. Thus, we argue that an external constraint, such as EU trade policy, can overcome the commitment

lower prices are beneficial to consumers. From Proposition 6, it follows that the optimal value for s^* would now be greater, compared to the level of s^* in the absence of CS. However, the result $s^* \mid_{t=t^*} < s^* \mid_{t=0}$ continues to hold with CS. See e.g. Collie (1991) for an analysis that explicitly incorporates CS.

problem policy-makers in transition economies are facing in reducing various types of SBCs.

References

Bertero E. and L. Rondi (2000), 'Financial pressure and the behaviour of public enterprises under soft and hard budget constraints: evidence from Italian panel data', Journal of Public Economics, Vol. 75, No. 1, p. 73-98.

Brander J. (1995), 'Strategic trade policy', in G. Grossman and K. Rogoff (eds), Handbook of International Economics, Vol. III, Elsevier Science, chapter 27.

Brander J. and B. Spencer (1985), 'Export subsidies and international market share rivalry', Journal of International Economics, Vol. 18, p. 83-100.

Collie D. (1991), 'Export subsidies and countervailing tariffs', Journal of International Economics, Vol. 31, p. 309-24.

Dewatripont M. and E.S. Maskin (1995), 'Credit efficiency in centralized and decentralized economies', Review of Economic Studies, Vol. 62, p. 541-55.

EBRD, European Bank for Reconstruction and Development (1999), Transition Report.

Eaton, J. and G.M. Grossman (1986), 'Optimal Trade and Industrial Policy under Oligopoly', Quarterly Journal of Economics, Vol. 101, No. 2, p. 383-406.

European Commission (1996), '15th Annual Report to the European Parliament on the Community's Anti-Dumping and Anti-Subsidy Activities: 1995, http://europa.eu.int/comm/trade/policy/dumping/reports.htm.

European Commission (2000), '18th Annual Report to the European Parliament on the Community's Anti-Dumping and Anti-Subsidy Activities: 1999, http://europa.eu.int/comm/trade/policy/dumping/reports.htm.

Everaert G.M.M. (2000), 'Soft budget constraints: a survey of theory and evidence', mimeo, LICOS Centre for Transition Economics, K.U.Leuven, Belgium.

Hoekman B. (1998), 'Free trade and deep integration: Anti-dumping and antitrust in regional agreements', World Bank Working Paper 1950, April.

Huang H. and C. Xu (1999), 'Institutions; innovations and growth', American Economic Review, Vol. 89, No. 2, p. 438-443.

Kornai J. (1980), The economics of shortage, Amsterdam, North Holland.

Konings J. and H. Vandenbussche (2000), 'The adjustment of financial ratios in the presence of soft budget constraints: Evidence from Bulgaria', Centre for Applied Economics Discussion Paper 0041, Catholic University of Leuven, September.

Krueger A.O. (1996), 'Review of: Export restraint and the new protectionism: The political economy of discriminatory trade restrictions', Journal of Economic Literature, Vol. 34, No. 1, p. 142-44.

Majumdar S. (1998), 'Slack in the state-owned enterprise: An evaluation of the impact of soft-budget constraints', International Journal of Industrial Organisation, Vol. 16, p. 377-94.

Neary J.P. (1994), 'Cost asymmetries in international subsidy games: should governments help winners or losers?', Journal of International Economics, Vol. 37, No. 3-4, p. 197-218.

Pinto B., V. Drebentsov and A. Morozov (2000), 'Give Macroeconomic Stability and Growth in Russia a Chance: Harden Budgets by Eliminating Non-payments', Economics of Transition, Vol. 8, No. 2, p. 297-324.

Perotti E.C. and O. Carare (1996), 'The evolution of bank credit quality in transition: theory and evidence from Romania', http://www.fee.uva.nl/fm/.

Qian Y. and C. Xu (1998), 'Innovation and Bureaucracy under Soft and Hard Budget Constraints', Review of Economic Studies, Vol. 65, No. 1, p. 151-64.

Roland G. (2000), Transition and Economics: politics, markets and firms, MIT Press, Cambridge, Massachusetts.

Schaffer M.E. (1998), 'Do firms in transition economies have soft budget constraints? A reconsideration of concepts and evidence', Journal of Comparative Economics, Vol. 26, p. 80-103.

Shleifer A. and Vishny R. W. (1994), 'Politicians and Firms', Quarterly Journal of Economics, Vol. 109, No. 4, p. 995-1025.

Vandenbussche H. (1995), 'How can Japanese and Central European exporters to the EU, avoid Anti-dumping duties?', World Competition. Law and Economics Review, Vol. 18, No. 3, p. 55-74.

Vandenbussche H. and R. Veugelers (1999), 'European anti-dumping policy and the profitability of national versus international collusion', European Economic Review, January, 43 (1), p. 1-28.

Venables A.J. (1986), 'Production subsidies, import tariffs, and imperfectly competitive trade', in D. Greenaway and P.K.M. Thakaran (eds), Imperfect competition and international trade: the policy aspects of intraindustry trade, Brighton, Sussex, Harvestor Press, Wheatsheaf Books, p 68-87.

Appendix: Cournot competition

Stage 3: firms compete in quantities

In the final stage of the game, we solve for the optimal quantities by maximizing profits. First order conditions (FOCs) for the home and foreign firm respectively are

$$\Pi_x = (P - c) + xP' = 0 \tag{27}$$

$$\Pi^f_{x^f} = (P - c + s - t) + x^f P' = 0. \tag{28}$$

Given that demand is not too convex, second order conditions (SOCs) for a profit maximum are satisfied, i.e.

$$\begin{aligned} \Pi_{xx} &= 2P' + xP'' < 0 & (29) \\ \Pi^f_{x^f x^f} &= 2P' + x^f P'' < 0. & (30) \end{aligned}$$

From the properties imposed on the demand function, it follows that

$$\begin{aligned} \Pi_{xx^f} &= P' + xP'' < 0 & (31) \\ \Pi^f_{x^f x} &= P' + x^f P'' < 0, & (32) \end{aligned}$$

such that the solutions for x^* and $x^{f\,*}$ will be stable and unique (Brander, 1995). The equilibrium values[24] are function of the remaining variables in the model, i.e.

$$\begin{aligned} x^* &= x(\overset{+}{t}, \overset{-}{s}) & (33) \\ x^{f\,*} &= x^f(\overset{-}{t}, \overset{+}{s}). & (34) \end{aligned}$$

[24]We assume an interior solution, i.e. x^* and $x^{*\,f}$ are strictly positive. See Venables (1986) for a discussion.

Comparative statics' results for s can be found by differentiating both FOCs (27) and (28) with respect to s[25].

$$\frac{d\Pi_x}{ds} = \Pi_{xx}\frac{dx}{ds} + \Pi_{xx^f}\frac{dx^f}{ds} + \Pi_{xs} = 0 \tag{35}$$

$$\frac{d\Pi^f_{x^f}}{ds} = \Pi^f_{x^f x^f}\frac{dx^f}{ds} + \Pi^f_{x^f x}\frac{dx}{ds} + \Pi^f_{x^f s} = 0. \tag{36}$$

As $\Pi_{xs} = 0$ and $\Pi^f_{x^f s} = 1$, we can rewrite this set of equations in matrix notation

$$\begin{pmatrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{pmatrix} \begin{pmatrix} \frac{dx}{ds} \\ \frac{dx^f}{ds} \end{pmatrix} = \begin{pmatrix} 0 \\ -1 \end{pmatrix}. \tag{37}$$

Using Cramer's rule, the solutions for $\frac{dx}{ds}$ and $\frac{dx^f}{ds}$respectively are easy to find, being

$$\frac{dx}{ds} = \frac{\begin{vmatrix} 0 & \Pi_{xx^f} \\ -1 & \Pi^f_{x^f x^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{vmatrix}} = \frac{\Pi_{xx^f}}{\triangle} < 0 \tag{38}$$

$$\frac{dx^f}{ds} = \frac{\begin{vmatrix} \Pi_{xx} & 0 \\ \Pi^f_{x^f x} & -1 \end{vmatrix}}{\begin{matrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{matrix}} = \frac{-\Pi_{xx}}{\triangle} > 0. \tag{39}$$

The determinant in the denominator is positive, i.e. $\triangle = \Pi_{xx}\Pi^f_{x^f x^f} - \Pi_{xx^f}\Pi^f_{x^f x} > 0$, since $|\Pi_{xx}| > |\Pi_{xx^f}|$ and $\left|\Pi^f_{x^f x^f}\right| > \left|\Pi^f_{x^f x}\right|$. From expression (31) we know that $\Pi_{xx^f} < 0$ whereas from (29) $\Pi_{xx} < 0$. This results in a negative effect of s on the optimal quantity x^* and a positive effect of s on the optimal level of output of the foreign producer $x^{f\,*}$. Since $|\Pi_{xx}| > |\Pi_{xx^f}|$, the effect of a subsidy is stronger on the optimal foreign output level, compared to the effect on the home equilibrium output, i.e. $\left|\frac{\partial x}{\partial s}\right| < \frac{\partial x^f}{\partial s}$.

We proceed completely analogously for the effect of a tariff increase on the optimal output levels. In (35) and (36), we know have $\Pi_{xt} = 0$ and

[25] Notice that at this stage $\frac{dt}{ds} = 0$ such that $\frac{dx}{ds}$ corresponds to the direct effect of s on output.

$\Pi^f_{x^f t} = -1$, and we immediately write down the set of equations in matrix notation:

$$\begin{pmatrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{pmatrix} \begin{pmatrix} \frac{dx}{dt} \\ \frac{dx^f}{dt} \end{pmatrix} = \begin{pmatrix} 0 \\ 1 \end{pmatrix}, \tag{40}$$

and solve for $\frac{dx}{dt}$ and $\frac{dx^f}{dt}$ respectively, using Cramer's rule and our knowledge of the signs of the numerators and denominators:

$$\frac{dx}{dt} = \frac{\begin{vmatrix} 0 & \Pi_{xx^f} \\ 1 & \Pi^f_{x^f x^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{vmatrix}} = \frac{-\Pi_{xx^f}}{\triangle} > 0 \tag{41}$$

$$\frac{dx^f}{dt} = \frac{\begin{vmatrix} \Pi_{xx} & 0 \\ \Pi^f_{x^f x} & 1 \end{vmatrix}}{\begin{vmatrix} \Pi_{xx} & \Pi_{xx^f} \\ \Pi^f_{x^f x} & \Pi^f_{x^f x^f} \end{vmatrix}} = \frac{\Pi_{xx}}{\triangle} < 0. \tag{42}$$

Again, we see that $\frac{dx}{dt} < \left|\frac{dx^f}{dt}\right|$ since $|\Pi_{xx}| > |\Pi_{xx^f}|$. Notice that the effect of a tariff increase on the price, is given by

$$\frac{dP}{dt} = P'\frac{dx}{dt} + P'\frac{dx^f}{dt} > 0.$$

This expression is positive, as $P' < 0$ and $\frac{dx}{dt} < \left|\frac{dx^f}{dt}\right|$.

Stage 2: optimal level of taxation

In the second stage of the game under the protectionist case, the home government sets its level of the tariff so as to maximise its total welfare

$$G(t, s) = \Pi(x(t, s), x^f(t, s)) + tx^f(t, s). \tag{43}$$

The FOC implies setting the derivative with respect to t equal to zero.

$$G_t = \frac{d\Pi}{dx}\frac{dx}{dt} + \frac{d\Pi}{dx^f}\frac{dx^f}{dt} + x^f + t\frac{dx^f}{dt} = 0. \tag{44}$$

The first term from (44) drops, since $\frac{d\Pi}{dx} = 0$ from the FOC (27) in stage 3. To see whether the optimal tariff is positive, we look at the sign of G_t at $t = 0$, i.e.

$$G_t \mid_{t=0} = \frac{d\Pi}{dx^f}\frac{dx^f}{dt} + x^f. \tag{45}$$

In (45) $\frac{d\Pi}{dx^f} = xP'$. Given the interior solution and that $P' < 0$, this is negative. Further, we have that $\frac{dx^f}{dt} < 0$ from comparative statics. Since we assume that foreign demand is also positive in equilibrium ($x^{f\,*} > 0$), the optimand function at $t = 0$ is increasing. The properties of our demand functions ensure we have a single-peaked government welfare function. Therefore, the fact that the derivative of G at a zero tariff rate is still increasing, implies that the maximum of G will correspond to a value of $t^* > 0$: we can do better in terms of government welfare to increase the tariff above zero. The optimal tariff is strictly positive in equilibrium.

Proposition 7 *The optimal countervailing tariff is strictly positive.*

An alternative way to show this property is to rewrite FOC (44) to find an expression for t^* :

$$t^* = \frac{-\frac{d\Pi}{dx^f}\frac{dx^f}{dt} - x^f}{\frac{dx^f}{dt}} > 0. \tag{46}$$

The sign of the numerator is negative, that of the denominator is also negative. Thus, the tariff rate is positive.

The SOC still has to be verified. Therefore, we calculate the second derivative of G with respect to t:

$$G_{tt} = 2\frac{dx^f}{dt}. \tag{47}$$

From comparative statics we know that $\frac{dx^f}{dt} < 0$ and the SOC is satisfied:

$$G_{tt} < 0. \tag{48}$$

When we differentiate the FOC (44) with respect to s, the expression we become is

$$G_{ts} = \frac{dx^f}{ds} > 0. \tag{49}$$

Totally differentiating the FOC (44) yields

$$G_t = 0 \Rightarrow \frac{\partial G_t}{\partial t} dt + \frac{\partial G_t}{\partial s} ds = 0. \tag{50}$$

Solving for $\frac{dt}{ds}$ and taking into account that $G_{tt} < 0$ and $G_{ts} > 0$, we have shown that

$$\frac{dt}{ds} = -\frac{G_{ts}}{G_{tt}} > 0. \tag{51}$$

An increase in the level of the subsidy causes an increase in the optimal level of import taxation.

Proposition 8 : *Soft budget constraints lead to higher levels of international trade protection.*

Notice that we can derive an explicit value for $\frac{dt}{ds}$:

$$\frac{dt}{ds} = -\frac{G_{ts}}{G_{tt}} = -\frac{\frac{dx^f}{ds}}{2\frac{dx^f}{dt}} = \frac{\frac{dx^f}{ds}}{2\frac{dx^f}{ds}} = 0.5. \tag{52}$$

This implies that an increase of the level of subsidy gives rise to a less than proportional increase of the tariff,

$$\frac{dt(s)}{ds} < 1, \tag{53}$$

i.e. subsidies are not fully offset by countervailing tariffs.

Proposition 9 *Countervailing tariffs are not fully countervailing.*

Stage 1A: optimal level of the SBC under protectionism

In the final stage of solving the model, we maximise the welfare function of the foreign government

$$G^f(s) = \Pi^f(x(t(s),s), x^f(t(s),s), t(s), s) - sx^f(t(s),s), \tag{54}$$

or alternatively

$$G^f(s) = (P(s) - c - t(s))x^f(s). \tag{55}$$

Again, we set the derivative with respect to s[26]

$$\begin{aligned} G_s^f &= (P-c-t)(\frac{\partial x^f}{\partial t}\frac{dt}{ds}+\frac{\partial x^f}{\partial s})+x^f P'(\frac{\partial x^f}{\partial t}\frac{dt}{ds}+\frac{\partial x^f}{\partial s}) \\ &\quad +x^f P'(\frac{\partial x}{\partial t}\frac{dt}{ds}+\frac{\partial x}{\partial s})-x^f\frac{dt}{ds}, \end{aligned} \tag{56}$$

equal to zero, $G_s^f = 0$. To derive the sign of the optimal level of subsidy, we look at the sign of G_s^f when $s = 0$. From the FOC of profit maximisation, we get that

$$\Pi_{x^f}^f \mid_{s=0} \Rightarrow P-c-t = -x^f P'. \tag{57}$$

Substituting this in the expression for G_s^f , gives that the first and second term drop. We are left with investigating the sign of

$$G_s^f \mid_{s=0} = x^f P'(\frac{\partial x}{\partial t}\frac{dt}{ds}+\frac{\partial x}{\partial s})-x^f\frac{dt}{ds}. \tag{58}$$

We derive whether

$$x^f P'(\frac{\partial x}{\partial t}\frac{dt}{ds}+\frac{\partial x}{\partial s}) \overset{?}{<} x^f\frac{dt}{ds}. \tag{59}$$

Given that $x^f > 0$, we compare

$$P'(\frac{\partial x}{\partial t}\frac{dt}{ds}+\frac{\partial x}{\partial s}) \overset{?}{<} \frac{dt}{ds}. \tag{60}$$

Using the fact that $\frac{\partial x}{\partial t} = -\frac{\partial x}{\partial s}$ and that $\frac{dt}{ds} = 0.5$, we have to show that

$$-P'\frac{\partial x}{\partial t} \overset{?}{<} 1. \tag{61}$$

Substitution of (41) in (61) yields

$$P'\frac{\Pi_{xx^f}}{\triangle} \overset{?}{<} 1. \tag{62}$$

We further substitute the expressions in the numerator and denominator to get

[26] Notice that now, $\frac{dt}{ds} \neq 0$ and therefore $\frac{dx}{ds}$ is composed of both the direct effect of s on x, $\frac{\partial x}{\partial s}$, as well as the indirect effect of s on x through t, $\frac{\partial x}{\partial t}\frac{dt}{ds}$.

$$\frac{P'(xP''+P')}{\Pi_{xx}\Pi^f_{x^fx^f}-\Pi_{xx^f}\Pi^f_{x^fx}} \overset{?}{<} 1. \tag{63}$$

The denominator can be written as

$$(2P'+xP'')(2P'+x^fP'')-(xP''+P')(x^fP''+P'), \tag{64}$$

and simplifies to

$$3(P')^2+x^fP'P''+xP'P'', \tag{65}$$

such that expression (63) can be written as

$$xP'P''+(P')^2<3(P')^2+x^fP'P''+xP'P'', \tag{66}$$

or

$$(P')^2 \overset{!}{<} 3(P')^2+P'P''x^f. \tag{67}$$

Given that demand is not too convex, the second term is not too negative such that the above inequality is satisfied. Consequently, inequality (59) is also satisfied and we have

$$G^f_s\mid_{s=0}<0. \tag{68}$$

Given that the properties of the demand functions yield single-peaked welfare functions, the optimal level of subsidy, in the presence of a countervailing tariff is strictly negative, $s^*<0$.

Finally, one has to check whether the SOC for a maximum is satisfied. Taking the second derivative of G^f with respect to s yields:

$$G^f_{ss}<0, \tag{69}$$

from demand that is well-behaved and implies we have indeed found a maximum.

Stage 1B: optimal level of the SBC under 'free trade'

In the case of 'free trade', the foreign government's welfare function is the following:

$$G^f(s) = \Pi^f(x(s), x^f(s), s) - sx^f(s). \tag{70}$$

Solving the first stage of the model implies that we maximise the welfare function of the foreign government by setting the derivative with respect to s equal to zero:

$$G_s^f = \frac{d\Pi^f}{dx}\frac{dx}{ds} + \frac{\partial \Pi^f}{\partial s} - x^f - s\frac{dx^f}{ds} = 0, \tag{71}$$

where the term

$$\frac{d\Pi^f}{dx^f}\frac{dx^f}{ds} = 0, \tag{72}$$

has dropped from the FOC (71), as a result of the previous FOC (28). Notice that $\frac{\partial \Pi^f}{\partial s} = x^f$ such that the second and third terms also drop from expression (71). To see whether the optimal level of subsidy is positive, we look at the sign of G_s^f when $s = 0$:

$$G_s^f \mid_{s=0} = \frac{d\Pi^f}{dx}\frac{dx}{ds} > 0. \tag{73}$$

From (38) we know that $\frac{dx}{ds} < 0$. Further, we know that $\frac{d\Pi^f}{dx} = x^f P' < 0$. In sum, $G_s^f \mid_{s=0}$ is positive such that the optimal level of subsidisation under the no-protection case is $s^* > 0$.

Alternatively, one can show that the optimal level of subsidisation is positive by explicitly solving for s^* in the FOC (71). We then get:

$$s^* = \frac{\frac{d\Pi^f}{dx}\frac{dx}{ds}}{\frac{dx^f}{ds}} > 0, \tag{74}$$

since both the numerator and denominator are positive.

A final way to show that the optimal level of subsidisation is strictly positive follows the analysis under (57). We can rewrite the FOC of foreign welfare optimisation as

$$G_s^f = (P - c - t)\frac{dx^f}{ds} + x^f P'\frac{dx^f}{ds} + x^f P'\frac{dx}{ds} = 0. \tag{75}$$

Using the FOC of foreign profit maximisation at $s = 0$ in (58), we obtain the expression

$$G_s^f \mid_{s=0} = x^f P' \frac{dx}{ds} > 0,$$

as shown before. Collecting the results from (68) and (73), we get the following ranking:

$$s^*_{t=0} > 0 > s^*_{t=t^*}. \tag{76}$$

Under protectionism, SBCs are hardened.

Proposition 10 *Protection hardens budget constraints.*

Notice that $\frac{d\Pi^f}{ds} = \frac{d\Pi^f}{dx}\frac{dx}{ds} + \frac{\partial \Pi^f}{\partial s} > 0$ as both terms are positive.

Finally, one has to check whether the SOC for a maximum is satisfied. Taking the second derivative of G^f with respect to s yields:

$$G_{ss}^f = -\frac{dx^f}{ds} < 0. \tag{77}$$

Well-behaved demand properties ensure we have indeed found a maximum.

Appendix: Bertrand competition

In the case of Bertrand competition with differentiated products, demand in the home market for the home and foreign product respectively is given by:

$$\begin{aligned} X &= X(\overset{-}{p}, \overset{+}{p}{}^f) & (78) \\ X^f &= X^f(\overset{-}{p}{}^f, \overset{+}{p}). & (79) \end{aligned}$$

Demand is downward sloping with respect to its own price, but positively related to the rival price. We assume that the cross-price effect is weaker than the own price effect. Profits of the home and foreign producer respectively equal

$$\begin{aligned} \Pi(p, p^f) &= (p - c)X & (80) \\ \Pi^f(p^f, p, t, s) &= (p^f - c + s - t)X^f. & (81) \end{aligned}$$

The expressions for the home and foreign government's welfare continue to apply.

Stage 3: firms compete in prices

We solve for the optimal prices by maximizing profits. FOCs for the home and foreign firm respectively are:

$$\Pi_p = (p-c)X_p + X = 0 \tag{82}$$

$$\Pi^f_{p^f} = (p^f - c + s - t)X^f_{p^f} + X^f = 0. \tag{83}$$

Given that the demand functions are not too convex, SOCs for a profit maximum are satisfied, i.e.

$$\begin{aligned} \Pi_{pp} &= (p-c)X_{pp} + 2X_p < 0 & (84)\\ \Pi^f_{p^f p^f} &= (p^f - c + s - t)X^f_{p^f p^f} + 2X^f_{p^f} < 0. & (85) \end{aligned}$$

From the properties imposed on the demand functions, it follows that

$$\begin{aligned} \Pi_{pp^f} &= (p-c)X_{pp^f} + X_{p^f} > 0 & (86)\\ \Pi^f_{p^f p} &= (p^f - c + s - t)X^f_{p^f p} + X^f_p > 0. & (87) \end{aligned}$$

such that the solutions for p and p^* will be stable and unique (Brander, 1995) and will yield expressions that are a function of the remaining variables of the model, i.e.[27]

$$\begin{aligned} p^* &= p(\overset{+}{t}, \overset{-}{s}) & (88)\\ p^{f\,*} &= p^f(\overset{+}{t}, \overset{-}{s}). & (89) \end{aligned}$$

Comparative statics' results for s can be found by differentiating FOCs (86) and (87) with respect to s[28],

[27] We assume an interior solution, i.e. X and X^f are strictly positive. For a discussion, see Venables (1986).

[28] Notice that at this stage $\frac{dt}{ds} = 0$ such that $\frac{dp}{ds}$ corresponds to the direct effect of s on price.

$$\frac{d\Pi_p}{ds} = \Pi_{pp}\frac{dp}{ds} + \Pi_{pp^f}\frac{dp^f}{ds} + \Pi_{ps} = 0 \tag{90}$$

$$\frac{d\Pi^f_{p^f}}{ds} = \Pi^f_{p^f p^f}\frac{dp^f}{ds} + \Pi^f_{p^f p}\frac{dp}{ds} + \Pi^f_{p^f s} = 0. \tag{91}$$

As $\Pi_{ps} = 0$ and $\Pi^f_{p^f s} = X^f_{p^f}$, we can rewrite this set of equations in matrix notation

$$\begin{pmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{pmatrix} \begin{pmatrix} \frac{dp}{ds} \\ \frac{dp^f}{ds} \end{pmatrix} = \begin{pmatrix} 0 \\ -X^f_{p^f} \end{pmatrix}. \tag{92}$$

Using Cramer's rule, the solutions for $\frac{dp}{ds}$ and $\frac{dp^f}{ds}$respectively are easy to find, being

$$\frac{dp}{ds} = \frac{\begin{vmatrix} 0 & \Pi_{pp^f} \\ -X^f_{p^f} & \Pi^f_{p^f p^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{vmatrix}} = \frac{\Pi_{pp^f} X^f_{p^f}}{\triangle} < 0 \tag{93}$$

$$\frac{dp^f}{ds} = \frac{\begin{vmatrix} \Pi_{pp} & 0 \\ \Pi^f_{p^f p} & -X^f_{p^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{vmatrix}} = \frac{-\Pi_{pp} X^f_{p^f}}{\triangle} < 0. \tag{94}$$

The determinant in the denominator is positive, i.e. $\triangle = \Pi_{pp}\Pi^f_{p^f p^f} - \Pi_{pp^f}\Pi^f_{p^f p} > 0$, since $|\Pi_{pp}| > \Pi_{pp^f}$ and $\left|\Pi^f_{p^f p^f}\right| > \Pi^f_{p^f p}$. This can be understood by recognising that $(p-c)\,|X_{pp}| > (p-c)X_{pp^f}$ and $2\,|X_p| > X_{p^f}$, and similarly for $\left|\Pi^f_{p^f p^f}\right| > \Pi^f_{p^f p}$. From expression (90) it follows that $\Pi_{pp^f} > 0$ while foreign demand is downward sloping in its own price, i.e. $X^f_{p^f} < 0$. This results in a negative effect of s on the optimal price p^*. Analogously, from expression (84) $\Pi_{pp} < 0$ while $X^f_{p^f} < 0$ continues to hold. Given the negative sign in front of the expression, the effect of an increase in s on the optimal level of $p^{f\,*}$ is negative. Since $|\Pi_{pp}| > \Pi_{pp^f}$, the effect of a subsidy is stronger on the foreign price, compared to the effect on the home price, i.e. $\left|\frac{dp}{ds}\right| < \left|\frac{dp^f}{ds}\right|$.

We proceed completely analogously for the effect of a tariff increase on the optimal level of the prices. Differentiating the FOCs (82) and (83) with respect to t and keeping in mind that $\Pi_{pt} = 0$ and $\Pi^f_{p^f t} = -X^f_{p^f}$, we can immediately write down the set of equations in matrix notation:

$$\begin{pmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{pmatrix} \begin{pmatrix} \frac{dp}{dt} \\ \frac{dp^f}{dt} \end{pmatrix} = \begin{pmatrix} 0 \\ X^f_{p^f} \end{pmatrix}, \tag{95}$$

and solve for $\frac{dp}{dt}$ and $\frac{dp^f}{dt}$ respectively, using Cramer's rule

$$\frac{dp}{dt} = \frac{\begin{vmatrix} 0 & \Pi_{pp^f} \\ X^f_{p^f} & \Pi^f_{p^f p^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{vmatrix}} = \frac{-\Pi_{pp^f} X^f_{p^f}}{\triangle} > 0 \tag{96}$$

$$\frac{dp^f}{dt} = \frac{\begin{vmatrix} \Pi_{pp} & 0 \\ \Pi^f_{p^f p} & X^f_{p^f} \end{vmatrix}}{\begin{vmatrix} \Pi_{pp} & \Pi_{pp^f} \\ \Pi^f_{p^f p} & \Pi^f_{p^f p^f} \end{vmatrix}} = \frac{\Pi_{pp} X^f_{p^f}}{\triangle} > 0. \tag{97}$$

Again, we see that $\frac{dp}{dt} < \frac{dp^f}{dt}$ since $|\Pi_{pp}| > \Pi_{pp^f}$.

Stage 2: optimal level of taxation

In the second stage of the game, the home government sets the tariff level that maximises total welfare,

$$G(t, s) = \Pi(p(t, s), p^f(t, s)) + tX^f(p(t, s), p^f(t, s)). \tag{98}$$

The FOC implies setting the derivative with respect to t equal to zero:

$$G_t = \frac{d\Pi}{dp}\frac{dp}{dt} + \frac{d\Pi}{dp^f}\frac{dp^f}{dt} + X^f + t(\frac{\partial X^f}{\partial p^f}\frac{dp^f}{dt} + \frac{\partial X^f}{\partial p}\frac{dp}{dt}) = 0. \tag{99}$$

The first term from the expression drops, since $\frac{d\Pi}{dp} = 0$ from the FOC (82) in stage 3. To see whether the optimal tariff is positive, we look at the sign of G_t at $t = 0$, i.e.

$$G_t \mid_{t=0} = \frac{d\Pi}{dp^f}\frac{dp^f}{dt} + X^f. \tag{100}$$

If the domestic firm is to produce anything in equilibrium, i.e. $X > 0$, this implies that $p - c > 0$. Moreover, cross-price effects have been assumed to be positive, i.e. $\frac{\partial X}{\partial p^f} > 0$. Thus, $\frac{d\Pi}{dp^f} > 0$. Further, we have shown that $\frac{dp^f}{dt} > 0$. Since we assume that foreign demand is also positive in equilibrium $(X^f > 0)$, the optimand function at $t = 0$ is increasing. The properties of our demand functions ensure we have a single-peaked government welfare function. Therefore, the fact that the derivative of G at a zero tariff rate is still increasing, implies that the maximum of G will correspond to a value of $t^* > 0$: we can do better in terms of government welfare to increase the tariff above zero. The optimal tariff is strictly positive in equilibrium.

Proposition 11 *The optimal countervailing tariff is strictly positive.*

An alternative way to show this property is to find an expression for t^* from the FOC (99):

$$t^* = \frac{-\frac{d\Pi}{dp^f}\frac{dp^f}{dt} - X^f}{\frac{\partial X^f}{\partial p^f}\frac{dp^f}{dt} + \frac{\partial X^f}{\partial p}\frac{dp}{dt}} > 0. \tag{101}$$

We already know that the sign of the numerator is negative. In the denominator, both $\frac{dp^f}{dt}$ and $\frac{dp}{dt}$ are positive. We also know that cross-price effects are positive and own price effects are negative, i.e. $\frac{\partial X^f}{\partial p^f} < 0$ and $\frac{\partial X^f}{\partial p} > 0$. Moreover, we know that the effect of t on the optimal price is stronger for p^f, i.e. $\frac{dp}{dt} < \frac{dp^f}{dt}$ and cross-price effects are smaller in absolute value than own-price effects, i.e. $\left|\frac{\partial X^f}{\partial p^f}\right| > \frac{\partial X^f}{\partial p}$, such that the denominator is negative. This yields a tariff rate that is positive.

From the properties of demand, the SOC is assumed to be satisfied, i.e. $G_{tt} < 0$.

Totally differentiating the FOC (99) yields:

$$G_t = 0 \Rightarrow \frac{\partial G_t}{\partial t}dt + \frac{\partial G_t}{\partial s}ds = 0. \tag{102}$$

Solving for $\frac{dt}{ds}$ and taking into account that $G_{tt} < 0$ and $G_{ts} > 0$, we have shown that

$$\frac{dt}{ds} = -\frac{G_{ts}}{G_{tt}} > 0. \tag{103}$$

An increase in the level of the subsidy causes an increase in the level of import taxation.

Proposition 12 : *Soft budget constraints lead to higher levels of international trade protection.*

Stage 1A: optimal level of the SBC under protectionism

In the final stage of solving the model, we maximise the welfare function of the foreign government,

$$G^f(s) = \Pi^f(p(t(s),s), p^f(t(s),s), t(s), s) - sX^f(p(t(s),s), p^f(t(s),s)) \quad (104)$$
$$= (p^f - c - t)X^f. \quad (105)$$

Again, we set the derivative with respect to s equal to zero[29]

$$G^f_s = \frac{d\Pi^f}{dp}\left(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s}\right) + \frac{\partial \Pi^f}{\partial t}\frac{dt}{ds} + \frac{\partial \Pi^f}{\partial s} - X^f - s\frac{dX^f}{ds} = 0, \quad (106)$$

where

$$\frac{dX^f}{ds} = \frac{\partial X^f}{\partial p^f}\left(\frac{\partial p^f}{\partial t}\frac{dt}{ds} + \frac{\partial p^f}{\partial s}\right) + \frac{\partial X^f}{\partial p}\left(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s}\right), \quad (107)$$

and where the term

$$\frac{d\Pi^f}{dp^f}\left(\frac{\partial p^f}{\partial t}\frac{dt}{ds} + \frac{\partial p^f}{\partial s}\right) = 0, \quad (108)$$

has dropped from the FOC (106). To derive the sign of the optimal level of subsidy, we look at the sign of G^f_s when $s = 0$.

$$G^f_s \mid_{s=0} = \frac{d\Pi^f}{dp}\left(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s}\right) - X^f\frac{dt}{ds} \overset{?}{<} 0. \quad (109)$$

From (103) we know that $\frac{dt}{ds} > 0$. Further, foreign demand is nonnegative in equilibrium, i.e. $X^f > 0$. Therefore $(p^f - c - t + s) > 0$. If not, it would

[29] Notice that now, $\frac{dt}{ds} \neq 0$ and therefore $\frac{dp}{ds}$ is composed of both the direct effect of s on p, $\frac{\partial p}{\partial s}$, as well as the indirect effect of s on p through t, $\frac{\partial p}{\partial t}\frac{dt}{ds}$.

be better not to produce at all, i.e. $X^f = 0$. By the assumption of cross-price effects, $\frac{\partial X^f}{\partial p} > 0$. What remains to be shown, for (109) to hold, is that $\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s} < 0$. In other words, we want to show that

$$\frac{-\Pi_{pp^f} X^f_{p^f}}{\triangle} \frac{(-1)G_{ts}}{G_{tt}} + \frac{\Pi_{pp^f} X^f_{p^f}}{\triangle} \; < \; 0 \tag{110}$$

$$\frac{\Pi_{pp^f} X^f_{p^f}}{\triangle}(1 + \frac{G_{ts}}{G_{tt}}) \; < \; 0. \tag{111}$$

From (93) we know that the first factor of the above expression is negative. Therefore, it has to be shown that

$$(1 + \frac{G_{ts}}{G_{tt}}) \overset{?}{>} 0 \tag{112}$$

$$G_{ts} \overset{?}{<} -G_{tt}. \tag{113}$$

Writing out the expressions for G_{ts} and G_{tt} yields:

$$\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s} + \frac{\partial X^f}{\partial p}\frac{\partial p}{\partial s} \overset{?}{<} (-2)(\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial t} + \frac{\partial X^f}{\partial p}\frac{\partial p}{\partial t}) \tag{114}$$

$$\frac{\partial X^f}{\partial p^f}\frac{(-1)\Pi_{pp} X^f_{p^f}}{\triangle} + \frac{\partial X^f}{\partial p}\frac{\Pi_{pp^f} X^f_{p^f}}{\triangle} \overset{!}{<} 2\frac{\partial X^f}{\partial p^f}\frac{(-1)\Pi_{pp} X^f_{p^f}}{\triangle} + 2\frac{\partial X^f}{\partial p}\frac{\Pi_{pp^f} X^f_{p^f}}{\triangle} \tag{115}$$

Therefore, we have proven that

$$G^f_s \mid_{s=0} = \frac{d\Pi^f}{dp}(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s}) - X^f \frac{dt}{ds} \overset{!}{<} 0. \tag{116}$$

Given the properties of the demand functions, the foreign welfare function can be assumed to be single peaked. The above findings imply that the optimal level of subsidy is negative: $s^* < 0$. The proofs also imply that an increase in the subsidy level gives rise to a less than proportional increase in the tariff,

$$(1 + \frac{G_{ts}}{G_{tt}}) > 0 \Longrightarrow \frac{dt(s)}{ds} < 1, \tag{117}$$

i.e. subsidies are not fully offset by countervailing tariffs.

Proposition 13 *Countervailing tariffs are not fully countervailing.*

Alternatively, one can show that the optimal level of subsidisation is negative by explicitly solving for s^* in the FOC (106). We then get

$$s^* = \frac{\frac{d\Pi^f}{dp}(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s}) - X^f\frac{dt}{ds}}{\frac{\partial X^f}{\partial p^f}(\frac{\partial p^f}{\partial t}\frac{dt}{ds} + \frac{\partial p^f}{\partial s}) + \frac{\partial X^f}{\partial p}(\frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s})} < 0. \tag{118}$$

The numerator of s^* bears a negative sign. The denominator is positive, since $\left|\frac{\partial X^f}{\partial p^f}\right| > \frac{\partial X^f}{\partial p}$ and $\frac{\partial p^f}{\partial t}\frac{dt}{ds} + \frac{\partial p^f}{\partial s} < \frac{\partial p}{\partial t}\frac{dt}{ds} + \frac{\partial p}{\partial s} < 0$. The holds since

$$\begin{aligned}\frac{\Pi_{pp}X^f_{p^f}}{\triangle}(\frac{dt}{ds} - 1) &< \frac{(-1)\Pi_{pp^f}X^f_{p^f}}{\triangle}(\frac{dt}{ds} - 1)\\ \Pi_{pp} &< (-1)\Pi_{pp^f}.\end{aligned}$$

Finally, the demand properties ensure we have a maximum: SOCs are satisfied.

Stage 1B: optimal level of the SBC under 'free trade'

In the case of 'free trade', the foreign government's welfare function is the following:

$$G^f(s) = \Pi^f(p(s), p^f(s), s) - sX^f(p(s), p^f(s)). \tag{119}$$

Solving this stage of the model implies that we maximise the welfare function of the foreign government by setting the derivative with respect to s equal to zero

$$G^f_s = \frac{d\Pi^f}{dp}\frac{dp}{ds} + \frac{\partial \Pi^f}{\partial s} - X^f - s\frac{dX^f}{ds} = 0, \tag{120}$$

where

$$\frac{dX^f}{ds} = \frac{\partial X^f}{\partial p^f}\frac{dp^f}{ds} + \frac{\partial X^f}{\partial p}\frac{dp}{ds}, \tag{121}$$

and where the term

$$\frac{d\Pi^f}{dp^f}\frac{dp^f}{ds} = 0, \tag{122}$$

has dropped from the FOC (120). To see whether the optimal level of subsidy is positive, we look at the sign of G^f_s when $s = 0$:

$$G^f_s \mid_{s=0} = \frac{d\Pi^f}{dp}\frac{dp}{ds} < 0. \tag{123}$$

From (93) we know that $\frac{dp}{ds} < 0$. Again, we assume that foreign demand is nonnegative in equilibrium, i.e. $X^f > 0$. Therefore, $(p^f - c - t + s) > 0$. If not, it would be better not to produce at all, i.e. $X^f = 0$. By the assumption of cross-price effects $\frac{\partial X^f}{\partial p} > 0$. In sum, $G^f_s \mid_{s=0}$ is negative, i.e.

$$G^f_s \mid_{s=0} = \frac{d\Pi^f}{dp}\frac{dp}{ds} < 0. \tag{124}$$

Given the properties of the demand functions, the foreign welfare function can be assumed to be single peaked. The above findings thus imply that the optimal level of subsidy is negative. $s^* < 0$.

Alternatively, one can show that the optimal level of subsidisation is negative by explicitly solving for s^* in the FOC (120). We then get

$$s^* = \frac{\frac{d\Pi^f}{dp}\frac{dp}{ds}}{\frac{\partial X^f}{\partial p^f}\frac{dp^f}{ds} + \frac{\partial X^f}{\partial p}\frac{dp}{ds}} < 0. \tag{125}$$

The numerator of s^* bears a negative sign. The denominator is positive, since $\left|\frac{dp^f}{ds}\right| > \left|\frac{dp}{ds}\right|$ and $\left|\frac{\partial X^f}{\partial p^f}\right| > \frac{\partial X^f}{\partial p}$.

Finally, one has to check whether the SOC for a maximum is satisfied. Taking the second derivative of G^f with respect to s yields

$$G^f_{ss} < 0. \tag{126}$$

which implies we have indeed found a maximum.

Comparison between levels of subsidy

Although both levels of subsidy were negative in the optimisation exercises, we still van show that subsidisation is looser under the 'free trade' case. We can show that

$$s^*_{t=0} > s^*_{t=t^*}. \tag{127}$$

We cross-multiply the numerators and denominators of the expressions for $s^*_{t=0}$ and $s^*_{t=t^*}$, (118) and (125) respectively and become

$$\begin{aligned}&\frac{d\Pi^f}{dp}\frac{\partial p}{\partial s}(\frac{\partial X^f}{\partial p^f}(\frac{\partial p^f}{\partial t}\frac{dt}{ds}+\frac{\partial p^f}{\partial s})+\frac{\partial X^f}{\partial p}(\frac{\partial p}{\partial t}\frac{dt}{ds}+\frac{\partial p}{\partial s}))\overset{?}{>}\\&(\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s}+\frac{\partial X^f}{\partial p}\frac{\partial p}{\partial s})(\frac{d\Pi^f}{dp}(\frac{\partial p}{\partial t}\frac{dt}{ds}+\frac{\partial p}{\partial s})-X^f\frac{dt}{ds}).\end{aligned} \tag{128}$$

This expression can be simplified as follows

$$\begin{aligned}&\frac{d\Pi^f}{dp}\frac{\partial p}{\partial s}\frac{\partial X^f}{\partial p^f}(\frac{\partial p^f}{\partial t}\frac{dt}{ds}+\frac{\partial p^f}{\partial s})\overset{?}{>}\\&\frac{d\Pi^f}{dp}(\frac{\partial p}{\partial t}\frac{dt}{ds}+\frac{\partial p}{\partial s})\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s}-(\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s}+\frac{\partial X^f}{\partial p}\frac{\partial p}{\partial s})X^f\frac{dt}{ds}.\end{aligned} \tag{129}$$

Collecting terms yields

$$\begin{aligned}&\frac{d\Pi^f}{dp}\frac{\partial X^f}{\partial p^f}(\frac{\partial p}{\partial s}(\frac{\partial p^f}{\partial t}\frac{dt}{ds}+\frac{\partial p^f}{\partial s})-\frac{\partial p^f}{\partial s}(\frac{\partial p}{\partial t}\frac{dt}{ds}+\frac{\partial p}{\partial s}))\overset{?}{>}\\&-(\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s}+\frac{\partial X^f}{\partial p}\frac{\partial p}{\partial s})X^f\frac{dt}{ds}.\end{aligned} \tag{130}$$

The expression on the right hand side of the inequality is strictly negative, since $\frac{\partial X^f}{\partial p^f}\frac{\partial p^f}{\partial s}+\frac{\partial X^f}{\partial p}\frac{\partial p}{\partial s}>0$ as shown before, $\frac{\partial t}{\partial s}>0$ from (103) and foreign demand is positive, i.e. $X^f>0$. On the left hand side, we already know that $\frac{d\Pi^f}{dp}$ is positive, whereas $\frac{\partial X^f}{\partial p^f}$ is negative. The sign of the last factor still has to be verified. As both terms are positive, it is unclear which expression is the bigger one. If we can show that

$$\frac{\partial p}{\partial s}(\frac{\partial p^f}{\partial t}\frac{\partial t}{\partial s}+\frac{\partial p^f}{\partial s})-\frac{\partial p^f}{\partial s}(\frac{\partial p}{\partial t}\frac{\partial t}{\partial s}+\frac{\partial p}{\partial s})\leq 0, \tag{131}$$

$s^*_{t=0} > s^*_{t=t^*}$ is satisfied. Using the comparative statics' results, we can rewrite (131) as

$$\frac{\Pi_{pp^f}X^f_{p^f}}{\triangle}(\frac{(-1)\Pi_{pp}X^f_{p^f}}{\triangle}(1-\frac{\partial t}{\partial s})) \overset{?}{\leq} \frac{(-1)\Pi_{pp}X^f_{p^f}}{\triangle}(\frac{\Pi_{pp^f}X^f_{p^f}}{\triangle}(1-\frac{\partial t}{\partial s})). \quad (132)$$

It immediately follows that

$$\Pi_{pp^f}(-1)\Pi_{pp} \overset{!}{\leq} (-1)\Pi_{pp}\Pi_{pp^f}, \quad (133)$$

since both expressions in (132) are equal. Thus, we have $s^*_{t=0} > s^*_{t=t^*}$: subsidisation is looser under the 'free trade' case. Protection hardens budget constraints.

Proposition 14 *Protection hardens budget constraints.*