

**Short-run policy commitment and international rivalry under
uncertainty:
“More harm than good?”**

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Abstract: This paper examines optimal trade policy for a government that has commitment power for one period, but cannot commit to its policy in the longer run. We construct a two-period oligopoly model, with a home and a foreign firm choosing capital and output. Period one is characterised by demand uncertainty, which is resolved in period two. Firms' investment timing is endogenous. We show that firms will invest early to strategically manipulate the subsidy policy of the government. When a government can commit for one period only, its policy may become self-defeating and the country would gain from free trade.

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1. Introduction

It is well known that commitment power is often a necessary –though not sufficient– condition for the government to implement its policies successfully¹. A government’s ability to commit lends credibility to its policies. Without it, private agents in general and firms in particular may be able to reshape, through their own actions, the government’s policies to their own –although usually not to their country’s– advantage. Rodrik (1992) reserves the term “autonomous” or “hard” states for governments with commitment power, while those that lack commitment power are referred to as “subordinate” or “weak” states. The policy packages of an autonomous state are typically successfully implemented and benefit the country, while those of a subordinate state are never implemented or tend to be altered in ways that could be harmful to the country².

The black and white contrast between hard and weak states highlights the important differences between these two extreme regimes in a clear way. However, in practice policy regimes are likely to lie somewhere between these two poles. In particular, governments may have commitment power in the short-run, but lack the ability to commit to their policies in the long run (extending Rodrik’s terminology, we could refer to this type of government as the “semi-autonomous” state). Should governments put in place policy schemes if they can only commit to them in the short run, or should they adhere to a laissez-faire policy instead? This question is particularly relevant to countries that, although they have reached a certain level of development, are still characterised by a significant degree of instability, either economically or politically or both. The most prominent examples are the newly emerging economies of South-East Asia and the Eastern European transition economies. To firmly establish their firms as players in global markets, the –often relatively unstable– governments of these countries may feel they have sufficient credibility to successfully pursue export promotion policies. That the temptation to adopt such policies is great is reflected in the fact that even highly economically

¹ The importance of commitment power in policy design has been widely discussed, not least in the strategic trade and industrial policy literature (see, for instance, Brander (1995) and Leahy and Neary (2000)) and in the macroeconomic policy literature.

² Rodrik (1992) contrasts the Park regime in Korea with the earlier Rhee regime. Under Park’s rule, most of the government’s decisions affecting business were implemented, while under Rhee most of the government decisions were either implemented in modified form or were seldom thoroughly implemented (based on survey evidence reported by Jones and Sakong, 1980).

developed nations have –often covertly– embraced such policies³. But, it is not clear *a priori* whether governments with limited credibility and hence limited commitment power are capable of improving their country’s welfare beyond the welfare level attained under a free trade policy.

More specifically, intervention by a “semi-autonomous” state may not benefit a country when the private sector can commit to some of its actions *before* policy is set. One important way through which firms can obtain commitment power is through irreversible investment. It is well understood that firms may have an incentive to invest early in order to affect the strategic environment in which future competition takes place⁴. But, firms that invest early incur a cost. Since investment decisions are typically made under uncertainty about future economic conditions, early investment reduces a firm’s capital flexibility, whereas investment delay has the advantage of retaining flexibility⁵. It is not hard to show that, if firms delay investing until *after* the government sets its policy, they cannot affect it and intervention must yield higher welfare than a laissez-faire regime. We argue, however, that the government’s inability to commit long term to its policy strengthens firms’ incentives to invest early, since doing so enables them to manipulate the government’s policy⁶. Hence, the absence of long-term government commitment can make policy schemes self-defeating.

We show this using a two-period model in an open economy set-up. In period one, there is uncertainty about future demand, which is resolved at the start of period two. Two international rivals, a “home” and a “foreign” firm, compete in the same third market and produce in period two. Prior to exporting in period two, they invest in

³ Abraham, Couwenberg and Dewit (1992) and Stephens (1999) show that export credit insurance schemes were extensively subsidised during the late 1980s and early 1990s, in spite of the fact that the WTO Subsidy Code prohibited this practice.

⁴ The implications of the irreversibility of investment have been widely discussed, not least in the industrial organisation literature in the context of strategic commitment. Tirole (1988) provides a textbook treatment of this issue.

⁵ See Dixit and Pindyck (1994) for a comprehensive discussion of the option value associated with investment delay.

⁶ In their strategic trade policy model, Grossman and Maggi (1998) show that free trade can be superior to a strategic export policy for the country. They assume that the home firm *always* invests early and that the foreign firm does not invest. In our paper, the investment timing of *both* firms is endogenous and is –as we will show– influenced radically by the existence of the policy scheme.

capital and can do this either in period one or in period two⁷. While firms' investment decisions are irreversible, the policies of a government without long-term commitment power are not. We assume that the government has commitment power in the short run only. In the model, the government cannot commit to a policy for longer than one period. It is for this reason that it cannot credibly set its export policy in period one⁸. To illustrate why this is the case, suppose the government were, nonetheless, to announce a policy in period one. Since firms would be aware of the fact that the government cannot guarantee that there will be no subsidy readjustments in period two, they would rightly perceive the policy announced in period one as "cheap talk" and hence ignore it. In short, any government attempt by to set its policy earlier than in period two is bound to fail. The government's limited credibility forces it to determine its policy in period two. This is, nevertheless, not without advantages: unlike policy set in period one, the policy will now be chosen with full knowledge of demand. However, we show that, in spite of this advantage, a "semi-autonomous" government's trade policy may reduce the country's welfare below the free trade welfare level by affecting the investment-timing decision of both the home and the foreign firm.

In section 2, we describe the model. Section 3 examines firms' investment timing under free trade, thus providing a benchmark against which to assess the trade policy of the government. In section 4, we discuss firms' investment timing when the home government is policy active. Section 5 examines the welfare implications of the government's policy by comparing it to the free trade case. Some possible extensions of the basic model are presented in section 6. Section 7 concludes.

2. The model

Consider a home and a foreign firm, producing identical goods, which are exported to a third market. Firms compete *à la* Cournot. There are two periods. Period one ($t=1$)

⁷ The theme of commitment versus flexibility in a strategic environment has been studied in different models. Some authors endogenised the investment timing of one firm only (for instance, Appelbaum and Lim (1985)), while others explored endogenous timing in output games with uncertainty (examples are Spencer and Brander (1992) and Sadanand and Sadanand (1996)).

⁸ Dewit and Leahy (2003) present a model in which the government does have long-run commitment power. Such a government never has to worry about being manipulated by firms as investment *always* takes place after policies are set.

is characterised by uncertainty about future demand, which is resolved at the start of period two ($t=2$). Demand is given by:

$$p = a - b(x + y) + u \quad (1)$$

where p denotes the price, x and y are the respective output levels of the home and the foreign firm, a and b are positive constants; u is a stochastic variable, defined over the closed interval $[\underline{u}, \bar{u}]$, with mean zero and variance σ^2 .

Production always takes place in period two, after actual demand is observed. Prior to production, both firms invest in capital: firms invest *either* in period one *or* in period two and are assumed to be risk neutral⁹. The total capital cost of investment for the home firm is given by ik , where i denotes the per unit capital cost and k stands for the home firm's capital level¹⁰. The corresponding variables for the foreign firm are starred. Production costs are given by $(c_0 - \sqrt{k})x$ for the home firm and by $(c_0^* - \sqrt{k^*})y$ for the foreign firm (c_0 and c_0^* are positive constants). Thus, capital investment reduces marginal production costs at a decreasing rate. Unless otherwise stated, we assume that firms are (ex ante) symmetric (i.e., $c_0 = c_0^*$ and $i = i^*$).

We assume that the home government is policy active and puts an export subsidy scheme into place. So, the home and the foreign firm's profits are given by

$$\mathbf{p} = (p + s)x - (c_0 - \sqrt{k})x - ik \quad (2a)$$

and

$$\mathbf{p}^* = py - (c_0^* - \sqrt{k^*})y - i^*k^* \quad (2b)$$

respectively, where s is the export subsidy per unit¹¹. The government's objective is to maximise home welfare (W), consisting of the home firm's profits net of subsidy costs, or

$$W = \mathbf{p} - sx \quad (3)$$

⁹ Risk aversion complicates the analysis significantly, but without changing the qualitative nature of our results. The approach in this paper is commonly adopted in the literature (see, for instance, Spencer and Brander (1992) and Sadanand and Sadanand (1996)).

¹⁰ Thus, we implicitly assume that the cost of capital is the same in $t=1$ and in $t=2$. The model can be easily extended to allow for different capital costs across time periods. We discuss this briefly in section 6.

¹¹ The discount factor is set equal to one. The effects of extending the model to allow for discounting future profits are discussed in section 6.

With both firms choosing the timing of their investment, there are four possible investment-timing combinations: both firms commit early to investment (i.e., invest in $t=1$), the home firm commits early while the foreign firm delays, the foreign firm commits early while the home firm delays, and both firms delay. C denotes early investment commitment by the home firm, while D indicates the home firm's decision to delay investment. The corresponding investment timing decisions for the foreign firm are starred.

We will show that the investment timing equilibrium that emerges depends, among other things, on the policy stance of the government. Crucially, we assume here that the latter can only commit to its policy in the short run. Our model reflects the government's inability to commit long-term: unlike a government with long-run commitment power, it sets its subsidy at the start of period two¹².

The firms and the government play a two-period four-stage game, which is depicted in Figure 1. In period one, firms that choose to invest early, choose their capital level (stage one). In period two, the government sets its export subsidy (stage two). Subsequently, firms that delayed investment, choose their capital level in stage three¹³. Outputs are always simultaneously chosen in the last stage of the game. Each firm maximises its profits in period two, implying that the respective outputs for the home and foreign firm are equal to

$$x = [2A - A^* + 2\sqrt{k} - \sqrt{k^*} + u]/3b \quad (4a)$$

and

$$y = [2A^* - A + 2\sqrt{k^*} - \sqrt{k} + u]/3b \quad (4b)$$

with $A \equiv a - c_0$ and $A^* \equiv a - c_0^*$. Expressions (4a) and (4b) can be used to show that a firm's output flexibility is determined both by its own and its rival's investment timing. Consider the home firm. If it invests in $t=2$, it maximises profits choosing its capital level after period-two demand has been observed, with

¹² If the government had long-run commitment power, it would set the subsidy at the start of period one (see Dewit and Leahy (2003), for a complete analysis of the long-run commitment case).

¹³ The assumption that firms cannot invest in both periods allows us to make the trade-off between early investment commitment and investment flexibility as sharp as possible. Although it is true that some types of investment can relatively easily be augmented, there are other types of investment that are characterised by indivisibilities (for instance, after a factory of a certain size has been built, it may not

$$\sqrt{k} = \frac{4}{3}hb x \quad \text{and} \quad h \equiv \frac{1}{2bi} \quad (5)$$

If the home firm delays, its capital level increases in u (since $\partial x / \partial u > 0$ from expression (4a), we know $d\sqrt{k} / du > 0$ from expression (5)), thereby magnifying its output response to a change in u . By contrast, if the home firm invests in $t=1$, it chooses its capital based on its expectation of period-two demand and hence its capital level is fixed ($d\sqrt{k} / du = 0$). So, the home firm's output flexibility (captured by dx / du) is larger with investment delay than with early investment commitment. The home firm's investment timing also affects its rival's output flexibility. If the home firm delays investment, the foreign firm's output flexibility is dampened; the reason for this lies in the fact that home capital investment, which increases in u , lowers foreign output ($dy / d\sqrt{k} < 0$ from expression (4b)). Hence, the foreign firm's output flexibility is larger when the home firm invests early than when the latter delays investment¹⁴.

[Figure 1 about here]

3. Free trade

In this section we look at firms' investment timing without government policy. One could interpret this benchmark as the case in which the government is, by signing up to international agreements, committed to free trade (i.e., $s = 0$). Firms face a trade-off between committing early to a particular capital level (in $t=1$) and delaying investment until period two. Because of the uncertainty in period one, firms have an incentive to wait and delay investment until period two when they can choose their capital level flexibly, in line with observed demand.

However, delaying investment may entail strategic disadvantages. Take the perspective of the home firm. If its foreign rival delays, the home firm obtains investment leadership. It maximises expected profits, choosing

be easy to increase its size later without incurring significant costs). In section 6, we discuss the implications of introducing the possibility that firms can invest in both periods.

¹⁴Note that, from (4a) and (4b), outputs are linear in u and hence profits (which are proportional to the square of a firm's output) are convex in u , implying that expected profits increase in \mathbf{s}^2 .

$$\sqrt{k^{CD*}} = \frac{4}{3} \mathbf{y}^* \mathbf{hbEx}^{CD*} \quad (6)$$

with $\mathbf{y}^* > 1$ (\mathbf{y}^* is defined in Table 1). Because capital levels are strategic substitutes, the home firm can, through investing before its rival, force the latter to choose a lower capital level, which in turn gives the home firm a strategic advantage when outputs are chosen in the final stage. If the home firm chooses to delay investment, it foregoes this strategic benefit. Furthermore, if the rival commits early to capital, investment delay forces the home firm to accept the strategically inferior role of investment follower.

Firms will delay only if expected profits from doing so exceed those from early commitment. The capital and expected profit levels for the four investment-timing combinations are reported in Table 1.

[Table 1 about here]

The commitment-flexibility trade-off is now examined. We first look at a firm's investment timing, *given* rival commitment, and subsequently explore a firm's incentives to commit early *given* rival delay. Then, we discuss the investment-timing pattern that emerges when both firms choose when to invest.

Given delay by its rival, a firm faces a trade-off between commitment and delay. If it invests early, committing to capital in period one, it benefits from the first-mover advantage associated with investment leadership. However, early commitment implies a loss in flexibility, which becomes larger as the level of uncertainty in period one rises. As a result of this trade-off, early investment will be chosen at low levels of uncertainty, whereas delay will be preferred as the uncertainty level exceeds a critical threshold.

Given rival commitment, there is no trade-off between early investment and investment delay. For convenience and without loss of generality (because of the symmetry assumption) we adopt the home firm's perspective to explain this. If the foreign rival invests early, it commits to a particular capital level k^* . Given k^* , the

home firm will compare $Ep(r_1(k^*), k^*)$ to $Ep(r_2(k^*), k^*)$, where $r_1(k^*)$ and $r_2(k^*)$ respectively stand for the home firm's first-period and second-period best response to k^* . Because its rival's capital level is irrevocably fixed at k^* , the home firm will neither gain strategically by committing in period one nor lose strategically by delaying investment. However, it will be more flexible if it delays. Note that, because of symmetry, the same reasoning applies to the foreign firm. This implies that early investment by both firms can never be an equilibrium under free trade for $s^2 > 0$. In fact, given rival commitment, a firm will assume the role of investment follower under free trade¹⁵.

The investment-timing pattern that emerges under free trade is depicted in Figure 2. At a large range of uncertainty, both firms choose to delay¹⁶. Only when uncertainty is very low does investment leadership, either of the home or of the foreign firm, occur¹⁷.

[Figure 2 about here]

4. Investment timing with short-run policy commitment

In this section we solve the game when the home government is policy active. The optimal export subsidy is obtained by maximising welfare in period two (see expression (3)). If the home firm invests early, the subsidy is chosen *after* the home firm has set its capital level. The optimal subsidy is then given by

$$s = p_y \frac{dy/ds}{dx/ds} \tag{6a}$$

¹⁵ Beside (C, D^*) and (D, C^*) , (C, C^*) could also be an equilibrium at $s^2 = 0$. However, even a minute degree of uncertainty would cause the equilibrium (C, C^*) to collapse.

¹⁶ Risk aversion raises the range of uncertainty over which investment flexibility is preferred to early investment commitment.

¹⁷ In a game in which firms choose whether to produce (rather than invest) in period one or period two, Sadanand and Sadanand (1996) obtain similar timing patterns. By contrast, Spencer and Brander (1992) do not find leadership equilibria. This is because in their paper, unlike in Sadanand and Sadanand or in this paper, early investment involves a "two-step" form of commitment; more particularly, they introduce an additional stage in period one; in stage one of period one firms decide to produce early or not and if they produce early, they choose their output level in the second stage of period one. For a thorough discussion of the difference between the alternative ways of modelling commitment, see Dewit and Leahy (2002).

with $\mathbf{p}_y = -bx$. Note that $\frac{dy/ds}{dx/ds} = dy/dx$, the slope of the foreign firm's output reaction function, is smaller (in absolute value) when the foreign firm delays than when the latter invests early¹⁸. If the home firm delays investment, then the subsidy is chosen *before* the home firm has fixed its capital level and is given by

$$s = \mathbf{p}_y \frac{dy/ds}{dx/ds} + \mathbf{p}_k \frac{dk/ds}{dx/ds} \quad (6b)$$

Note that $\mathbf{p}_k = -\mathbf{p}_y \frac{dy}{dk} < 0$, reflecting the fact that the home firm strategically over-invests when it chooses its capital. In contrast to the case in which the home firm invests early and thus investment is sunk before the subsidy is set, the government can now correct for the socially costly over-investment. This correction is captured by the last term in (6b), which is negative, thus reducing the optimal subsidy level. Again, the slope of the foreign firm's output reaction function will depend on the investment timing decision of the foreign firm.

While the subsidy is not always set before capital is chosen, it is always fixed prior to production. Hence, the subsidy is chosen in the tradition of the strategic trade policy models, shifting profits from the foreign rival towards the home firm. It effectively gives the home country a first-mover advantage in output. So, s is, not surprisingly, positive but different for each investment-timing combination, with $E_s^{CD*} > E_s^{CC*} > E_s^{DD*} > E_s^{DC*}$ ¹⁹. For each investment-timing combination, s is increasing in u ($ds/du > 0$): the subsidy is large in “good times” but is low in “bad times”. Importantly, because s is increasing in u , the home firm's output flexibility is always larger than its output flexibility in the corresponding investment-timing

¹⁸ The slope of the foreign firm's output reaction function is $-1/2$ with foreign investment in $t=1$ and $-\frac{1}{2(1-(1/3bi^*))}$ with foreign investment in $t=2$. This is true regardless of whether the home firm invests in $t=1$ or in $t=2$.

¹⁹ The subsidy increases in the home firm's price-cost margin. Since $k^{CD*} > k^{CC*}$, the home firm's cost reduction brought about by capital investment is larger if the firm is the investment leader than when both firms invest early. Also, $k^{DD*} > k^{DC*}$, so the home firm's cost reduction brought about by capital investment is smaller when the firm is an investment follower compared to when it invests at the same time as its rival. Because the optimal subsidy increases in the home firm's price-cost margin, $E_s^{CD*} > E_s^{CC*}$ and $E_s^{DD*} > E_s^{DC*}$. Furthermore, since firms choose capital prior to output, they strategically over-invest. Only when both firms delay, can the home government mitigate this social inefficiency by setting a lower subsidy (which will make the home firm choose a lower capital level); hence, $E_s^{CC*} > E_s^{DD*}$.

combination under free trade, while the foreign firm's is smaller²⁰. The equilibrium capital, subsidy and expected profit levels under the policy regime are reported in Table 2.

[Table 2 about here]

Before solving the game in section 4.3, it proves useful to discuss whether and how the home government's subsidy scheme changes the trade-off between "commitment" and "flexibility" for each firm. The reasons why each firm may want to commit (or to delay instead) as described in the free trade case remain valid. However, the presence of the subsidy scheme strengthens the incentive for both firms to invest early.

4.1. The effect of the policy regime on the home firm

Given rival delay, the home firm compares $Ep(k^{DD^*}, k^{DD^*}; s^{DD^*})$ to $Ep(k^{CD^*}, k^{CD^*}; s^{CD^*})$ in deciding when to invest. If it delays, its capital will be chosen more flexibly. If it commits early to capital, it will benefit from a first-mover advantage in investment. These considerations also held under free trade. Now, however, the home firm's capital level chosen in period one will influence the subsidy set in period two: the government is forced to choose the subsidy associated with investment leadership, with $Es^{CD^*} > Es^{DD^*}$. This implies that, compared to free trade, the incentive for the home firm to commit is stronger: by investing early it increases the subsidy. Importantly, since the subsidy is set in line with *actual* rather than with *expected* demand, the home firm's output flexibility remains relatively high *even* when it invests *early*.

As discussed in section 3.1, no firm ever wants to commit under free trade *given* rival commitment for $s^2 > 0$. Is this still true with the subsidy scheme? Now, if faced with a rival that invests early and commits to capital level k^* , the home firm wants to deviate from delay to commitment below a critical uncertainty level. The reason why this is the case lies in the fact that, by investing early, the home firm forces the government to give a higher subsidy compared to when it delays. So, with the subsidy

²⁰ Alternatively, the home firm's profits are more convex in u in the presence of the subsidy policy than under free trade, while the opposite is true of the foreign firm's profits.

policy in place, (C, C^*) cannot be eliminated as an equilibrium at sufficiently low levels of uncertainty.

4.2. The effect of the policy regime on the foreign firm

Given delay by the home firm, early investment is preferred by the foreign firm, provided that the level of uncertainty is not too high. In addition to its incentives to invest early under free trade, the existence of the policy scheme gives the foreign firm an additional incentive to commit. For the foreign firm, early investment does not only imply that it is less vulnerable to the manipulations of the home government, it also means that it can influence the home government's subsidy. This is reflected in the fact that the subsidy with foreign commitment is smaller than the one with foreign delay (i.e., $Es^{DC^*} < Es^{DD^*}$). Given early commitment to capital by its rival, the foreign firm did not have an incentive to invest early under free trade. Now it does; more specifically, it wants to play strategically against the government, thereby lowering the subsidy.

From our discussion in subsection 4.1 and in this subsection, we know that (C, C^*) will be the unique equilibrium at sufficiently low levels of uncertainty.

4.3. Investment timing with the subsidy regime

Figure 3 contrasts the investment-timing pattern that emerges under the subsidy regime with the one that prevails with free trade. For the range of uncertainty depicted in Figure 3, *both* firms will *commit* under the policy regime²¹. With free trade, both firms delay when uncertainty is sufficiently high (area II), and there is investment leadership at low levels of uncertainty (area I).

²¹ For reasonable assumptions about the distribution of u (for instance, under the uniform or truncated normal distribution), $(C, C^*; s^{CC^*})$ is the unique equilibrium for all uncertainty levels that are consistent with interior solutions (i.e., for $s^2 \leq 0.1$); in fact, the levels of uncertainty required for $(D, D^*; s^{DD^*})$, $(D, C^*; s^{DC^*})$ and $(C, D^*; s^{CD^*})$ to occur would be so high that the conditions for interior solutions would be violated. Strictly speaking, there exist distributions of u , for which other investment timing combinations can be equilibrium outcomes without violating the condition for interior solutions; then $(D, D^*; s^{DD^*})$ will occur with the policy regime, but only at extremely high levels of uncertainty, whereas investment-leadership equilibria will occur at slightly lower but still very high uncertainty levels (with $(D, C^*; s^{DC^*})$ prevailing at wider ranges of uncertainty than $(C, D^*; s^{CD^*})$). The main message that both firms will have an increased incentive to commit with the existence of the policy scheme, does, however, remain.

[Figure 3 about here]

5. Welfare

Should governments adopt subsidy schemes if they can only commit to these in the short run or should they adhere to a policy of free trade instead? Based on the arguments presented in the strategic trade policy literature, the claim that subsidy intervention will raise welfare in the home country beyond the level attained under free trade may –at least at first thought– seem correct²². Indeed, *ceteris paribus*, that is, keeping firms' investment timing the same, a subsidy would often benefit the home country compared to free trade. In particular, a subsidy would increase home welfare *given* that both firms choose to delay investment (investment delay occurs under free trade except at very low levels of uncertainty, as depicted in Figure 2), i.e. $W(D, D^*; s^{DD*}) > W(D, D^*; s = 0)$. However, as shown in section 4, firms' investment timing does *not* stay the same if firms know that the government will be policy active in period two. In fact, the very presence of the subsidy scheme compels firms to invest early while they would delay under free trade.

Figure 4 depicts the investment timing patterns that prevail under free trade and under the subsidy regime. Consider the critical uncertainty level $\tilde{\mathbf{S}}^2$, above which early investment is the outcome with the subsidy policy and investment delay occurs under free trade²³. So, when assessing the policy regime relative to the free trade benchmark, the relevant welfare comparison above $\tilde{\mathbf{S}}^2$ consists of comparing $W(D, D^*; s = 0)$ and $W(C, C^*; s^{CC*})$. Note that the $\tilde{\mathbf{S}}^2$ -locus separating area IIa and IIb, along which $EW(C, C^*; s^{CC*}) = EW(D, D^*; s = 0)$, is downward sloping. This means that the home country is more flexible under the policy regime than with free trade, in spite of the fact that firms invest early under the subsidy regime but delay investment under free trade²⁴. However, although the home government's policy

²² Note that under free trade, home welfare is equal to profit of the home firm.

²³ Under free trade, at $\mathbf{s}^2 = \tilde{\mathbf{S}}^2$ firms are indifferent between commitment and delay given rival delay.

²⁴ For instance, at $i=0.523$ in Figure 4, the policy regime yields higher welfare *above* $\tilde{\mathbf{S}}^2=0.005$, while free trade leads to the higher welfare level *below* $\tilde{\mathbf{S}}^2=0.005$.

always raises flexibility, it does not always achieve higher home welfare than free trade.

[Figure 4 about here]

As long as the capital cost is sufficiently small (area IIa), free trade is preferred to the policy regime from a home welfare point of view. A low cost of capital induces firms to over-invest significantly for strategic reasons. Socially inefficient over-investment is higher the more firms can affect the subsidy, implying that the social cost of strategic over-investment is higher in $(C, C^*; s^{CC*})$ than in $(D, D^*; s = 0)$. Hence, when investing in capital is cheap, the extra social cost of over-investment caused by the subsidy scheme dominates its profit-shifting benefits.

At uncertainty levels below \tilde{S}^2 , either foreign or home investment leadership occurs under free trade, with investment leadership by the home firm being the preferred outcome from the home country's point of view. With the subsidy policy, both firms commit early to capital. Only when the capital cost is sufficiently high will the policy regime yield higher home welfare than the outcome with home investment leadership under free trade (area Ic). In fact, at low i (see area Ia), free trade is preferred *even* if it leads to foreign investment leadership²⁵.

6. Extensions

Even when the basic model is extended in a number of ways, the main message remains relevant. We briefly discuss the effects of time-varying capital costs and profit discounting, inter-firm cost differences, the possibility of capital investment in both periods and two policy active governments.

6.1. Time-varying capital costs and profit discounting

If the marginal cost of capital investment differs across time, the trade-off between early investment commitment and capital flexibility will be affected. More specifically, if the capital cost in period one is lower than the expected capital cost in period two, then firms have an increased incentive to invest early. Conversely, if

²⁵ If the alternative endogenous timing model with “two-step” commitment à la Spencer and Brander (1992) is used, the same basic policy lessons can be drawn.

firms expect capital in period two to be cheaper than in period one, they will exhibit a stronger tendency to delay investment.

Similarly, profit discounting lowers the attractiveness of early investment. Early investment in order to raise future profits implies that capital costs are sunk in period one. But, if future profits are discounted, the benefits of committing early to capital are lower, thus intensifying the relative advantages of investment delay.

However, in all these cases it remains true that, compared to free trade, the subsidy scheme gives firms an extra incentive to commit early to capital.

6.2. Cost asymmetries

In the model we assume firms are *ex ante* symmetric (i.e., $c_0 = c_0^*$ and $i = i^*$). Here, we relax this symmetry assumption and explore how production and capital cost differences between firms affect our results.

Consider first the case in which firms' production costs are different ($c_0 \neq c_0^*$). From expressions (4a) and (4b), we know that a firm's capital investment leads to an expansion of its output. The return generated from this increased output is higher the wider the firm's price-cost gap. So, the lower-cost firm gains more from an output expansion that results from capital investment than its higher-cost rival. Since a firm's capital investment is largest when it leads in investment, the low-cost firm has the stronger incentive to invest early. This implies that, under free trade, investment leadership by the low-cost firm will occur as the unique equilibrium for some (intermediate) levels of uncertainty.

If firms' capital costs differ ($i \neq i^*$), the slope of the low-cost firm's capital reaction function is larger (in absolute terms) than its rival's: the capital level of the low-cost firm is relatively more responsive to rival capital changes. This in turn increases the high-cost firm's ability to strategically manipulate the low-cost firm. For this reason, capital cost asymmetry leads to investment leadership by the higher-cost firm as a unique equilibrium under free trade for some levels of uncertainty.

Importantly, production and capital cost asymmetries do not change the fact that both firms have an increased incentive to invest early *with* the subsidy regime; $(C, C^*; s^{CC*})$ remains the investment timing equilibrium with the subsidy regime in place²⁶.

6.3. Partial commitment

How would our results change if firms can invest in *both* periods? Assume capital costs are the same in $t=1$ and $t=2$. If a firm wants to delay, nothing changes. If it wants to invest early, it still over-invests strategically in order to capture the benefits from early investment. Hence, in the “bad times” ($u < 0$), early investment implies commitment power, since firms that have invested early will not want to expand capital investment in $t=2$ and cannot scale down due to the irreversibility of their investment. However, if u is very high, a firm that has invested early may want to invest in more capital in period two. Therefore, in the “good times” early investment does not have any commitment value *ex post*, but leaves the firm with capital flexibility. So, if firms can invest in both periods, early investment implies partial commitment power, in the sense that early investing firms will effectively remain flexible in the good times, preserving their commitment power in the bad times only. The possibility of capital investment in both periods does, however, not affect the comparison between the subsidy regime and free trade in any qualitative way. It remains the case that the incentive to invest early is higher under the subsidy regime.

6.4. Two policy active governments

One could assume that the government of the foreign country is policy active too, setting an export subsidy at the start of period two. This would, as is usual the case in the strategic trade policy literature, result in a prisoner’s dilemma, in which each country’s welfare is lower than the welfare level obtained under free trade. Furthermore, each firm now has an additional incentive to invest early: firms’ early investment does not only influence the subsidy set by the home government, but also the one chosen by the foreign government. The home firm invests early to lower the foreign export subsidy, whereas the foreign firm prefers early investment in order to

²⁶ $(C, C^*; s^{CC*})$ is the unique equilibrium that does not violate the conditions for interior solutions under reasonable assumptions about the u -distribution.

increase its government's subsidy. This means that the presence of a foreign subsidy scheme reinforces firms' incentives to invest early and hence further strengthens the message that emerges from our basic model.

7. Conclusion

The analysis in this paper suggests that, even though a government may have sufficient credibility to commit to policy schemes in the short run, if it cannot commit for the longer run, a laissez-faire policy stance will often lead to higher welfare for the country involved. Many governments, but perhaps in particular those in newly emerging economies characterised by political instability, may only be able to commit to policy in the short run.

If such governments use export promotion schemes, firms have the opportunity as well as the motive to influence the government subsidy by investing before it is set. The irreversibility of investment gives firms the commitment power and thus the opportunity to influence the subsidy, while the knowledge that they can affect the policy to their own advantage gives them the motive to invest before the subsidy is determined.

Whether –both domestic and foreign– firms investing early in order to influence the policy actually reduces domestic welfare depends on how effective their investment is in manipulating the government. When it leads to severe manipulations of the export promotion scheme, the country is likely to benefit from a laissez-faire policy stance, when it does not have commitment power in the long run.

Figure 1 : The game

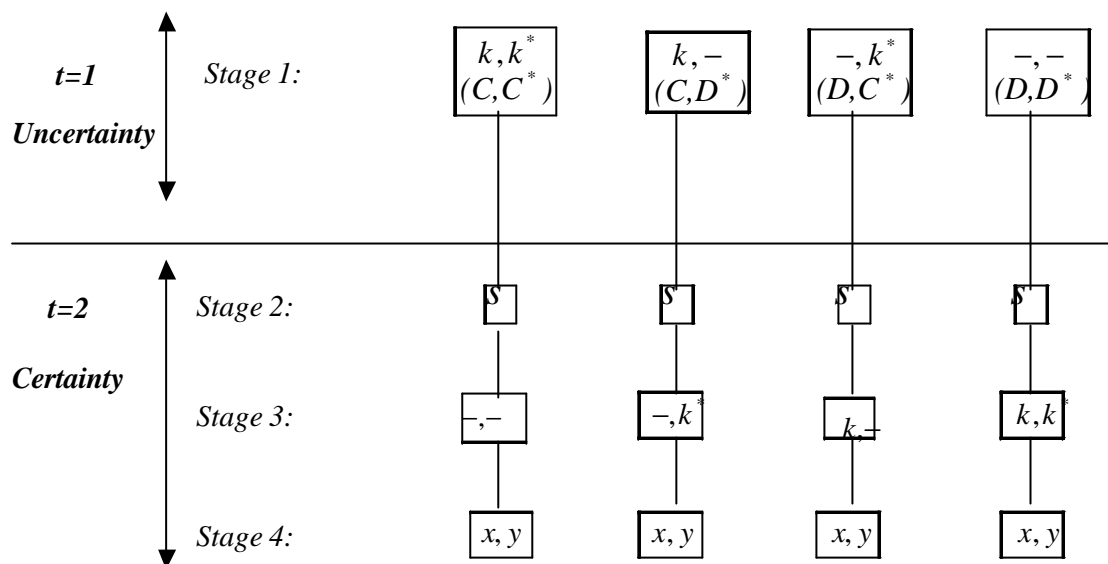
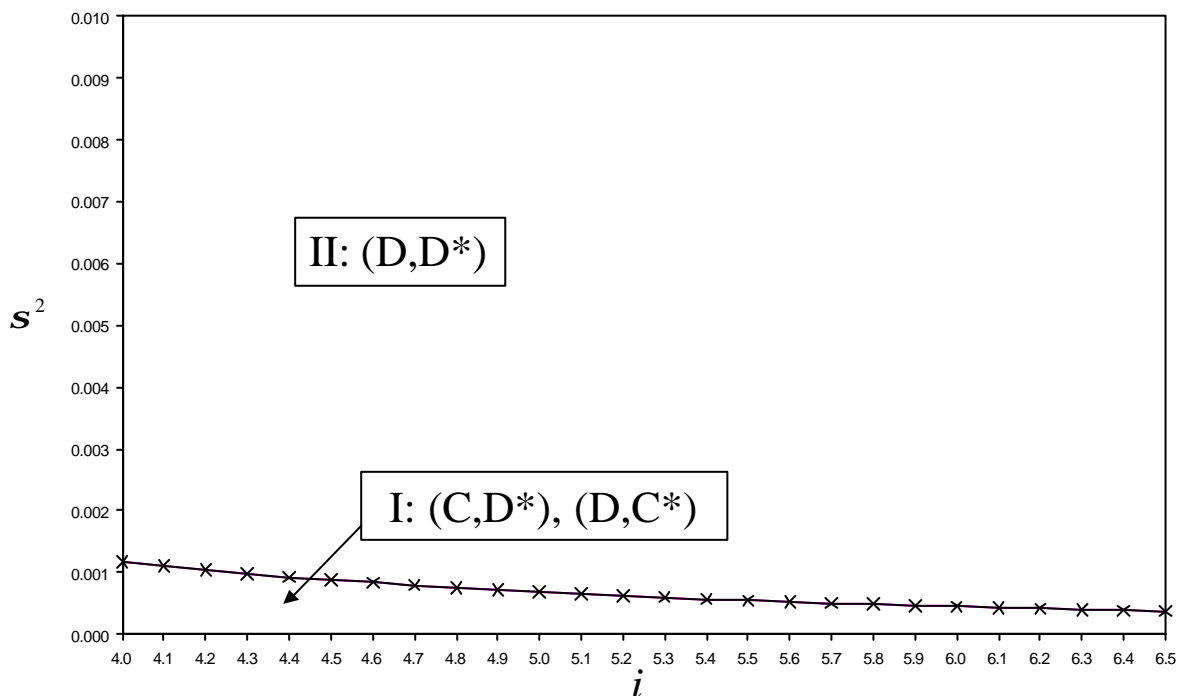


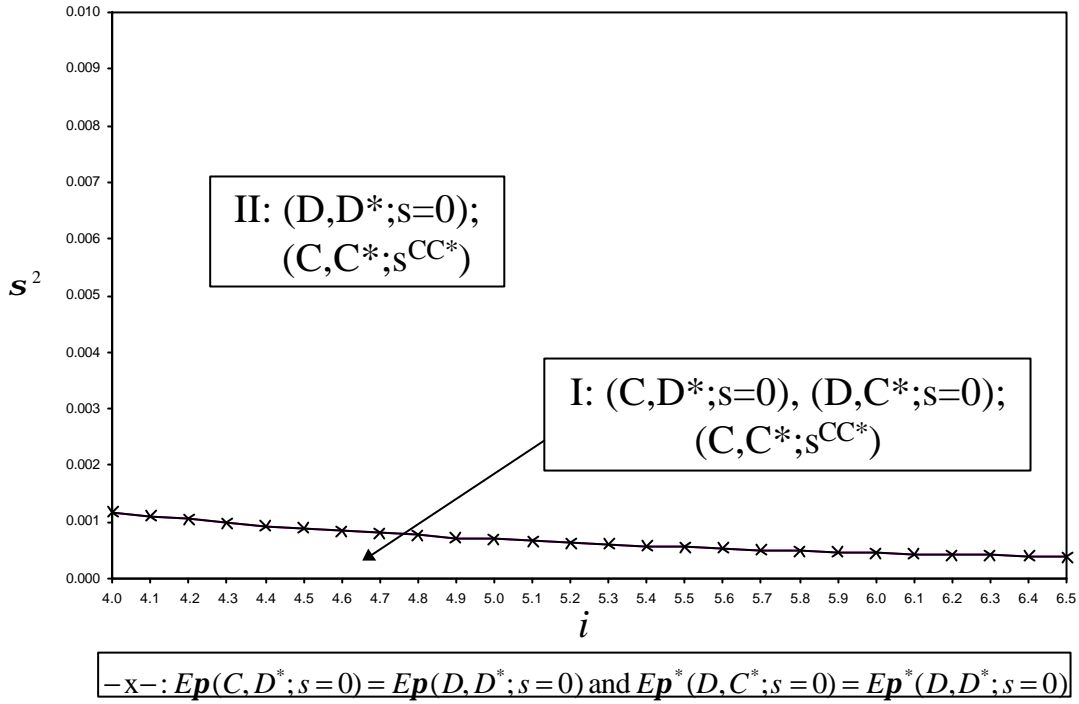
Figure 2: Firms' investment timing under free trade
 ($A=A^*$, $i=i^*$, $b=1$)



$-x- : Ep(C, D^*) = Ep(D, D^*) \text{ and } Ep^*(D, C^*) = Ep^*(D, D^*)$

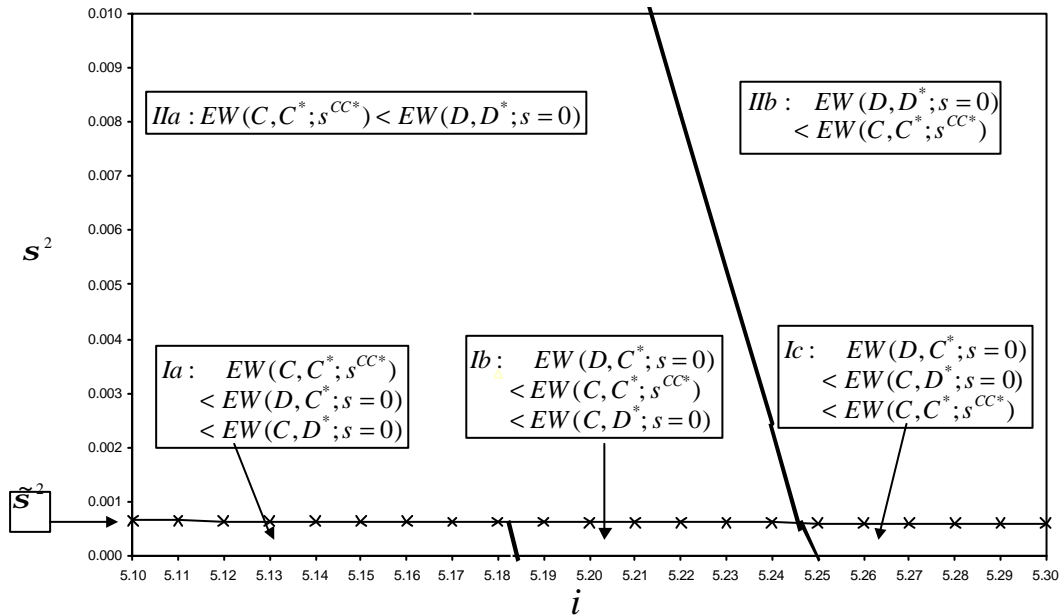
Note: At $s^2 = 0$, the equilibria are (C, C^*) , (C, D^*) and (D, C^*) .

Figure 3: Firms' investment timing with the subsidy policy and under free trade ($A=A^*$, $i=i^*$, $b=1$)



Note: At $s^2=0$, the equilibria are $(C, C^*; s=0)$, $(C, D^*; s=0)$ and $(D, C^*; s=0)$ under free trade, while $(C, C^*; s^{CC*})$ is the unique equilibrium with the subsidy policy.

Figure 4: A welfare comparison: the subsidy regime versus free trade ($A=A^*$, $i=i^*$, $b=1$)



Note: The values for i on the horizontal axis are chosen in the neighbourhood of the critical values that demarcate the areas with different welfare rankings.

Table 1: Capital levels and expected profits for the four investment-timing combinations under free trade

	(D, D^*)	(C, D^*)	(D, C^*)	(C, C^*)
k	$\left(\frac{4}{3}hbEx^{DD^*}\right)^2$	$\left(y^* \frac{4}{3}hbEx^{CD^*}\right)^2$	$\left(\frac{4}{3}hbEx^{DC^*}\right)^2$	$\left(\frac{4}{3}hbEx^{CC^*}\right)^2$
k^*	$\left(\frac{4}{3}h^*by^{DD^*}\right)^2$	$\left(\frac{4}{3}h^*by^{CD^*}\right)^2$	$\left(y \frac{4}{3}h^*bEy^{DC^*}\right)^2$	$\left(\frac{4}{3}h^*bEy^{CC^*}\right)^2$
Ep	$bn(Ex^{DD^*})^2 + n\left(\frac{r^*}{\Delta}\right)^2 \frac{S^2}{9b}$	$b\left[1 - \frac{8}{9}hy^{*2}\right](Ex^{CD^*})^2 + \left(\frac{r^*}{n^*}\right)^2 \frac{S^2}{9b}$	$bn(Ex^{DC^*})^2 + \frac{1}{n} \frac{S^2}{9b}$	$bn(Ex^{CC^*})^2 + \frac{S^2}{9b}$
Ep^*	$bn^*(Ey^{DD^*})^2 + n^*\left(\frac{r}{\Delta}\right)^2 \frac{S^2}{9b}$	$bn^*(Ey^{CD^*})^2 + \frac{1}{n^*} \frac{S^2}{9b}$	$b\left[1 - \frac{8}{9}h^*y^2\right](Ey^{DC^*})^2 + \left(\frac{r}{n}\right)^2 \frac{S^2}{9b}$	$bn^*(Ey^{CC^*})^2 + \frac{S^2}{9b}$

With $h \equiv \frac{1}{2bi}$, $h^* \equiv \frac{1}{2bi^*}$, $f \equiv 1 - (2/3)h$, $f^* \equiv 1 - (2/3)h^*$, $n \equiv 1 - (8/9)h$, $n^* \equiv 1 - (8/9)h^*$, $y \equiv f/n$, $y^* \equiv f^*/n^*$, $r \equiv 1 - (4/3)h$,

$$r^* \equiv 1 - (4/3)h^*, \Delta \equiv mn^* - \left[\frac{4}{9}\right]^2 hh^*.$$

Table 2: Capital levels, the export subsidy and expected profits for the four investment-timing combinations with a policy active home government

	(D, D^*)	(C, D^*)	(D, C^*)	(C, C^*)
k	$\left(\frac{4}{3}\mathbf{h}bx^{DD^*}\right)^2$	$\left(\frac{\mathbf{f}^*}{\mathbf{r}^*}2\mathbf{h}bEx^{CD^*}\right)^2$	$\left(\frac{4}{3}\mathbf{h}bx^{DC^*}\right)^2$	$(2\mathbf{h}bEx^{CC^*})^2$
k^*	$\left(\frac{4}{3}\mathbf{h}^*by^{DD^*}\right)^2$	$\left(\frac{4}{3}\mathbf{h}^*by^{CD^*}\right)^2$	$\left(\frac{\mathbf{m}3}{\mathbf{n}2}\mathbf{h}^*bEy^{DC^*}\right)^2$	$\left(\frac{3}{2}\mathbf{h}^*bEy^{CC^*}\right)^2$
s	$\left[\frac{1}{\mathbf{f}^*} - \frac{8}{9}\mathbf{h}\right] \frac{bx^{DD^*}}{2}$	$\frac{1}{\mathbf{f}^*} \frac{bx^{CD^*}}{2}$	$\frac{\mathbf{n}}{2} \frac{bx^{DC^*}}{2}$	$\frac{bx^{CC^*}}{2}$
Ep	$b\mathbf{n}(Ex^{DD^*})^2 + \mathbf{n} \left[\frac{\mathbf{r}^*}{\nabla}\right]^2 \frac{\mathbf{s}^2}{4b}$	$b \left[1 - 2\mathbf{h} \left(\frac{\mathbf{f}^*}{\mathbf{r}^*}\right)^2\right] (Ex^{CD^*})^2 + \frac{\mathbf{s}^2}{4b}$	$b\mathbf{n}(Ex^{DC^*})^2 + \frac{1}{\mathbf{n}} \frac{\mathbf{s}^2}{4b}$	$b[1 - 2\mathbf{h}](Ex^{CC^*})^2 + \frac{\mathbf{s}^2}{4b}$
Ep^*	$b\mathbf{n}^*(Ey^{DD^*})^2 + \mathbf{n}^* \left[\frac{2\mathbf{f}^*\mathbf{n} - 1}{\mathbf{f}^*\nabla}\right]^2 \frac{\mathbf{s}^2}{16b}$	$b\mathbf{n}^*(Ey^{CD^*})^2 + \frac{\mathbf{n}^*}{\mathbf{f}^{*2}} \frac{\mathbf{s}^2}{16b}$	$b \left[1 - \left(\frac{\mathbf{m}}{\mathbf{n}}\right)^2 \frac{9}{8}\mathbf{h}^*\right] (Ey^{DC^*})^2 + \left[\frac{(2\mathbf{n} - 1)}{\mathbf{n}}\right]^2 \frac{\mathbf{s}^2}{16b}$	$b\mathbf{n}^*(Ey^{CC^*})^2 + \frac{\mathbf{s}^2}{16b}$

With $\mathbf{h} \equiv \frac{1}{2bi}$, $\mathbf{h}^* \equiv \frac{1}{2bi^*}$, $\mathbf{f}^* \equiv 1 - (2/3)\mathbf{h}^*$, $\mathbf{r}^* \equiv 1 - (4/3)\mathbf{h}^*$, $\mathbf{n} \equiv 1 - (8/9)\mathbf{h}$, $\mathbf{n}^* \equiv 1 - (8/9)\mathbf{h}^*$, $\nabla \equiv \mathbf{f}^*(2 - (8/9)\mathbf{h}) - 1$, $\mathbf{m} \equiv 1 - (16/27)\mathbf{h}$.

Note: $Es^{cd^*} > Es^{dd^*} > Es^{cc^*} > Es^{dc^*}$.

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