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IMPLEMENTING MARKET ACCESS

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ABSTRACT

The outcome of trade policies to increase access for foreign firms to the home country's market is shown to be sensitive to the implementation procedure used. The importance of the timing of moves between government and firms is highlighted by focusing on taxes and subsidies to implement minimum market share requirements. Both taxes and subsidies chosen by the home government after firms have picked prices create powerful incentives for firms to raise prices - effects that are similar in nature to those found with quotas/VERs. We show that some degree of imprecision in implementing the target engenders less anticompetitive outcomes relative to perfect enforcement.

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1. Introduction:

While policies to increase market access have received much attention in recent years, scant attention has been paid to the issue of implementation of these policies. Consider, for example, the persistent calls to 'open up' the Japanese market by negotiating 'voluntary' minimum market share targets for U.S. firms in Japan. Though there is still considerable debate about the desirability of instituting such VIEs, the problem of implementation has never surfaced as being important. Irwin (1994, pg. 65) notes that'...the United States never seems concerned about the mechanism by which "voluntary" bilateral agreements are carried out and acts as if the foreign government can solve the problem by fiat.'

Since it is well understood that enforcement is critical to the success of any results oriented policy, it is somewhat surprising that implementation *per se*, has been ignored. While Ethier and Horn (1993) and Cronshaw and Markusen (1995), among others, examine results oriented policies Greaney (1995) specifically incorporates the problem of implementation in her analysis. In her model, the government enforces the market share agreement by threatening the home firm with a financial penalty in the event the import target is not met. Nonetheless, neither this, nor other studies of VIEs, examine alternative methods of implementing market share requirements.[1] In reality, there are a number of ways of implementing a market share requirement, and the effects of the requirement depend critically on the details of the implementation procedure used.

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[1] See Dinopoulos and Kreinin (1990), Irwin (1993), Helpman and Krugman (1989), Kowalczyk (1994), Bjorksten (1994) and Nakamura (1995).

Understanding these effects is important, since unlike VERs, no obvious procedure comes to mind for implementing a VIE.[2] An implementation procedure that is feasible for one market may not be viable for another. For instance, setting minimum physical requirements on the use of imported intermediate goods, say semiconductors, may be a viable method of implementation when the number of purchasing firms is small.[3] Such an implementation scheme would, however, be impossible to apply to the case of a final good demanded by many small agents, and, even when feasible, such a mechanism may have undesirable effects.

In this paper, we examine the use of tax/subsidy instruments to enforce market share requirements. While there are a number of instruments that could be used, taxes/subsidies are feasible in a wide range of environments where direct control is not. The tax/subsidy schemes that we consider reveal the importance of the sequence of moves between firms and the government, and they capture, albeit loosely, some aspects of MITI's handling of the semiconductor VIE. In particular, we consider taxes/subsidies that are set before firms make their strategic choices, as well as those which are imposed only if market outcomes violate the market share requirement. In the latter case, firms know that a violation of the market share target will, with some probability, trigger either a tax on the Japanese product or a subsidy on the U.S. good. The introduction of uncertainty attempts to capture MITI's imperfect monitoring of the VIE target in the semiconductor case and yields equilibrium outcomes where the U.S. firm's market share can (*ex post*) fall short of the mandated minimum (both of which are well documented in the semiconductor VIE).[4] It also allows us to demonstrate that some degree of imprecision in implementing the target engenders less

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[2] The use of quotas is an obvious way to implement a VER since the exporting/importing country's government can physically monitor the exact amounts of the good leaving/entering the country, putting an end to the outflow/inflow the moment the quantitative ceiling is reached.

[3] Tyson (1992, pg. 111-112) suggests that this was what was done in the first semiconductor agreement.

[4] Both Irwin (1996) and Greaney (1995) discuss the continual seesawing of the U.S. market share below the 20 percent mark before finally climbing to just above the target in the fourth quarter of 1992.

anticompetitive outcomes relative to perfect enforcement - perhaps, one reason behind the Japanese government's perpetual opposition to exact market shares in any VIE negotiation.

We show that a timing framework where governments choose tax/subsidy levels to implement market share requirements after firms have made their strategic decisions, but before markets clear, imparts incentive effects to tax/subsidy policy that are similar to those found with quotas/VERs. Such effects are absent from the existing literature on tax/subsidy policy, which with the exception of Carmichael (1987) and Gruenspecht (1988), has consistently adhered to a timing structure where governments are first movers.[5] In keeping with that tradition, Greaney (1995) compares an import subsidy when the government **moves first**, with a VIE (enforced by a penalty threat) when the government **moves second**. She finds the two instruments have opposite effects on price, with the VIE raising prices. Our analysis suggests that this distinction is somewhat misleading since a VIE can be enforced by an import subsidy, and if the subsidy is triggered by a violation of the market share target, firms with market power will have an incentive to raise price.

In the case of a tax used to implement the VIE, our results are similar to Greaney's with the exception that in our model the VIE affects the strategic behavior not only of the Japanese firm but also that of the U.S. firm. Greaney assumes the Japanese government moves only after market shares have been observed - an assumption that leaves the U.S. firm's behavior unchanged and removes the kinds of strategic aspects of interest to us. On the other hand, her scheme has the decided advantage that the home government can implement the VIE with a minimum of information. In contrast, our *ex post* subsidy/tax imposes

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[5] Carmichael (1987) is the first to investigate an alternative timing framework where firms' pricing decisions precede government's choice of export subsidy levels. Citing evidence from practices followed by the U.S. Export-Import Bank to rationalize the sequence of government and firm actions, he shows that the rent seeking behavior of the firms yields positive export subsidies in equilibrium. This departure from the Eaton and Grossman (1986) result that first mover governments should tax the exports of Bertrand firms is again observed in Gruenspecht's (1988) model with big ticket differentiated products where governments set subsidy levels after firms choose prices.

substantial informational requirements on the part of the government.[6] Thus, since the government moves after firms set prices but before market shares are realized, successful implementation necessitates, for instance, perfect information regarding the demand functions. However, the assumption that governments face no informational constraints is not uncommon and characterizes most of the literature on strategic trade policy, e.g., Brander and Spencer (1985).[7]

It can be argued that our *ex post* subsidy accords better with MITI's actual handling of the semiconductor VIE than does the *ex post* tax on Japanese producers. As is well documented by Irwin (1996, pg. 53), MITI exercised its influence more on the demand side by trying to force Japanese firms (most of which were themselves semiconductor producers) to purchase more foreign chips. In fact, MITI's early efforts in 1987 to boost prices by directing domestic semiconductor producers to reduce output were shot down by the U.S. Semiconductor Industry Association.

The paper is organized as follows. In the next section, we look at the obvious ways of implementing VIEs, namely, via the use of taxes and subsidies when governments can precommit to their policies. Section 3 then identifies the kinds of incentive effects at work when governments are second movers. In order to clearly isolate the incentive effects of each instrument - tax and subsidy - on each of the firms, we first consider situations of one-sided market power and, later, combine the analyses to study the case of two-sided market power. When a subsidy on the U.S. product is used by the Japanese government to implement a minimum market share target, the U.S. monopoly firm has an incentive to raise price in order to trigger the subsidies. If monopoly power is on the Japanese side, the incentives are for the Japanese firm to raise price to reduce the amount of the subsidy granted or to

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[6] We are grateful to Theresa Greaney for pointing this out.
[7] See, also, Brainard and Martimort (1992) for a discussion of the high informational requirements of strategic trade policy.

eliminate it altogether. Under a tax policy, if market power is on the U.S. side the incentives are for the U.S. firm to raise its price to trigger taxes on the Japanese good. If power is on the Japanese side, then the incentive is to, always, prevent taxes from being invoked by charging higher prices. In Section 4, we put the two sides together and show that since price increases are still matched by each firm, both taxes and subsidies result in higher prices when firms have market power.

In Section 5, we present a simple but concrete numerical example to highlight the differences in equilibrium outcomes when comparing an *ex ante* policy with its *ex post* counterpart. By deriving prices, quantities, profits and welfare in each case, the exercise yields valuable insights into the economic effects of the various policies and helps rank them in terms of desirability from the Japanese and U.S. standpoints. For our example, instruments imposed *ex post* with some degree of imprecision engender less anticompetitive outcomes and higher profits for the Japanese firm than those which are perfectly enforced. To the extent that this result generalizes, it could explain the Japanese government's continued opposition to exact market shares in any VIE negotiation. Section 6 offers concluding comments.

2.   Implementation Through Taxes or Subsidies:

While there may exist a number of different ways to implement market share requirements, we focus on the instrument of tax/subsidy as a natural policy to consider over a wide range of environments. Consider as an illustrative example the case where the U.S. negotiates a market access requirement with Japan. If a minimum market share for U.S. firms is the form of the market access requirement, a reasonable way to implement it may be to either tax Japanese firms until their sales fall enough for the market share of U.S. firms to attain the target specified, or to subsidize U.S. firms until their sales rise enough for the market share

requirement to be met. While both methods appear reasonable ways of implementing this policy, in both the tax case and the subsidy case the timing of moves is critical to the nature of the outcomes that obtain. In particular, when there exists some degree of market power, allowing governments to set tax/subsidy levels **after firms have made their strategic choices** (but before markets clear) gives rise to incentive effects that are absent with the traditional timing scheme.

The literature has found some support for a second mover role of governments in real world settings. In fact, the timing scheme used in Carmichael (1987) is identical to our *ex post* scheme in that the governments set subsidy levels taking the firm prices as given, and the prices faced by consumers are the subsidy ridden 'effective' prices. Goldberg and Knetter (1995) provide evidence of a similar timing structure in the implementation of the Export Enhancement Program (EEP) for agricultural commodities, namely, wheat: U.S. exporters first submit bids specifying the price, quantity and quality of wheat (already negotiated with the foreign country) to be delivered; the Foreign Agricultural Service (FAS) then examines these bids and approves the subsidies if the quoted price is greater than the minimum acceptable price and the bonus is smaller than the maximum allowable bonus. In the interests of competition, both the minimum price and the maximum bonus are kept unknown to the firms, i.e., there is a positive probability that the EEP subsidy is not granted. While neither of these examples involves market share targets *per se*, this sequence of moves seems to be the most natural when examining VIEs. Further, our scheme has the added merit of capturing the real world concern that if firms anticipate their behavior will affect government policy, this anticipation must alter their strategic behavior. The next subsection discusses the issue of timing in greater detail and provides some justification for the specific timing structure used in this paper.

2.1 Ex Ante versus Ex Post Taxes and Subsidies:

The behavior of firms when faced with these kinds of taxes and subsidies is very different depending on whether they think and act like these are given to them, or whether they think and act like these taxes/subsidies can be affected by their own behavior. In the former case, firms will not ask how changes in their behavior will change the taxes/subsidies offered by the government. In the latter case they will. The difference in the two cases can be thought of, at a formal level, as a difference in timing assumptions made. If the government chooses its tax/subsidy level first – what we call *ex ante* policy – then firms who subsequently decide on their behavior must take the government's choices as given. The government can look forward and take account of how its choices affect the choices made by firms. If on the other hand, firms decide what to do first, and then government chooses its tax/subsidy level – what we call *ex post* policy – the government must take the firms' decisions as given while firms look forward and take account of how their behavior affects the government's behavior. Which timing assumption is appropriate depends on the ability of the government or the firm to precommit to its decision variable(s).

If taxes and subsidies are set *ex ante*, the analysis is trivial. Whatever be the market structure, the government looks forward and calculates the tax on Japanese firms or the subsidy on U.S. firms, or, even possibly, a combination of the two, which results in the market share requirement being met. If, for example, there is a single foreign and a single domestic firm competing in prices and producing differentiated goods that are substitutes for one another, and if demand is linear, then the best response functions of the U.S. firm $B_2(p_1)$, and the Japanese firm $B_1(p_2)$, can be depicted as in Figure 1.[8] The equilibrium firm (and consumer) prices are given by the intersection of the best response functions, and

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[8] As usual, the best response function for firm 1 (firm 2) is its profit maximizing price given the price chosen by firm 2 (firm 1).

their relative slopes are as shown to ensure stability of equilibrium. The combination of consumer prices which result in a market share for the U.S. firm at the free trade level can be depicted by an upward sloping line EE, going through the equilibrium price pair and lying between the two best response functions.[9]

If a larger market share for the U.S. is required by the market share rule, it can be depicted by a line to the right of EE such as MM. Now this higher market share can be attained by setting a tax on the Japanese firm. As the tax results in the Japanese firm setting a higher price for any given U.S. price, this tax must move the Japanese firm's best response function to the right to go through the point C.

Alternatively, this higher U.S. market share can be attained by giving a subsidy per unit to the U.S. firm which moves its best response function down and to the right through the point A.[10] Notice that the two implementation procedures result in very different consumer prices. Consumer prices are raised by the scheme when implemented by a tax and reduced by it when implemented by a subsidy. Note, also, that the appropriate mix of tax and subsidy policies can, by shifting both firms' best response functions accordingly, realize any point on MM lying between A and C.

Now consider *ex post* taxes and subsidies. In a situation where the government wants to implement market access but cannot precommit to a tax/subsidy level there is considerable room for strategic behavior on the part of the firms. For instance, a government may announce that while it is serious about ensuring that the market share requirement is met, it will not intervene actively unless free market forces continue to violate the market share

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[9] In the case of linear demand, the locus of consumer price combinations (p_1^C, p_2^C) satisfying a market share constraint of k $(0 < k < 1)$ with equality is represented by the equation $p_2^C = \eta_0 + \eta_1 p_1^C$ where $\eta_0 = \frac{(1-k)a_2 - ka_1}{(1-k)b+kc}$, $\eta_1 = \frac{(1-k)c+kb}{(1-k)b+kc}$, and the demand for good i is $q_i(p_i^C, p_j^C) = a_i - bp_i^C + cp_j^C$; $b > c > 0, a_i > 0$; $i = 1, 2$; $j \neq i$. It is easy to verify that this is the equation of a straight line steeper than 2's best response but flatter than 1's best response.

[10] This is the type of subsidy that Greaney (1995) considers when comparing a "VIE" with an import subsidy.

targets. In such settings, firms can exploit the fact that their actions influence the government's choice of policies. Much of the concern in the real world about the effect of market share requirements has to do with how their presence will influence the behavior of firms. Such issues involve considerations of strategic interaction and cannot be analyzed within the *ex ante* policy framework. These questions can, however, be addressed meaningfully within the context of *ex post* tax/subsidy policy. Consequently, an understanding of the effects of such policies is important and relevant.

3.   Ex Post Policies with One-Sided Market Power:

The easiest way to develop some intuition about how *ex post* policy, geared towards implementing market share targets, affects firms' incentives is to consider situations of one-sided market power, i.e., either the Japanese or the U.S. firm has market power but not both. Let us assume that demand is linear, products are differentiated, firms are risk neutral and that the perfectly competitive firms make identical products. There are, then, four simple combinations of policy regime and market structure to consider:

(*a*) Subsidy policy with a U.S. monopoly firm and a competitive Japanese industry,

(*b*) Subsidy policy with a Japanese monopoly firm and a competitive U.S. industry,

(*c*) Tax policy with a U.S. monopoly firm and a competitive Japanese industry,

(*d*) Tax policy with a Japanese monopoly firm and a competitive U.S. industry.

The above serve the purpose of showing that even within such simple structures, *ex post* tax/subsidy policies create important incentive effects that are absent in their *ex ante* counterparts.

3.1 Subsidy policy with a U.S. monopoly firm and a competitive Japanese industry:

First consider the incentive effects under (a). Recall that the goods made in the two countries are imperfect substitutes for each other and that the Japanese industry is behaving competitively and pricing at marginal cost. The U.S. firm has monopoly power and has a first mover advantage over the Japanese government. It understands that if it charges a price such that demand for its product at this price violates the market share constraint, it will be given the subsidy per unit needed to meet the pre-specified market share. In this situation, the U.S. firm has an incentive to raise price as high as possible, to infinity, as there are no limits on its ability to exploit the government. To make the problem bounded, assume the Japanese government announces that whenever the market share constraint is violated the U.S. firm will be subsidized stochastically such that for any Japanese price, a higher divergence from the market share satisfying U.S. price will be associated with a lower probability of the subsidy being granted.[11] We introduce uncertainty to capture the notion that a government's enforcement of a VIE target may be less than perfect. Uncertainty also helps to mitigate the U.S. firm's rent seeking incentives because, intuitively, some degree of imprecision should reduce either firm's power to strategically exploit the VIE target. This is trivially true for the U.S. firm in the case of a subsidy because under certainty it has an incentive to charge an infinitely high price.[12]

Before proceeding to the formal analysis, some explanations regarding notation are in

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[11]This can limit the U.S. firm's rent-seeking ability since the incentive to charge an arbitrarily high price is dampened by the small probability of getting the subsidy.

[12]Further, even if an upper bound is placed on the U.S. firm's price, complete certainty regarding that bound leads to excess strategic maneuvering by the Japanese firm. For instance, if we use the Carmichael (1987) type of constraint where the subsidy is revoked with certainty whenever the U.S. firm prices above its ordinary best response, the Japanese firm chooses its ordinary best response for U.S. prices above the free trade level, but has an incentive to cut prices discontinuously for lower U.S. prices and charge a price infinitesimally smaller than the one that just triggers the subsidy.

order. In this case, the competitive Japanese firm price p_1, is always equivalent to the consumer price p_1^C.[13] However, the U.S. consumer price p_2^C equals the firm price p_2 only when the subsidy is not realized. Otherwise, when the subsidy is triggered, p_2^C equals $g_2(p_1)$ where $g_2(p_1)$ is the U.S. consumer price that makes the market share constraint just bind for given Japanese firm price p_1. Hence, given firm prices (p_1, p_2), demand for the U.S. good is $q_2(p_1, g_2(p_1))$ if the subsidy is invoked and demand equals $q_2(p_1, p_2)$ if the subsidy is not granted. The locus of prices $(p_1, g_2(p_1))$ traces out an upward sloping line MM (shown in Figure 3) such that the market access constraint is binding only for firm prices lying above (and to the left) of this line.

Now, let $f(p_1, p_2)$ be the probability of the subsidy being granted for any given price combination above MM. Assume that $f(.)$ is nondecreasing in p_1 and nonincreasing in p_2.[14]

Then, given constant unit cost r_2, for price combinations (p_1, p_2) above MM, we can define the U.S. firm's expected profits as

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\begin{aligned}
\bar{\pi}_2(p_1, p_2) &= f(.)(p_2 - r_2)q_2(p_1, g_2(p_1)) + [1 - f(.)](p_2 - r_2)q_2(p_1, p_2) \\
&= f(.)\pi_2^H(p_1, p_2) + [1 - f(.)]\pi_2(p_1, p_2)
\end{aligned}
$$

where $\pi_2^H(p_1, p_2)$ is its profit at subsidized prices while $\pi_2(p_1, p_2)$ is its ordinary profit function. $\pi_2^H(p_1, p_2)$ and $\pi_2(p_1, p_2)$ are depicted in Figure 2. Notice that for any given p_1, $\pi_2^H(p_1, p_2)$ is represented by a straight line with a constant positive slope of $q_2(p_1, g_2(p_1))$.[15] Figure 2 also shows $\bar{\pi}_2(p_1, p_2)$ for the special case of constant probability of subsidy.

Let $B_2(p_1)$ denote the U.S. firm's ordinary best response in the absence of a market

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[13]Henceforth, p_i will always denote the price charged by firm i while the consumer price will be represented by p_i^C. Recall that firms in the competitive industry (Japanese firms, in this case) are identical in every respect and, hence, when good i is competitively produced, p_i refers to the price of the representative firm.
[14]For instance, we could use $f(p_1, p_2) = 1 - h(p_2 - g_2(p_1))$ where $h \in (0, 1)$, and $h'(.) \geq 0$ since we know that $g_2'(.) > 0$. Henceforth, for simplicity, we shall assume $f(p_1, p_2)$ to be a constant.
[15]Given any p_1, $q_2(p_1, g_2(p_1))$ is simply the demand for firm 2's product at the corresponding point on the market share line MM. $q_2(p_1, g_2(p_1))$ decreases continuously as p_1 increases and we move up along MM.

share constraint. Define $\overline{B}_2(p_1)$ as the interior maximizer of $\overline{\pi}_2(p_1, p_2)$ which we assume bounded and concave. If the market share constraint is binding, the relevant profit function is $\overline{\pi}_2(p_1, p_2)$. On the other hand, if the constraint is not binding, then the U.S. firm maximizes $\pi_2(p_1, p_2)$ as before. As $\overline{\pi}_2(p_1, p_2) = \pi_2(p_1, p_2)$ at $p_2 = g_2(p_1)$, the overall profit function is given by

$$\begin{aligned}
\hat{\pi}_2(p_1, p_2) &= \pi_2(p_1, p_2) \text{ for } p_2 \leq g_2(p_1) \\
&= \overline{\pi}_2(p_1, p_2) \text{ for } p_2 > g_2(p_1)
\end{aligned}$$

In Figure 2, the bold line traces out $\hat{\pi}_2(p_1, p_2)$. Note that for prices to the right of the p_2 at which $\pi_2(p_1, p_2)$ and $\pi_2^H(p_1, p_2)$ intersect, the market share constraint is violated and $\overline{\pi}_2(p_1, p_2)$ is the relevant profit for these prices. Let the maximizer of $\hat{\pi}_2(p_1, p_2)$ be denoted by $\hat{B}_2(p_1)$. Then, there are three possibilities to consider when deriving the U.S. firm's overall best response. Given Japanese price p_1, $\pi_2(.)$ and $\overline{\pi}_2(.)$ may intersect at a p_2 where (i) both are increasing in p_2, (ii) both are decreasing in p_2, or (iii) $\pi_2(.)$ is decreasing and $\overline{\pi}_2(.)$ is increasing in p_2. Recall that at $p_2 = g_2(p_1)$, $\overline{\pi}_2(.) = \pi_2(.)$ and $\overline{\pi}_2(.)$ has a larger slope than $\pi_2(.)$. Then, given the definition of $\hat{\pi}_2(p_1, p_2)$, we must have $\hat{B}_2(p_1) = \overline{B}_2(p_1)$ in case (i) and $\hat{B}_2(p_1) = B_2(p_1)$ in case (ii). In case (iii), $\hat{B}_2(p_1)$ equals either $\overline{B}_2(p_1)$ or $B_2(p_1)$ depending on whether the peak of $\overline{\pi}_2(.)$ is higher or lower than that of $\pi_2(.)$. Case (i) occurs when $B_2(p_1) > g_2(p_1)$, case (ii) corresponds to situations where $\overline{B}_2(p_1) < g_2(p_1)$ while case (iii) occurs when $B_2(p_1) < g_2(p_1) < \overline{B}_2(p_1)$. Note that Figure 2 is representative of case (i).

Figure 3 shows $\overline{B}_2(p_1)$, $B_2(p_1)$ and the market share line MM in price space. Note that for p_1 less than R_1' (the p_1 at which MM intersects $B_2(p_1)$) we are in case (i), while case (ii) corresponds to p_1 greater than R_1''' (the p_1 at which MM intersects $\overline{B}_2(p_1)$). Case (iii) occurs for Japanese prices in the intermediate range between R_1' and R_1'''. Hence, from the above analysis, we may depict the overall U.S. best response $\hat{B}_2(p_1)$ by the bold line in Figure 3

which assumes one switchover point R_1'' at which $\widehat{B}_2(p_1)$ jumps down from $\overline{B}_2(p_1)$ to $B_2(p_1)$.

Now, let R_1 be any Japanese competitive price resulting in a free trade equilibrium point A, unconstrained by any market share target. If the market access requirement specifies a U.S. share greater than that in free trade, MM must lie below $B_2(p_1)$ at $p_1 = R_1$, and so, R_1 must lie to the left of R_1' in Figure 3. Clearly, this corresponds to case (i) and the U.S. firm maximizes its profit by picking a price $\overline{B}_2(R_1)$, resulting in the equilibrium at point C. In equilibrium, there is a positive probability of a subsidy being granted and the U.S. firm charges a higher price compared to free trade.

3.2 Subsidy policy with a Japanese monopoly firm and a competitive U.S. industry:

Now, consider the incentive effects under (b) where the Japanese firm has the market power. Analogous to the previous case, given firm prices (p_1, p_2), demand for the Japanese good is $q_1(p_1, g_2(p_1))$ if the subsidy is invoked and demand equals $q_1(p_1, p_2)$ if the subsidy is not granted. The Japanese firm knows that if the market share requirement is not met, a subsidy will be given (stochastically) to the U.S. firms. In this event, demand for the Japanese firm will fall, along with its profit. If, however, the Japanese firm were to raise its price, it could reduce or eliminate the subsidy given to the U.S. firms, and at least get a higher price in return for a lower demand. This is what creates incentives for price increases by the Japanese firm even when the U.S. firms are pricing competitively.

Proceeding similarly to the previous case, for any U.S. firm price p_2, let $g_1(p_2)$ be the Japanese consumer price that satisfies the market share constraint with equality. Then, given p_2, unit cost r_1 and the probability of subsidy $f(.)$, the Japanese firm's expected profit function for prices to the left of MM is:

$$\overline{\pi}_1(p_1, p_2) = f(.)(p_1 - r_1)q_1(p_1, g_2(p_1)) + [1 - f(.)](p_1 - r_1)q_1(p_1, p_2)$$

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$$= f(.)\pi_1^L(p_1) + [1 - f(.)]\pi_1(p_1, p_2)$$

$\pi_1(p_1, p_2)$ is the Japanese firm's ordinary profit function while $\pi_1^L(p_1)$ is its profit at the subsidized prices $(p_1, g_2(p_1))$, and equals its ordinary profit at the corresponding point on the MM line. For given p_2, note that the first derivative of $\pi_1^L(p_1)$ is greater than that of $\pi_1(p_1, p_2)$ at $p_1 = g_1(p_2)$, i.e., on the MM line, since demand at the subsidized prices is more inelastic than ordinary demand. Since $\overline{\pi}_1(p_1, p_2)$ is a convex combination of $\pi_1^L(p_1)$ and $\pi_1(p_1, p_2)$ and $f(.)$ is constant, the derivative of $\overline{\pi}_1(p_1, p_2)$ must also be greater than that of $\pi_1(p_1, p_2)$.[16] Figure 4 depicts $\pi_1^L(p_1)$, assumed concave, $\pi_1(p_1, p_2)$ and $\overline{\pi}_1(p_1, p_2)$.

The Japanese firm's overall profit function is given by

$$\widehat{\pi}_1(p_1, p_2) = \pi_1(p_1, p_2) \text{ for } p_1 \geq g_1(p_2)$$
$$= \overline{\pi}_1(p_1, p_2) \text{ for } p_1 < g_1(p_2)$$

$\widehat{\pi}_1(p_1, p_2)$ is shown as the bold curve in Figure 4. Note that, now, for prices less than the p_1 at which $\pi_1^L(p_1)$ and $\pi_1(p_1, p_2)$ intersect, the market share constraint is violated and $\overline{\pi}_1(p_1, p_2)$ is the relevant profit. Let $\widehat{B}_1(p_2)$ be the maximizer of $\widehat{\pi}_1(p_1, p_2)$. Again, we have three cases to consider in deriving the Japanese firm's overall best response. Given U.S. price p_2, $\pi_1(.)$ and $\overline{\pi}_1(.)$ may intersect at a p_1 where (i) both are increasing in p_1, (ii) both are decreasing in p_1, or (iii) $\pi_1(.)$ is decreasing and $\overline{\pi}_1(.)$ is increasing in p_1. Then, from the definition of $\widehat{\pi}_1(p_1, p_2)$, we must have $\widehat{B}_1(p_2) = B_1(p_2)$ in case (i) and $\widehat{B}_1(p_2) = \overline{B}_1(p_2)$ in case (ii). In case (iii), $\widehat{B}_1(p_2)$ equals $g_1(p_2)$, i.e., the Japanese firm prices along MM. Case (i) occurs when $B_1(p_2) > g_1(p_2)$, case (ii) corresponds to situations where $\overline{B}_1(p_2) < g_1(p_2)$ while case (iii) occurs when $B_1(p_2) < g_1(p_2) < \overline{B}_1(p_2)$. Figure 4 corresponds to the situation in case (ii).

[16]Formally, $\frac{\partial \overline{\pi}_1}{\partial p_1} = f \frac{\partial \pi_1^L}{\partial p_1} + (1 - f) \frac{\partial \pi_1}{\partial p_1}$, where $f \in (0, 1)$ is a constant and $\frac{\partial \pi_1^L}{\partial p_1} > \frac{\partial \pi_1}{\partial p_1}$ at $p_1 = g_1(p_2)$.

Now, consider Figure 5 which shows $B_1(p_2)$, $\overline{B}_1(p_2)$ and the market share line MM in price space. As drawn, the Japanese firm's profit, as we move up along MM, increases up to the point D (where an iso-profit curve is tangent to MM) and then decreases. For U.S. prices less than R'_2 (the p_2 at which MM intersects $B_1(p_2)$) we are in case (i) and the best response is to choose $B_1(p_2)$. For p_2 greater than R''_2 (the p_2 on MM corresponding to the price R'_1 which maximizes $\pi_1^L(p_1)$), we are in case (ii) and the Japanese firm is best off pricing along $\overline{B}_1(p_2)$. Note that for $p_2 \geq R'''_2$ (the p_2 at which $B_1(p_2)$ intersects R'_1), $\overline{B}_1(p_2)$ must lie to the left of $B_1(p_2)$. Finally, for prices in the intermediate range between R'_2 and R''_2, $\pi_1(p_1, p_2)$ is decreasing in p_1 while $\pi_1^L(p_1)$ is increasing in p_1 at $g_1(p_2)$. Hence, $\overline{\pi}_1(.)$ may be increasing - case (iii) with $\widehat{B}_1(p_2) = g_1(p_2)$ - or decreasing - case (ii) with $\widehat{B}_1(p_2) = \overline{B}_1(p_2)$. Since $\overline{\pi}_1(.)$ is a convex combination of $\pi_1(p_1, p_2)$ and $\pi_1^L(p_1)$, it is likely to be increasing for prices close to R'_2 but is likely to be decreasing for prices close to R''_2. This, in turn, suggests that $\widehat{B}_1(p_2)$ lies along the MM line for prices close to R'_2 and lies on $\overline{B}_1(p_2)$ for prices close to R''_2. The overall Japanese best response depicted by the bold line in Figure 5 is drawn under the assumption that $\overline{B}_1(p_2)$ intersects MM at prices $(\widetilde{R}_1, \widetilde{R}_2)$.

In Figure 5, suppose the U.S. good is priced competitively at R_2 and the market share target is greater than the free trade level. Then at R_2, MM must lie to the right of $B_1(p_2)$ and must intersect $B_1(p_2)$ at some point E as depicted. We are then in case (ii) and the Japanese firm prices along $\overline{B}_1(p_2)$ resulting in an equilibrium at point C. Compared to the free trade equilibrium at A, the *ex post* subsidy policy yields a higher Japanese price and a (stochastically) lower consumer price for the U.S. good.[17]

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[17]If the competitive U.S. price lies between R'_2 and $\widetilde{R}_2$, the *ex post* subsidy policy results in an unchanged U.S. price, a higher Japanese price and a zero subsidy in equilibrium.

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3.3 Tax policy with a U.S. monopoly firm and a competitive Japanese industry:

Turning to tax policy, consider (c). The ordinary best response function $B_2(p_1)$, and the market share constraint MM, are as depicted in Figure 6. Note that, analogous to the previous subsidy policy cases, MM must again lie to the right of the point where the competitive Japanese price R_1 intersects $B_2(p_1)$ since we are considering a market share requirement set above the free trade level. However, in contrast to the subsidy case, the analysis is carried out with a deterministic tax, i.e., perfect enforcement of the VIE is assumed. The motivation is to emphasize that it is the timing of moves, and not the uncertainty, which determines the nature of the realized outcomes. In particular, an *ex post* tax/subsidy instrument is always more anticompetitive in its effects than its *ex ante* counterpart.[18]

When the Japanese competitive price is R_1, the U.S. firm has an incentive to raise its price in response to the tax policy. By raising its price, it can ensure that its market share falls below the required level, triggering a tax on the Japanese industry which pulls up the real price to consumers of the Japanese good in tandem with the U.S. price along MM. The profit maximizing point along MM for the U.S. firm is the tangency point at D. Hence, when the Japanese price is R_1, the U.S. firm is best off choosing to invoke taxes on the Japanese firms, which restricts their ability to compete in their own market, and allows the U.S. firm to further enhance its monopoly power. It charges a price p_2^H that is greater than the free trade price and that results in an equilibrium at point C. Notice that the incentive effects of the tax results in behavior on the U.S. firm's part that is similar in nature to its pricing strategy under a VER on the rival good. (See Krishna, 1989).

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[18]The analysis with a stochastic tax is analogous to that in the subsidy case and results in best responses that are similar in nature. In fact, the equilibrium outcomes with a stochastic tax are explicitly calculated for the example in section 5, allowing for comparison with the deterministic tax.

Alternatively, it can choose not to invoke taxes on the Japanese industry and get the highest profit it can for this option. It compares its maximum profit from not invoking taxes with the maximum profit it can get by triggering taxes. It will choose not to invoke taxes on the rival industry if the Japanese price is high enough, and will trigger taxes otherwise. This is illustrated in Figure 6, where the U.S. firm's best response is depicted by the bold line. Note that it is discontinuous at $p_1 = \hat{p}_1$ where the profits from its two options are equal.[19]

3.4 Tax policy with a Japanese monopoly firm and a competitive U.S. industry:

Finally, consider (d) where the Japanese firm has the market power and is taxed whenever the market share target is violated. Now, for any U.S. price p_2, the Japanese firm will never want to charge a price to the left of MM since the resulting tax raises its consumer price to the corresponding point on MM. Consequently, it is better off raising its price to lie on MM and at least getting the benefit of a higher price. Thus, its best response to any U.S. price can never lie to the left of MM. This best response is depicted by the bold line in Figure 7. Again, if MM represents a U.S. market share greater than the free trade level, MM lies to the right of A and the tax policy raises the Japanese price from that at A to that at C. Note that the Japanese firm's best response is reminiscent of the case of a VER on its product.

4. Ex Post Policy with Two-Sided Market Power:

The effect of two-sided market power can be thought of as combining the elements of the analysis so far. If, for example, we consider the implementation of a minimum market share using a subsidy on the U.S. firm, then two-sided market power can be thought of as

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[19]It can be verified that when $p_1 = \hat{p}_1$, the U.S. firm's best strategy is to randomize between p_2^H and p_2^L (see Krishna, 1989, for a similar proof).

superimposing the best response of a U.S. firm having market power, case (a) and Figure 3 above, on the best response function of a Japanese firm having market power, case (b) and Figure 5 above. This is done in Figure 8 where the best responses for the Japanese and U.S. firms are labelled $\hat{B}_1(p_2)$ and $\hat{B}_2(p_1)$ respectively. When the U.S. firm alone exercises market power it has an incentive to raise prices in the hope of triggering subsidies. On the other hand, when the power is on the Japanese side, there is an incentive to increase prices to reduce the amount of the subsidy, as well as to receive a higher price for its product should the demand lowering subsidy occur. Since price increases are still matched by each firm (strategic complements), putting both the sides together results in higher prices compared to the free trade equilibrium.

If we consider the implementation of a minimum market share using taxes on the Japanese firm, then we need to superimpose the best response of a U.S. firm having market power, case (c) and Figure 6 above, on the best response function of a Japanese firm having market power, case (d) and Figure 7 above. Doing so gives Figure 9.[20]

Observe that the two best response functions do not intersect. There is no pure strategy equilibrium and the mixed strategy equilibrium consists of the U.S. firm mixing between the two points p_2^L and p_2^H in Figure 6, and the Japanese firm charging $\hat{p}_1$. The form of the equilibrium is analogous to that in Krishna (1989). The U.S. firm can either set a high price and trigger a tax on the Japanese firm which raises its price, or choose to ignore that option, and price along its old best response. It will ignore the option when the Japanese price is high enough and use it otherwise. When the Japanese firm charges $\hat{p}_1$, the U.S. firm is indifferent between its two options and is willing to mix between them in any way needed. The mixing is designed to make the Japanese firm choose to charge $\hat{p}_1$. In equilibrium, for

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[20]Alternatively, if we were to consider a stochastic tax, the situation would be similar in nature to the subsidy case. In fact, the example in the next section depicts the outcomes with either type of tax, demonstrating that a non-deterministic instrument is less collusive than a deterministic one.

market shares close to free trade levels, the prices charged are higher. The profits of the U.S. firm are higher in equilibrium.

Hence, both the obvious schemes - taxes and subsidies - to use in implementing market share requirements are seen to carry adverse incentive baggage with them in that, either scheme tends to raise prices charged by firms.

5. An Example:

This section presents a simple but concrete numerical example to highlight the importance of the timing of moves between government and firms in the presence of a minimum market share target. By focusing on the differences in equilibrium outcomes when comparing *ex ante* policies with their *ex post* counterparts, the exercise yields valuable insights into the economic effects of the various policies and helps rank them in terms of desirability from the Japanese government's standpoint. Further, by examining an alternative tax instrument, viz. the *ex post* stochastic tax, we demonstrate that some degree of imprecision in enforcing the VIE target makes for less anticompetitive outcomes.[21]

Using linear demand and a constant probability of subsidy/tax of 0.2 in a duopolistic setting, we consider a case where the U.S. firm initially has 46% of the Japanese market prior to the U.S. government's successful negotiation of a 60% VIE target.[22] Table 1 reports the resulting firm prices, consumer prices, outputs, profits, subsidy expenditures, tax revenues, Japanese consumer surplus and Japanese welfare across six different policy

[21]While the formal analysis has considered only *ex post* deterministic taxes, an *ex post* stochastic tax can readily be shown to yield best responses similar in nature to those found in the *ex post* subsidy setting.
[22]The example uses the demand structure $q_i = a_i - bp_i + cp_j, i,j = 1,2; j \neq i$; with $a_1 = 5, a_2 = 4, b = 2, c = 1$; and costs of production $r_1 = r_2 = 1$. These demands are derived from the underlying utility function $U(q_1, q_2) = \alpha_1 q_1 + \alpha_2 q_2 - (\beta q_1^2 + 2\gamma q_1 q_2 + \beta q_2^2)/2$ with $a_i = (\alpha_i \beta - \alpha_j \gamma)/(\beta^2 - \gamma^2), b = \beta/(\beta^2 - \gamma^2)$ and $c = \gamma/(\beta^2 - \gamma^2)$. Consumer surplus with prices (p_1, p_2) and quantities (q_1, q_2) is given by $U(q_1, q_2) - (\pi_1 + \pi_2)$. See Singh and Vives (1984) for details. Similar qualitative results hold for different parameter values, and also for the case where the probability of subsidy/tax is allowed to vary with firm prices.

regimes: no VIE target, *ex ante* subsidy, *ex ante* tax, *ex post* subsidy, *ex post* certain tax and *ex post* stochastic tax.[23] Note that U.S. welfare is simply the U.S. firm's profit. Also note that, in this example, though the equilibria (in firm prices) are in pure strategies, one should be very careful when comparing the *ex post* policies with their *ex ante* counterparts since in the *ex post* case, the consumer prices (and, hence, quantities, profits and welfare) reported in the table are only expected values.

At the very outset, we notice that an *ex post* subsidy results in higher consumer prices than an *ex ante* subsidy: (2.37, 2.16) compared to (2.10, 1.40). In fact, unlike the *ex ante* subsidy, the *ex post* subsidy actually increases consumer prices above free trade levels! The Japanese consumers are better off under the *ex ante* subsidy with a consumer surplus of 7.66 (compared to 5.05 under the *ex post* subsidy). However, from the Japanese government's viewpoint, the *ex post* subsidy dominates the *ex ante* subsidy in terms of profit: (3.32 compared to 2.42), and subsidy expenditure: the *ex ante* subsidy costs a whopping 4.13 while the *ex post* subsidy only costs .34! In fact, the unweighted sum of consumer surplus and profit less subsidy expenditures assigns a higher value to the *ex post* subsidy: welfare is 8.03 under the *ex post* subsidy but is only 5.96 with the ex ante subsidy. Nevertheless, the Japanese government may prefer the *ex ante* subsidy if consumer surplus is weighted more heavily in national welfare. The U.S. firm is better off with the *ex ante* subsidy than with the *ex post* subsidy.[24]

The tendency for prices to rise more when firms move first is again found in the tax case. The *ex post* certain tax yields consumer prices of (3.14, 2.54) and consumer surplus of only 2.83 while the *ex ante* tax results in lower prices of (2.80, 2.20) and a higher consumer

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[23]Japanese welfare is measured as the unweighted sum of consumer surplus, firm profit and tax revenues in the case of a tax instrument, and as the unweighted sum of consumer surplus and firm profit less subsidy expenditures in the case of a subsidy instrument.

[24]Note that consumer prices and outputs with a VIE and an import subsidy in Greaney's model correspond to those with an *ex ante* tax and an *ex ante* subsidy, respectively, in our framework.

surplus of 4.05. Since Japanese profit plus tax revenue is larger with the *ex ante* tax, the *ex ante* tax clearly dominates the *ex post* certain tax in terms of welfare. This serves to stress the point that the price increases are caused by the timing of moves and not by the uncertainty.

In fact, some degree of imprecision in the VIE's specification reduces the extent to which the firms can strategically exploit the VIE and yields less anticompetitive outcomes relative to the *ex post* certain tax. This is borne out in Table 1, where firm and consumer prices are lower for both goods with the *ex post* stochastic tax compared to the *ex post* certain tax. This translates into a much higher Japanese consumer surplus of 4.79 with the *ex post* stochastic tax relative to the low figure of 2.83 with the *ex post* certain tax. Further, since Japanese profit plus tax revenue is also higher, Japanese welfare is much higher with the *ex post* stochastic tax : 8.02 compared to 5.51. The intuition is that the average U.S. market share with the stochastic tax is .49 (not shown in Table 1) and, so, the uncertain *ex post* tax is less restrictive than the certain *ex post* tax.[25] However, not surprisingly, the U.S. is better off with the *ex post* certain tax enjoying a welfare of 3.13 compared to 2.49.

More interestingly, the *ex post* stochastic tax yields a higher consumer surplus than the *ex ante* tax: 4.79 compared to 4.05: due to smaller consumer prices: (2.47, 2.17) compared to (2.80, 2.20). Further, the higher profit plus tax revenue for the Japanese firm implies a larger national welfare with the stochastic tax and, consequently, the Japanese government would pick the *ex post* stochastic tax if faced with a choice between a stochastic tax and an *ex ante* tax. As for U.S. welfare, it continues to be better off with the *ex post* certain tax compared to the *ex ante* tax.

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[25]Even if the stochastic tax policy were designed to yield an equilibrium average U.S. market share of 60%, the *ex post* certain tax would still be dominated by the *ex post* stochastic tax. For instance, an 85% VIE target implemented through an *ex post* tax with a probability of .4 (not shown in Table 1), results in an average market share of 60% but generates a higher consumer surplus and welfare: 4.11 and 6.67, respectively, compared to the *ex post* certain tax.

How do the stochastic tax and *ex post* subsidy compare? While the consumer price of the U.S. good is roughly the same for both, the *ex post* subsidy produces a smaller price for the Japanese good. This is reflected in a higher consumer surplus of 5.05 for the *ex post* subsidy. On the other hand, Japanese profit plus tax revenue with the *ex post* stochastic tax is greater than profit less subsidy expenditure for the *ex post* subsidy. Using our measure of welfare, we find that the *ex post* subsidy is marginally superior to the *ex post* stochastic tax in this example. Note that with either the *ex post* subsidy or the *ex post* stochastic tax the actual U.S. market share realized may fall short of the mandated minimum.

6.   Conclusion:

The current U.S. preoccupation with negotiating minimum market share targets with the Japanese government has raised many questions regarding the economic consequences of these targets. However, recent work to analyze these questions has paid little attention to the implementation aspect, even though it is well understood that enforcement is critical to the success of any results-oriented policy. This paper explicitly considers tax and subsidy instruments to implement minimum market share agreements and demonstrates that their effects depend critically on the sequence of moves between government and firms. In partic- ular, when the home government can move only after firms have made their strategic choices (*ex post* policy), both taxes and subsidies create powerful incentives for firms to raise prices - incentive effects that are absent in the traditional *ex ante* timing framework.

Under subsidy policy with monopoly power on the U.S. side, the incentives are for the U.S. firm to raise price and trigger the subsidies. If monopoly power is on the Japanese side, the incentives are for the Japanese firm to try and ensure that the subsidies are not triggered since such an occurrence lowers sales without a compensatory high price. Thus,

it raises price to prevent subsidies (and reduce their amount) to the U.S. firms. In either case, under the *ex post* timing structure, subsidies create incentives to raise prices. If the minimum import requirement is implemented by a tax on the Japanese good and market power is on the U.S. side, then the incentives are for the U.S. firm to raise its price, triggering taxes on the Japanese good, which in turn enhances demand for the U.S. firm's product and increases its profit. If power is on the Japanese side, then the incentive is always to prevent taxes from being invoked by charging higher prices. Here, too, a timing structure with government as second mover produces incentives that result in higher prices. Thus, both tax and subsidy schemes, in the presence of market power, are anticompetitive in their effects. These incentive effects, while well documented for quotas/VERs, are not found in the literature on tax/subsidy policy.

These anticompetitive effects are mitigated to some extent when the government's enforcement ability is less than perfect. Some degree of imprecision in implementing the VIE target reduces the firms' power to strategically exploit the target and yields less anticompetitive outcomes - a fact which may account, in part, for the Japanese government's steadfast opposition to precise numerical targets. Further, imperfect enforcement gives rise to situations where the actual market share realized by the foreign firm falls short of the VIE target - a phenomenon frequently observed in the case of the semiconductor VIE. Hence, our framework captures, albeit loosely, some aspects of MITI's handling of the semiconductor VIE.

Given the anticompetitive nature of the specific tax and subsidy instruments considered so far, the natural question that arises is: 'are there situations in which an import target can be implemented without raising prices?' This issue is examined in depth in Krishna, Roy and Thursby (1996) where we show that such pro-competitive policies are indeed possible.

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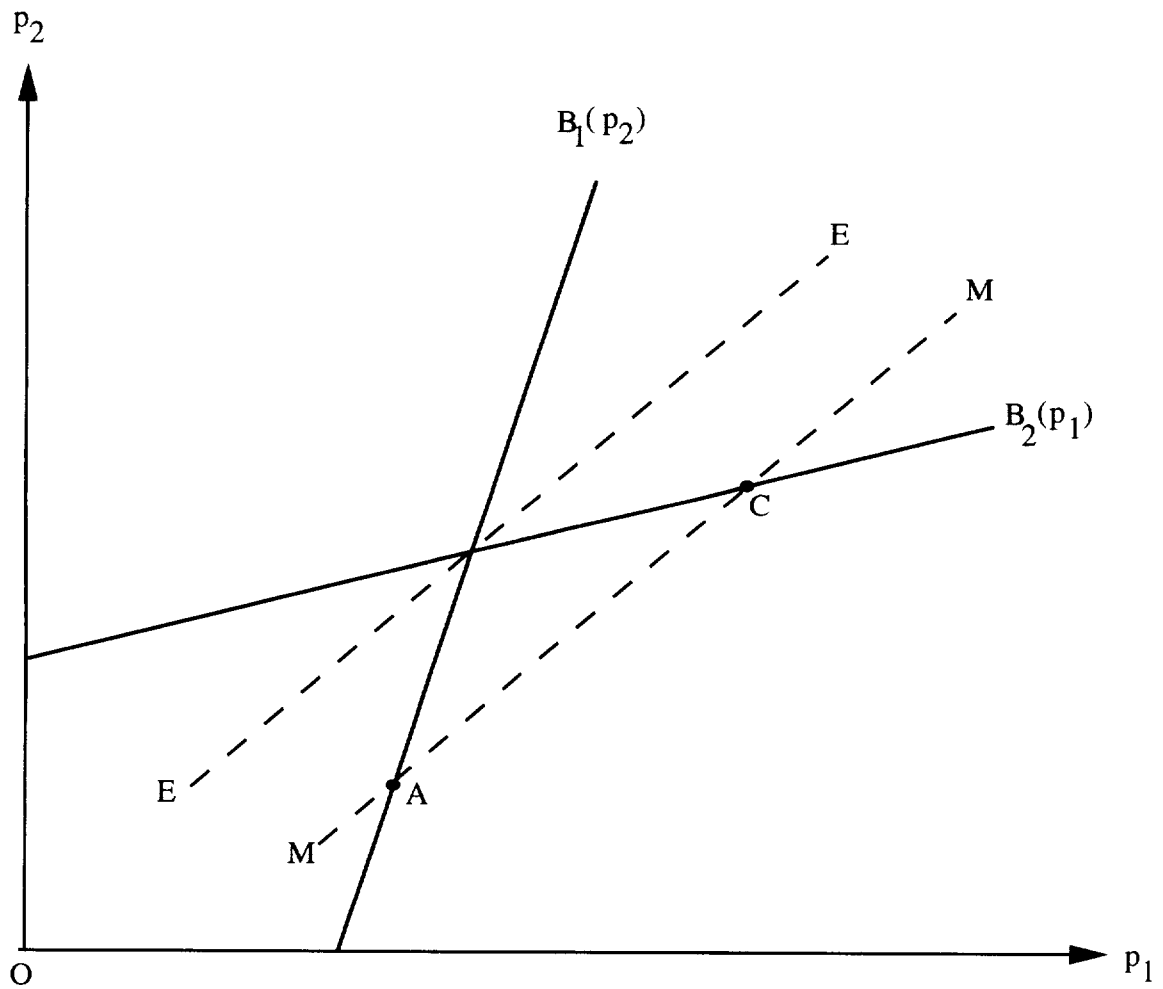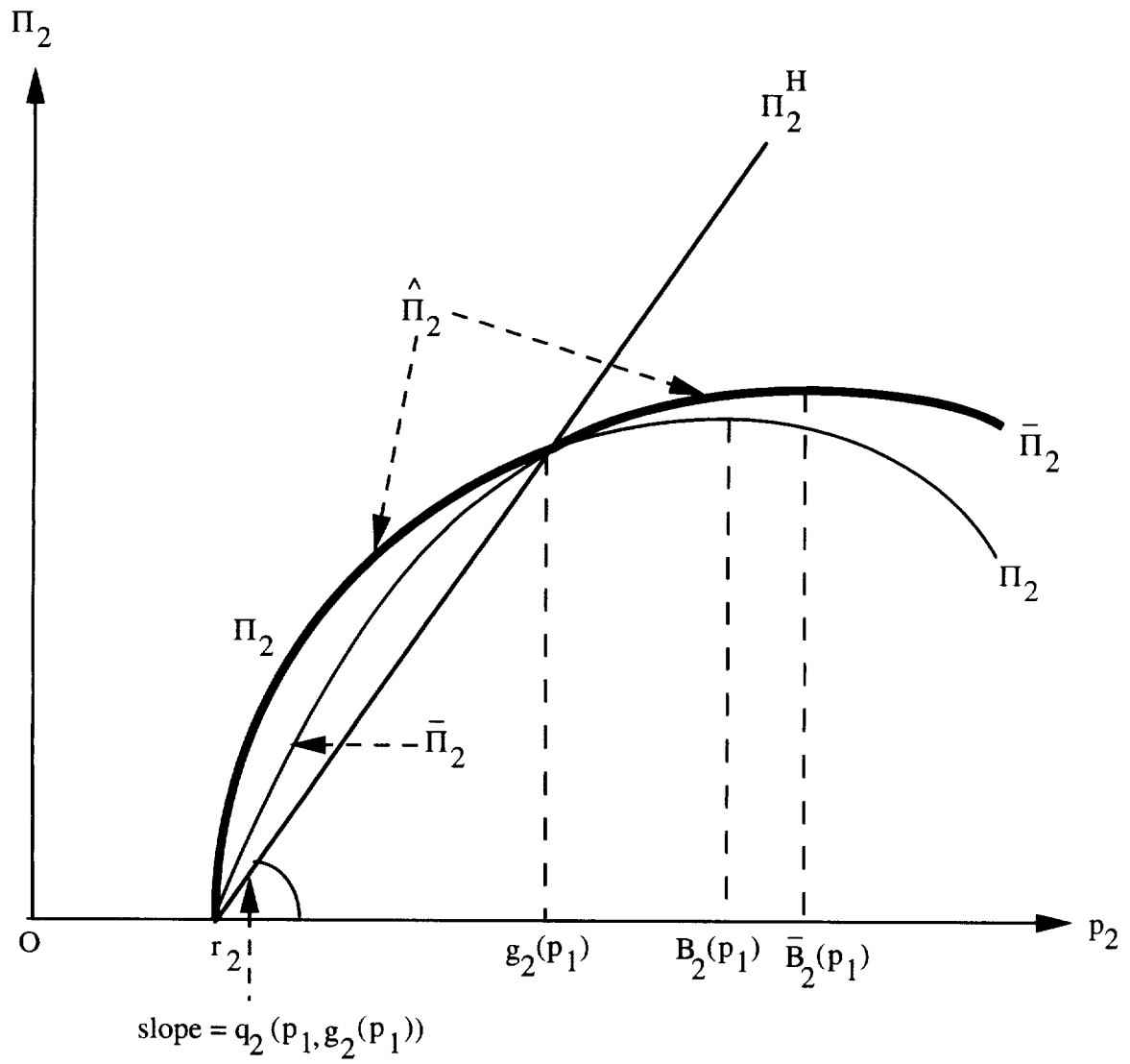21. Tyson, Laura D'Andrea, 1992, Who's Bashing Whom: Trade Conflict in High Technology Industries, Washington, D.C.: Institute for International Economics.
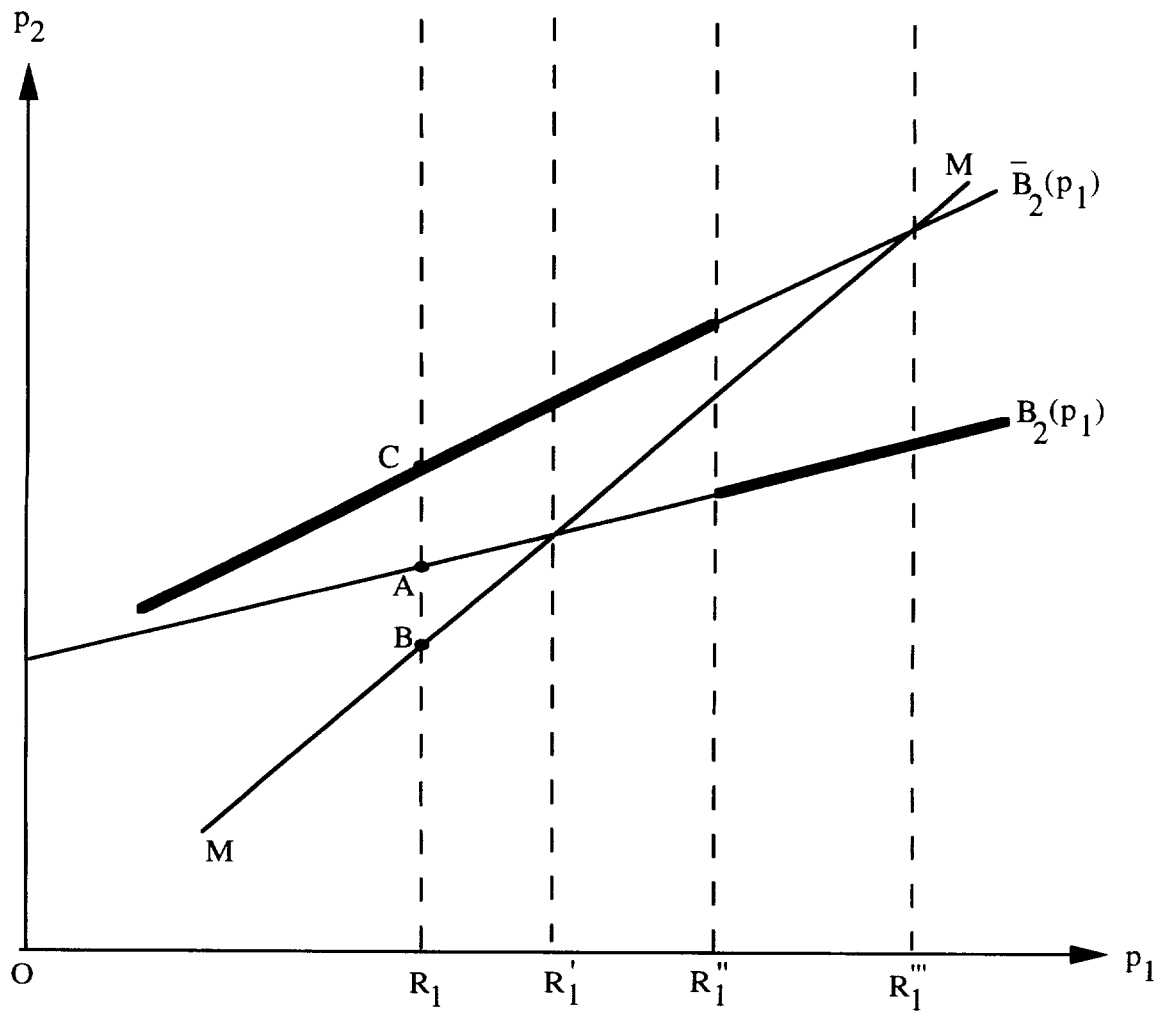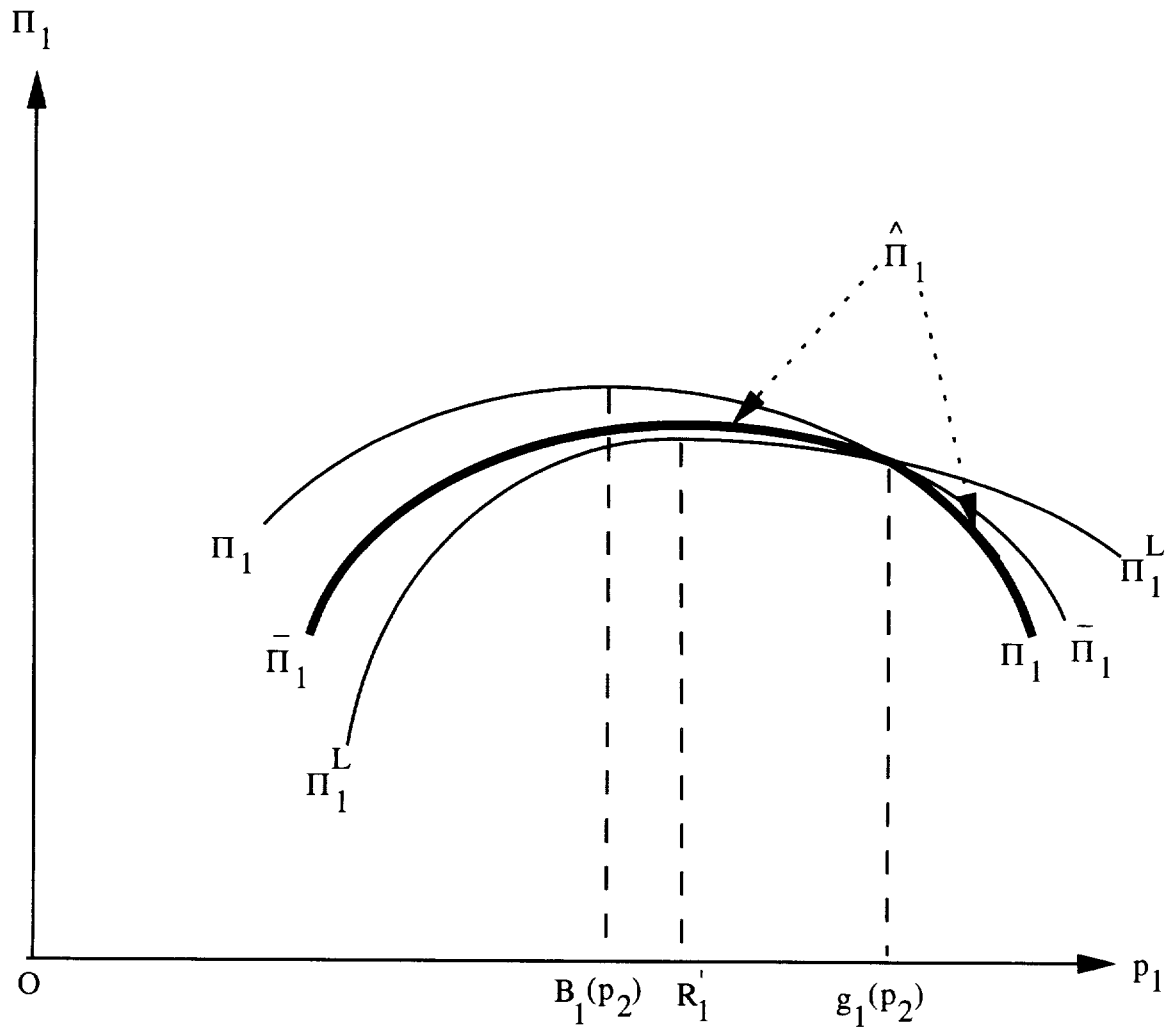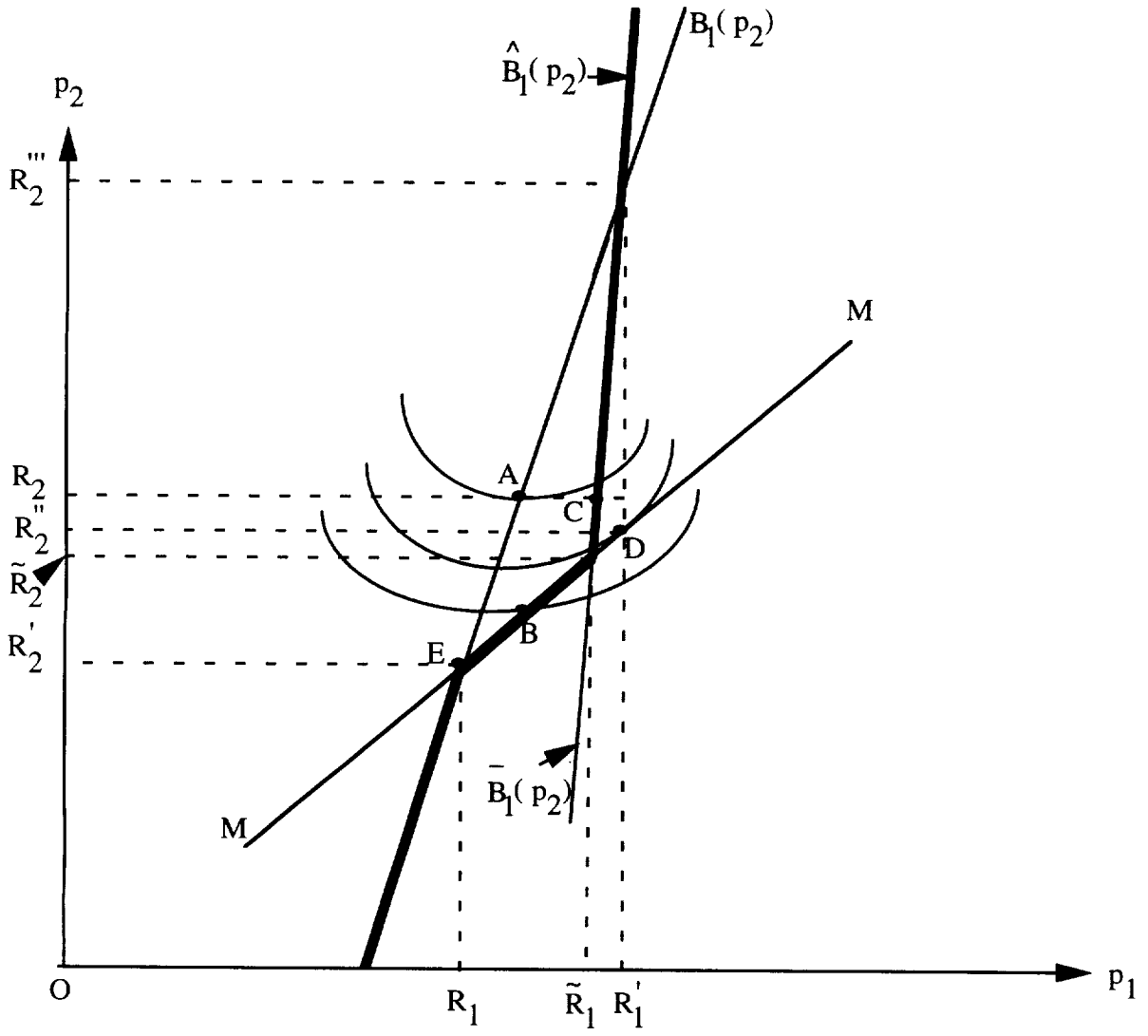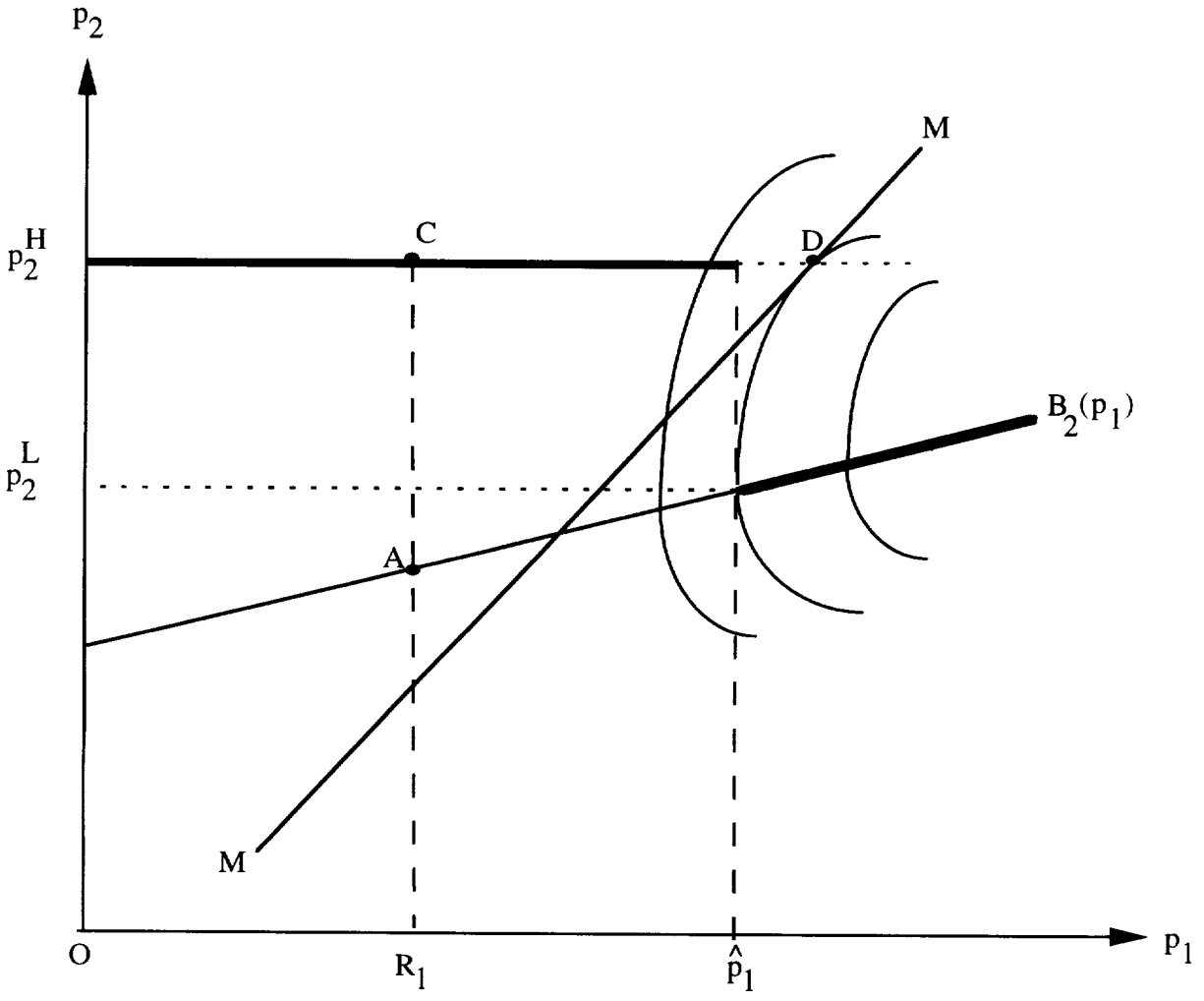
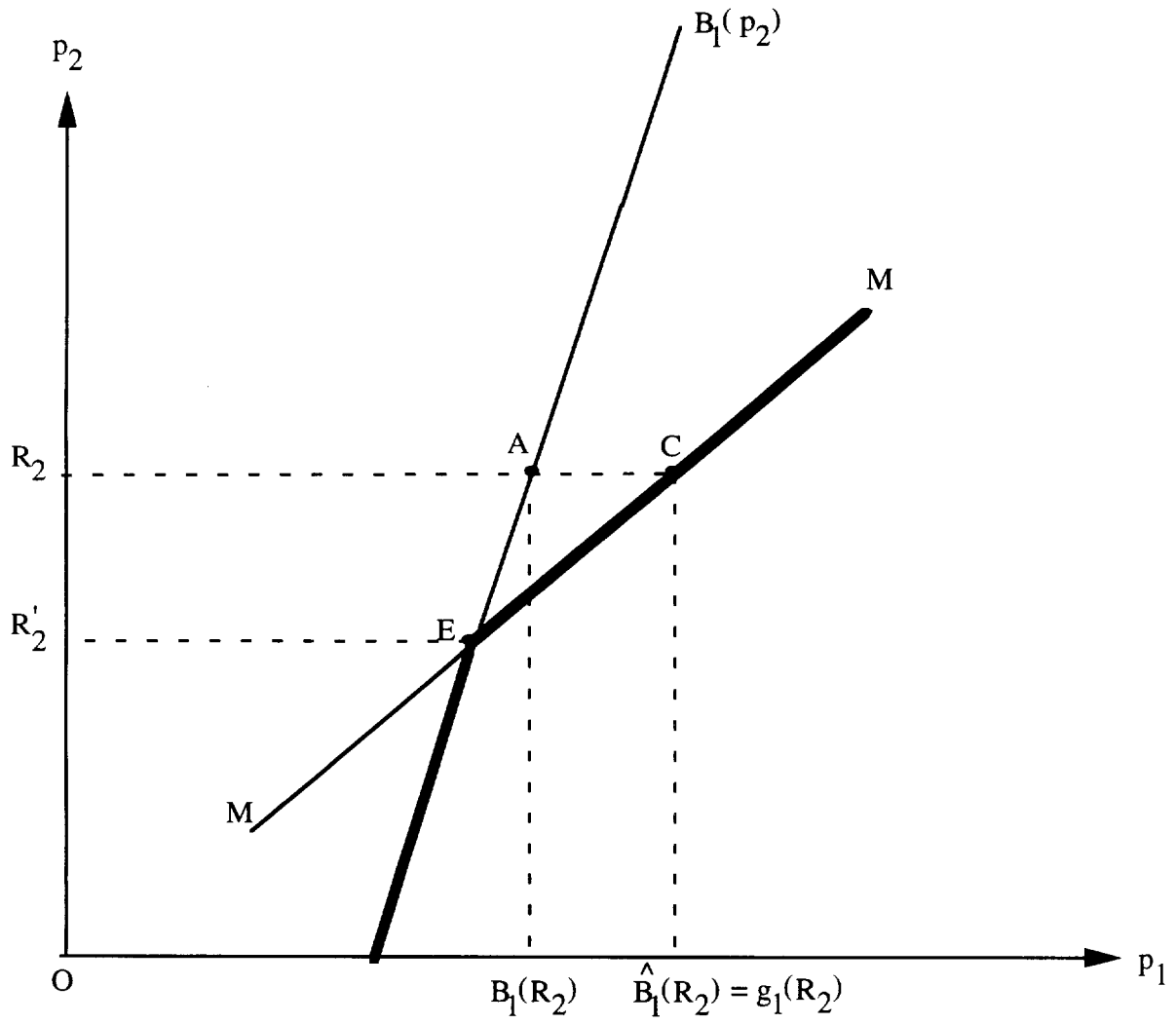Figure 1

Figure 2

Figure 3

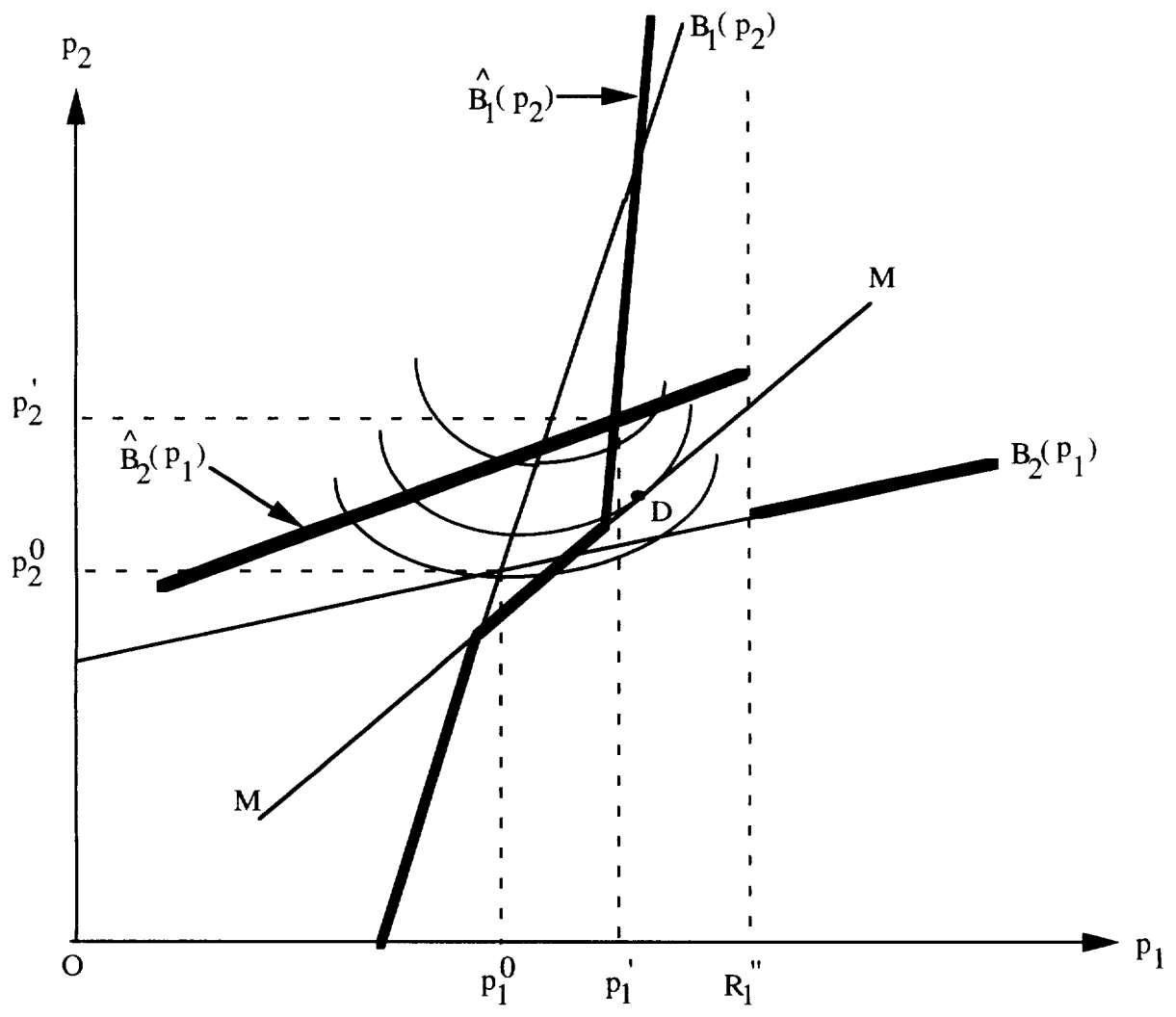Figure 4

Figure 5

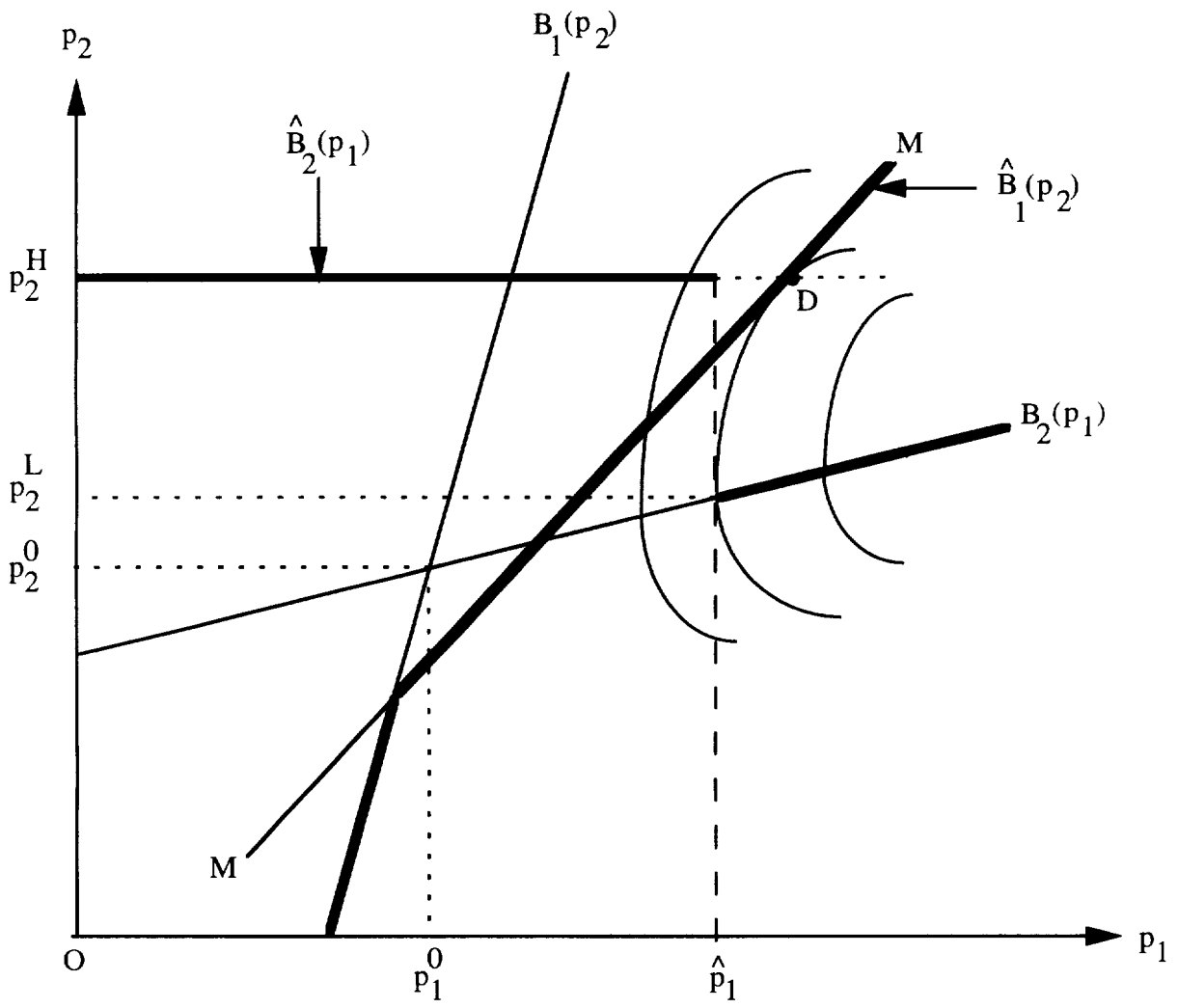Figure 6

Figure 7

Figure 8

Figure 9

Table 1.* **Firm and consumer prices, quantities, profits, subsidy expenditures, tax revenues, consumer surplus and welfare for const. probability .2 and VIE target 0.6**

	No VIE target	Ex ante Subsidy	Ex ante Tax	Ex post Subsidy	Ex post Certain Tax	Ex post Stoch. Tax
Jap. firm price	2.27	2.10	1.80	2.37	3.00	2.39
U.S. firm price	2.07	2.65	2.20	2.28	2.54	2.17
Jap. cons. price	2.27	2.10	2.80	2.37	3.14	2.47
U.S. cons. price	2.07	1.40	2.20	2.16	2.54	2.17
Jap. quantity	2.53	2.20	1.60	2.43	1.25	2.23
U.S. quantity	2.13	3.30	2.40	2.04	2.07	2.13
Jap. profit	3.21	2.42	1.28	3.32	2.50	3.11
U.S. profit	2.28	5.45	2.88	2.61	3.13	2.49
Subsidy expen.	NA	4.13	NA	.34	NA	NA
Tax revenue	NA	NA	1.6	NA	.18	.12
Jap. cons. surplus	5.44	7.66	4.05	5.05	2.83	4.79
Jap. welfare	8.66	5.96	6.93	8.03	5.51	8.02

*Numbers have been rounded off to two decimal places.