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WTO Exceptions as Insurance

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Abstract

The paper formalizes the notion that GATT exceptions such as antidumping and escape clause actions can act as insurance for import competing sectors affected by adverse price shocks. The authors use a general-equilibrium model with several import competing sectors and assume incomplete markets so that agents cannot contract insurance. It is shown that sector-specific contingent protection measures are superior to uniform contingent tariffs as an insurance mechanism. A tax-cum-subsidy policy (i.e., taxing all sectors in order to subsidize the shocked sector) also improves welfare and is superior to contingent protection.

1. Introduction

Thanks primarily to the tariff reductions negotiated under the auspices of the GATT and WTO, international trade is likely as unfettered by restrictions as at any other time in history. While the gains from free trade are widely recognized, it is also well known that openness makes economies more vulnerable to injury from adverse trade shocks. GATT founders were cognizant that injured import competing groups might use such shocks as an excuse to renege on GATT agreements; for that reason exceptions to tariff obligations were provided within the GATT. These exceptions allow governments to protect the injured sector while not abandoning the tariff liberalization achieved in other sectors.[1]

GATT exceptions allow governments to take actions in response to imports which are deemed to have harmed the domestic competing industry. If injury is caused by "fair" trade (e.g., an increase in imports due to tariff reductions), a government can invoke the escape clause to restrain imports; if injury is caused by "unfair" trade (e.g., dumping or government subsidization of imports), the policy response is antidumping or countervailing duties. Dam (1970) points out that these exceptions have been included in *every* GATT agreement. Moreover, he argues that the inclusion of these exceptions was crucial for the success of the early GATT rounds. His view is that exceptions greatly increased the number of sectors where tariffs were liberalized by diffusing domestic political opposition toward trade liberalization. In a sense, exceptions offered the promise of insurance for sectors injured by the liberalization.

Clearly then, for many years policymakers have taken for granted that trade policy can act as insurance. However, the notion that trade policy can act as insurance was not formalized until Eaton and Grossman (1985; EG hereafter).[2] In their model there is a single import competing sector and single export sector. The import competing sector is subject to price shocks. The goods are produced with two factors; one factor (labor) can be allocated after the price shock is realized while the other factor (capital)

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can only be allocated before the terms of trade are realized. EG demonstrate that a tariff can raise *ex ante* welfare if insurance markets are incomplete.

EG's insight has spurred a number of other papers, most notably those by Staiger and Tabellini (1987) and Dixit (1987, 1989a,b). These related papers also assume that markets are incomplete and that factors are not completely mobile *ex post*. Staiger and Tabellini use the basic EG framework to examine the time consistency of tariff protection. While EG and Staiger and Tabellini were willing to leave implicit the reasons for the incompleteness of insurance markets, Dixit argues that the source of the incompleteness can be important. For instance, he shows that when the market failure is explicitly tied to adverse selection or moral hazard, the laissez-faire equilibrium may be Pareto-optimal. Following EG's approach, we will leave the precise source of the market failure implicit, but note that unobservable actions and outcomes are not the only source of market incompleteness. Rather, the transaction costs of insuring agents against trade shocks are surely quite large and will likely preclude complete insurance. In addition, trade shocks may well give rise to bankruptcy concerns, implying that markets will likely be at least partially incomplete. Finally, there might be other distortions in the economy that preclude complete insurance.[3]

We believe, however, the EG model is not well suited to study GATT exceptions for at least two reasons. First, GATT MNF tariffs are typically negotiated years in advance and thus are very difficult to be levied in a contingent fashion. GATT exceptions, on the other hand, are precisely designed to be levied *after* the trade shock. Second, and the more troubling concern, exceptions like antidumping and the escape clause are sector-specific protection. With a single import-competing sector, EG's model cannot adequately characterize the conditions when sector-specific protection is desirable. In their model the tariff is levied on all import competing sectors; therefore their paper is better interpreted as formalizing the effect of a uniform *non-contingent* tariff.

In this paper we develop a model that allows us to better answer the question of whether GATT exceptions can act as insurance. With the EG model serving as the foundation for our analysis, we allow for multiple import competing sectors which are subject to sector-specific price shocks. This allows us to understand and contrast the distortions created across sectors. As in the EG paper, we assume capital is immobile *ex post* and markets are incomplete. We show that GATT exceptions raise welfare by providing insurance.

In addition, we compare the efficacy of sector-specific contingent measures with the traditional "across the board" *contingent* tariff protection *à la* EG. We show that sector-specific policies dominate uniform tariffs. In contrast with EG, we find that the optimal uniform policy may involve export taxes. The difference lies in the fact that in our somewhat more general model only one sector benefits from the imposition of a uniform tariff while the other sector is worse off. Since a sector-specific contingent tariff is targeted at the distressed sector, it reduces the negative effects on other sectors.

Thus, our model provides a theoretical foundation for the notion that GATT exceptions can provide insurance. Given the unprecedented use of GATT exceptions—in particular antidumping actions—during the past twenty years, many question whether insurance is the motivation for many of the actions (Bhagwati, 1988; Finger, 1993; Krueger, 1995).[4] Briefly stated, the concern is that antidumping procedures allow investigations to be conducted when there is little evidence of injury or unfair actions. Given the apparent capture of antidumping by protectionist interests, we also examine whether an alternative policy could also serve as insurance. In particular, we consider a policy wherein the adversely affected sector is offered a subsidy which is financed by (lump-sum) taxes on all sectors; we find that this "tax and subsidize" policy also increases welfare and is in fact welfare-superior to contingent protection. This suggests that even though it is possible to design alternative policies that have the beneficial risk-sharing properties of current GATT exceptions, these alternative policies are not used for political economy reasons (i.e., it is politically difficult to raise taxes).

2. The Model

We consider a three-sector model of a small open economy facing stochastic international prices.[5] The goods are X, Y^1, Y^2; all are consumed domestically. We also assume that in all states of the world all three goods are produced domestically. Following EG we assume that at the time capital must be allocated between productive sectors the terms of trade are unknown. In contrast, labor can move between sectors after the uncertainty is resolved and after the trade policy is implemented.

We assume that good X, the export good, is produced under constant returns to scale using only labor. We let X be the *numéraire* good; to simplify we assume that $X = G(L^X) = L^X$, so $w = 1$. The other two goods are imported and are produced using a CRS technology with capital and labor. The outputs of the import competing goods in state s are

$$Y^{1s} = F^1(K^1, L^{1s}), \quad Y^{2s} = F^2(K^2, L^{2s}),$$

where K^i and L^{is} denote the amount of capital and labor employed in the production of good i in state s. The production functions are quasi-concave and twice differentiable.

Each household has one unit of labor and k units of nondivisible capital. Each household must allocate its capital to one sector. We assume that total endowment of labor is one ($L = 1$) implying that $K = k$ is total capital. Full employment implies $L^{Xs} + L^{1s} + L^{2s} = 1$ and $K^1 + K^2 = K = k$. Let $\lambda^i \equiv K^i/K = K^i/k$ be the proportion of households that allocate their capital to sector i, so that $K^i = \lambda^i K$. Since we can associate the households to the sector in which they invest, it follows that there are λ^1 households in sector 1 and $\lambda^2 = 1 - \lambda^1$ households in sector 2.

Let P^{is} be the world price of good $i = 1, 2$ in state s. The domestic price can be written as $p^{is} = (1 + t^{is})\mathsf{P}^{is}$, where t^{is} denotes the *ad valorem* tariff for good i in state s. Let C^{ijs} be the consumption of good i by households invested in sector j in state s. The value of imports are defined as

$$M^s = M^{1s} + M^{2s} = \mathsf{P}^{1s}(\lambda^1 C^{11s} + \lambda^2 C^{12s} - F^1) + \mathsf{P}^{2s}(\lambda^1 C^{21s} + \lambda^2 C^{22s} - F^2). \tag{1}$$

We will assume that an imported good never becomes an exported good, so $M^{is} \geq 0$. The per-unit return to a household from her capital investment in sector i is

$$r^{is} = p^{is} F_K^i(K^i, L^{is}),$$

where the subscript K indicates partial derivative. The income accruing to the typical household in industry i is

$$y^{is} = p^{is} F_K^i(K^i, L^{is})k + w + T^s, \tag{2}$$

where T^s denotes tariff revenue in state s. We assume the revenue is distributed equally among households in a lump-sum fashion.

There are three states of nature. State s occurs with probability π^s, $s \in S = \{A, B, C\}$. In state A (B), sector 1 (2) receives a negative price shock; in state C neither import competing sector receives a shock.[6] Throughout much of the paper we will suppress the superscript s unless doing so leads to confusion.

The key question we are concerned with is the welfare effects of tariff policy. Given the small-country assumption, free trade is the optimal policy unless there are terms-of-trade shocks. In light of the uncertainty, trade policy may now act as insurance and hence raise welfare. The desirability of such a policy depends in part on the nature of the tariff. In section 3, we examine the benchmark case when the government sets a uniform tariff. In this case $t^1 = t^2 = t$ and tariff revenue is simply $T = tM$. In section 4, we consider sector-specific contingent tariffs—such as antidumping and escape clauses. In this scenario the tariff is levied only on the injured sector, implying case tariff revenue is $T = t^i \mathrm{P}^i M^i$.

Letting $V^{is} \equiv V(y^{is}, p^{1s}, p^{2s})$ denote the indirect utility function of a type i household in state s, we can define welfare as[7]

$$W \equiv \sum_{s \in S} \pi^s W^s = \sum_{s \in S} \pi^s (\lambda^1 V^{1s} + \lambda^2 V^{2s}). \tag{3}$$

Finally we assume that *ex ante* an investment in each sector produces the same expected utility, implying

$$\sum_{s \in S} \pi^s (V^{1s} - V^{2s}) = 0. \tag{4}$$

3. Uniform Tariff Policy

We begin by considering the effect of imposing a uniform tariff in case of a negative shock (and no tariff if there is no shock). Since we believe that anticipated policies are of greater interest, we assume that all agents internalize the existence of the uniform tariff.[8]

For notational convenience we will use dot notation to denote derivatives with respect to the tariff, e.g., $\dot{y} \equiv dy/dt$, $\dot{M} \equiv dM/dt$, etc. The following result will be useful in deriving the main welfare result. (Complete proofs are contained in the Appendix.)

LEMMA 1. *The effect of an anticipated uniform tariff on sector i income is*

$$\frac{dy^i}{dt} \equiv \dot{y}^i = \frac{\mathrm{P}^i F^i}{\lambda^i} + M + t\dot{M}, \quad i = 1, 2;$$

that is, the effect of a uniform tariff on income can be expressed as the sum of the direct income effect and the tariff income effect.

LEMMA 2. *The effect of a small uniform tariff on welfare in state s is*

$$\left.\frac{dW^s}{dt}\right|_{t=0} \equiv \dot{W}^s\big|_{t=0} = \lambda^1 \lambda^2 (V_y^{1s} - V_y^{2s})\{(\dot{y}^{1s} - \dot{y}^{2s}) + \mathrm{P}^{1s}(C^{12s} - C^{11s}) + \mathrm{P}^{2s}(C^{22s} - C^{21s})\}; \tag{5}$$

that is, the welfare effect of the uniform tariff is composed of the differential impact on the indirect utility of the two types weighed by the income change and the implicit income cost of the price changes.

PROOF. *Consider the effect of a tariff on welfare in state s (for details see the Appendix):*

$$\dot{W}^s = \lambda^1 [V_y^{1s} \dot{y}_1^s + V_1^{1s} \mathrm{P}^{1s} + V_2^{1s} \mathrm{P}^{2s}] + \pi^s \lambda^2 [V_y^{2s} \dot{y}_2^s + V_1^{2s} \mathrm{P}^{1s} + V_2^{2s} \mathrm{P}^{2s}], \tag{6}$$

where we have denoted $dV/dp^i \equiv V_i$. Using Roy's identity, Lemma 1, and equation (1), we get

$$\dot{W}^s = \lambda^1\lambda^2 V_y^1\{(\dot{y}^1 - \dot{y}^2) + (t\dot{M}/\lambda^2) + \mathrm{P}^1(C^{12} - C^{11}) + \mathrm{P}^2(C^{22} - C^{21})\}$$
$$+ \lambda^1\lambda^2 V_y^2\{(\dot{y}^2 - \dot{y}^1) + (t\dot{M}/\lambda^1) + \mathrm{P}^1(C^{11} - C^{12}) + \mathrm{P}^2(C^{21} - C^{21})\}.$$

Evaluating at $t = 0$ and simplifying we get the desired expression. □

Lemma 2 allows us to evaluate the welfare effect of a uniform tariff. Suppose there is a negative price shock to sector 1 (state A). We have that $y^{1A} < y^{2A}$; hence $(V_y^{1A} - V_y^{2A}) > 0$ because of diminishing marginal utility. We can also sign the consumption terms if the importables are not inferior (both terms are positive). Note, however, that the term $\dot{y}^{1A} - \dot{y}^{2A}$ is negative. Therefore we cannot sign the overall expression, $\dot{W}^s$. The same ambiguity exists in state B. Since the optimal policy in state C is free trade, we must conclude the following.

PROPOSITION 1. *A small uniform tariff has an ambiguous effect on welfare; that is*

$$\left.\frac{dW}{dt}\right|_{t=0} \gtreqless 0.$$

Proposition 1 contrasts with EG's (1985) finding that a small tariff raises welfare when there are negative import price shocks. The difference lies in the fact that our model allows for multiple import competing goods, and while a uniform tariff carries benefits to the injured sector (as in EG) it has a negative effect on the other import competing sector. This result helps explain why we do not observe countries using uniform tariff policies to safeguard domestic industries from sector-specific terms-of-trade shocks.

4. A Sector-Specific Tariff

We now consider the case when a sector-specific tariff is imposed whenever there is a shock to a particular sector. We will assume that the government reacts by imposing tariff t^i on good i when there is a shock to that sector. All other sectors remain unprotected. Formally, the domestic price of good i in state s is $p^{is} = \mathrm{P}^{is}(1 + t^{is})$ and

$$t^{is} = \begin{cases} t^i > 0 & \text{if } i = 1 \text{ and } s = A \text{ or if } i = 2 \text{ and } s = B, \\ 0 & \text{otherwise.} \end{cases}$$

A sector-specific tariff has two effects: an *ex post* effect on the allocation of labor once the state and the applicable tariff are known, and an *ex ante* effect on the allocation of capital between sectors. For instance, suppose we are in state A. An increase in the state A tariff raises the attractiveness of sector 1, since the bad state turns out to be not so bad (since the tariff raises the expected return to sector 1 capital). This implies that more capital will be invested in sector 1 (and less in other sectors). Hence, a state contingent tariff will have an effect on the capital stocks in all states, in contrast to the case of a uniform tariff.

Without loss of generality we will study the welfare effect of a state A contingent tariff (i.e., a tariff $t^1 > 0$). All the results are directly applicable to a state B contingent tariff. Differentiating equation (3) with respect to a state A contingent tariff leads to

$$\frac{dW}{dt^1} = \sum_{s\in S}\pi^s\left\{\left(\lambda^1\frac{\partial V^{1s}}{\partial t^1} + V^{1s}\frac{d\lambda^1}{dt^1}\right) + \left(\lambda^2\frac{\partial V^{2s}}{\partial t^1} + V^{2s}\frac{d\lambda^2}{dt^1}\right)\right\}. \tag{7}$$

The following lemma will be useful in solving for the effect of a state contingent tariff.

LEMMA 3.

$$\sum_{s \in S} \pi^s \left(V^{1s} \frac{d\lambda^1}{dt^1} + V^{2s} \frac{d\lambda^2}{dt^1} \right) = 0;$$

that is, all the effects on welfare of a state contingent tariff are due to the direct effect of the tariff on indirect utility; i.e., the effect due to changes in the capital allocation between sectors induced by the tariff is zero.

LEMMA 4. *The change in income due to a state A contingent tariff is*

$$\dot{y}^{1A} = \frac{\mathrm{P}^{1A} F^1}{\lambda^1} + M^{1A} + t^1 \dot{M}^{1A}, \tag{8}$$

$$\dot{y}^{2A} = M^{1A} + t^1 \dot{M}^{1A}. \tag{9}$$

The effect of a state contingent tariff on sector income is composed of the direct income effect plus the tariff income effect for the case of the sector hit by the price shock. For the other sector, the only effect on income is the tariff income effect.

PROPOSITION 2. *A small state contingent sector-specific tariff increases welfare; that is*

$$\left. \frac{\partial W}{\partial t^{is}} \right|_{t^{is}=0} > 0.$$

We now show that contingent tariffs are preferable to uniform tariffs, as follows.

PROPOSITION 3. *Assume that $M^{2A} < p^{2A}C^{21A}$ and $M^{1B} < P^{1B}C^{12B}$. Then a small sector-specific contingent tariff dominates a small uniform tariff as a response to trade shocks.*

5. Sector-Specific Taxes and Subsidies

An alternative policy instrument are sector-specific taxes and subsidies. We consider an *ad valorem* production subsidy σ^{is} to sector i in state s. To fix ideas, producers receive price $p^{is} = (1 + \sigma^{is})\mathrm{P}^{is}$ where

$$\sigma^{is} = \begin{cases} \sigma^i > 0 & \text{if } i = 1 \text{ and } s = A \text{ or if } i = 2 \text{ and } s = B, \\ 0 & \text{otherwise.} \end{cases}$$

In other words, producers in sector i receive the subsidy only when i receives a negative shock. We assume that consumers continue to face world prices and that the subsidy is paid by lump-sum taxation on all sectors, so that taxes in sector i are $\tau^{is} \equiv \lambda^i \sigma^{is} \mathrm{P}^{is} F^{is}$.

Consider for instance when state A is realized and sector 1 receives the negative price shock. In the rest of the section we will omit the superscript denoting the state unless doing so leads to confusion. Let $\rho^i \equiv \mathrm{P}^i F^i$; therefore the total value of the subsidy is $\sigma^1 \rho^1$. The income received by type i household is

$$y^i = w + p^i F_K^i k - \lambda^i \sigma^i \rho^i, \quad i = 1, 2. \tag{10}$$

We can show the following.

LEMMA 5. *The change in income due to a state A contingent subsidy-cum-tax is*

$$\dot{y}^1 = \frac{\rho^1}{\lambda^1} + \lambda^2(\sigma^1\dot{\rho}^1 + \rho^1) + \dot{\lambda}^2\sigma^1\rho^1,$$
$$\dot{y}^2 = -\lambda^2(\sigma^1\dot{\rho}^1 + \rho^1) - \dot{\lambda}^2\sigma^1\dot{r}^1.$$

PROPOSITION 4. *A small state contingent subsidy is welfare-improving; that is*

$$\left.\frac{\partial W}{\partial \sigma^{is}}\right|_{\sigma^{is}=0} > 0.$$

6. A Ranking of Sector-Specific Taxes-cum-Subsidies and Sector-Specific Tariffs

We now compare a sector-specific tariff with sector-specific taxes-cum-subsidies. As we have modeled the policies, the tax-cum-subsidy policy is financed with a nondistorting tax. Since the tariff is both a tax on consumption and a subsidy to producers, it will distort more by design. We show the following.

PROPOSITION 5. *Assume* $\mathrm{P}^{1A}C^{11A} > M^{1A}$ *and* $\mathrm{P}^{1A}C^{22B} > M^{2B}$. *A small sector-specific subsidy dominates a small sector-specific contingent tariff as a response to trade shocks.*

This is a nice result as it shows that there exist alternative instruments that also lead to improvements in welfare.[9] The result begs the question: "why do we observe so many countries using sector-specific tariffs rather than sector-specific subsidies?" We believe there are two reasons why sector-specific taxes and subsidies are not generally used as insurance against price shocks. First, from the point of view of the sectors requiring aid, subsidies are vulnerable to budgetary restrictions. In addition, there are political economy reasons which make the imposition of selective taxes unattractive. Second, over the past twenty years there is considerable support for the view that antidumping regulations have been captured by protectionist interests (Bhagwati, 1988; Krueger, 1995). Hence, from a protectionist viewpoint, the value of antidumping regulations lies not only in its insurance aspects, but also in the fact that it can be manipulated.

7. Conclusions and Extensions

Using a general-equilibrium model with incomplete insurance markets, we have shown that contingent protection on a sectoral basis will increase welfare when the economy is subject to sector-specific price shocks. Moreover, it is a more efficient instrument than uniform contingent tariffs. Our model thus provides a theoretical basis for the long-held notion that GATT exceptions can act as insurance. Trade negotiators have long argued that the inclusion of the most popular sector-specific tool—antidumping actions—is a precondition for the approval of any trade agreement. The main result of the paper affirms this intuition by showing that there is an insurance role for antidumping that had not been considered in the theoretical literature.

We also show that there exist alternative instruments that also lead to improvements in welfare, such as a set of lump-sum taxes on all sectors coupled to a subsidy to the sector that receives the shock. Moreover, these policies have a higher welfare impact. However, we believe political economy reasons explain the popularity of sector-specific tariffs.

One limitation of this paper is that it does not show why exceptions are needed in order to sign trade agreements. If protection is what is desired, why is that not included in the original agreements? Another caveat is that our results should be interpreted as second-best arguments for contingent protection. As a first best, policy should always be directed at removing the sources of distortion, if possible.

Appendix

Proof of Lemma 1

First note that

$$\dot{w} = \mathrm{P}^i F_L^i + p^i F_{LK}^i \dot{K}^i + p^i F_{LL}^i \dot{L}^i = 0, \quad i = 1, 2. \tag{A1}$$

Differentiating equation (2) and solving yields

$$\begin{aligned} \dot{y}^i &= \mathrm{P}^i F_K^i k + p^i F_{KK}^i k\dot{K}^i + p^i F_{KL}^i k\dot{L}^i + M + t\dot{M} \\ &= \left[\mathrm{P}^i F_K^i k + \mathrm{P}^i F_L^i \frac{L^i}{\lambda^i}\right] + \left[p^i F_{KK}^i k\dot{K}^i + p^i F_{LK}^i \dot{K}^i \frac{L^i}{\lambda^i}\right] \\ &\quad + \left[p^i F_{KL}^i k\dot{L}^i + p^i F_{LL}^i \dot{L}^i \frac{L^i}{\lambda^i}\right] + M + t\dot{M} \\ &= \frac{\mathrm{P}^i}{\lambda^i}[F_K^i K^i + F_L^i L^i] + \frac{p^i \dot{K}^i}{\lambda^i}[F_{KK}^i K^i + F_{LK}^i L^i] \\ &\quad + \frac{p^i \dot{L}^i}{\lambda^i}[F_{KL}^i K^i + F_{LL}^i L^i] + M + t\dot{M} \\ &= \frac{\mathrm{P}^i F^i}{\lambda^i} + M + t\dot{M}, \end{aligned} \tag{A2}$$

where we have used Euler's theorem three times. □

Proof of Lemma 2

Consider the effect of a tariff on welfare in state s:

$$\dot{W}^s = \lambda^1[V_y^{1s}\dot{y}_1^s + V_1^{1s}\mathrm{P}^{1s} + V_2^{1s}\mathrm{P}^{2s}] + \pi^s\lambda^2[V_y^{2s}\dot{y}_2^s + V_1^{2s}\mathrm{P}^{1s} + V_2^{2s}\mathrm{P}^{2s}], \tag{A3}$$

where we have denoted $dV/dp^i \equiv V_i$. Using Roy's identity, we get

$$\dot{W}^s = \lambda^1 V_y^{1s}[\dot{y}_1^s - \mathrm{P}^{1s}C^{11s} - \mathrm{P}^{2s}C^{21s}] + \lambda^2 V_y^{2s}[\dot{y}_2^s - \mathrm{P}^{1s}C^{12s} - \mathrm{P}^{2s}C^{22s}]. \tag{A4}$$

We now use Lemma 1 to get (we now suppress the superscript s to simplify the notation)

$$\begin{aligned} \dot{W}^s &= \lambda^1 V_y^1\{\mathrm{P}^1 F^1/\lambda^1 + t\dot{M} + M - \mathrm{P}^1 C^{11} - \mathrm{P}^2 C^{21}\} \\ &\quad + \lambda^2 V_y^2\{\mathrm{P}^2 F^2/\lambda^2 + t\dot{M} + M - \mathrm{P}^1 C^{12} - \mathrm{P}^2 C^{22}\}. \end{aligned} \tag{A5}$$

Using the import equation (1) we have

$$M - \mathrm{P}^1 C^{11} - \mathrm{P}^2 C^{21} = \mathrm{P}^1[\lambda^2(C^{12} - C^{11}) - F^1] + \mathrm{P}^2[\lambda^1(C^{22} - C^{21}) - F^2]$$

and a corresponding expression for $M - \mathrm{P}^1C^{12} - \mathrm{P}^2C^{22}$. Substituting these into (A5) yields

$$\dot{W}^s = \lambda^1V_y^1\{\mathrm{P}^1(F^1/\lambda^1)+t\dot{M}+\mathrm{P}^1[\lambda^2(C^{12}-C^{11})-F^1]+\mathrm{P}^2[\lambda^2(C^{22}-C^{21})-F^2]\} + \lambda^2V_y^2\{\mathrm{P}^2(F^2/\lambda^2)+t\dot{M}+\mathrm{P}^1[\lambda^1(C^{11}-C^{12})-F^1]+\mathrm{P}^2[\lambda^1(C^{21}-C^{22})-F^2]\}.$$

Using Lemma 1, note that

$$\dot{y}^1 - \dot{y}^2 = \frac{\lambda^2\mathrm{P}^1F^1 - \lambda^1\mathrm{P}^2F^2}{\lambda^1\lambda^2}. \tag{A6}$$

Substituting this expression gives

$$\dot{W}^s = \lambda^1\lambda^2V_y^1\{(\dot{y}^1-\dot{y}^2)+(t\dot{M}/\lambda^2)+\mathrm{P}^1(C^{12}-C^{11})+\mathrm{P}^2(C^{22}-C^{21})\} + \lambda^1\lambda^2V_y^2\{(\dot{y}^2-\dot{y}^1)+(t\dot{M}/\lambda^1)+\mathrm{P}^1(C^{11}-C^{12})+\mathrm{P}^2(C^{21}-C^{21})\},$$

from which we obtain

$$\dot{W}^s = \lambda^1\lambda^2(V_y^{1s}-V_y^{2s})\{(\dot{y}^{1s}-\dot{y}^{2s})+\mathrm{P}^{1s}(C^{12s}-C^{11s})+\mathrm{P}^{2s}(C^{22s}-C^{21s})\} + t\dot{M}\lambda^1\lambda^2\left(\frac{V_y^{1s}}{\lambda^2}+\frac{V_y^{2s}}{\lambda^1}\right), \tag{A7}$$

where we again use superscript s to denote the state. Evaluating at $t = 0$, we obtain the desired expression. □

Proof of Lemma 3

From $K^1 + K^2 = K$ it follows that

$$\frac{dK^1}{dt^1} = -\frac{dK^2}{dt^1}.$$

This implies

$$\frac{d\lambda^1}{dt^1} = \frac{d\lambda^1}{dK^1}\frac{dK^1}{dt^1} = -\frac{1}{k}\frac{dK^2}{dt^1}.$$

Substituting yields

$$\sum_{s\in S}\pi^s\sum_{i=1}^{2}V^{is}\frac{d\lambda^i}{dt^1} = \sum_{s\in S}\pi^s\left[(V^{2s}-V^{1s})(1/k)\frac{dK^2}{dt^1}\right] = (1/k)\frac{dK^2}{dt^1}\sum_{s\in S}\pi^s(V^{2s}-V^{1s}) = 0,$$

where the last equality follows from (4). □

Proof of Lemma 4

From the wage equation $1 = w = p^{iA}F_L^i$, $i = 1, 2$, we have that

$$\dot{w} = 0 = \mathrm{P}^{1A}F_L^1 + p^{1A}F_{LL}^1\dot{L}^1 + p^{1A}F_{LK}^1\dot{K}^1 = p^{2A}F_{LL}^2\dot{L}^2 + p^{2A}F_{LK}^2\dot{K}^2. \tag{A8}$$

Differentiating (2), it follows that the change in income in state A is

$$\begin{aligned}
\dot{y}^{1A} &= \mathrm{P}^{1A}F_K^1 k + p^{1A}F_{KK}^1\dot{K}^1 k + p^{1A}F_{KL}^1\dot{L}^1 k + t^1\dot{M}^{1A} + M^{1A} \\
&= \mathrm{P}^{1A}F_K^1 k + p^{1A}F_{KK}^1\dot{K}^1 k + p^{1A}F_{KL}^1\dot{L}^1 k + t^1\dot{M}^{1A} + M^{1A} \\
&\quad + \left(p^{1A}F_{LL}^1\dot{L}^1\frac{L^1}{\lambda^1} - p^{1A}F_{LL}^1\dot{L}^1\frac{L^1}{\lambda^1}\right) + \left(p^{1A}F_{KL}^1\dot{K}^1\frac{L^1}{\lambda^1} - p^{1A}F_{KL}^1\dot{K}^1\frac{L^1}{\lambda^1}\right) \\
&= \left(\mathrm{P}^{1A}F_K^1 k + \mathrm{P}^{1A}F_L^1\frac{L^1}{\lambda^1}\right) + \left(p^{1A}F_{KL}^1\dot{L}^1 k + p^{1A}F_{LL}^1\dot{L}^1\frac{L^1}{\lambda^1}\right) \\
&\quad + \left(p^{1A}F_{KK}^1\dot{K}^1 k + p^{1A}F_{KL}^1\dot{K}^1\frac{L^1}{\lambda^1}\right) + t^1\dot{M}^{1A} + M^{1A} \\
&= \frac{\mathrm{P}^{1A}F^1}{\lambda^1} + t^1\dot{M}^{1A} + M^{1A},
\end{aligned}$$

where we have used Euler's theorem three times; and

$$\begin{aligned}
\dot{y}^{2A} &= p^{2A}F_{KK}^2\dot{K}^2 k + p^{2A}F_{KL}^2\dot{L}^2 k + t^1\dot{M}^{1A} + M^{1A} \\
&= p^{2A}F_{KK}^2\dot{K}^2 k + p^{2A}F_{KL}^2\dot{L}^2 k + t^1\dot{M}^{1A} + M^{1A} \\
&\quad + \left(p^{2A}F_{LL}^2\dot{L}^2\frac{L^2}{\lambda^2} - p^{2A}F_{LL}^2\dot{L}^2\frac{L^2}{\lambda^2}\right) + \left(p^{2A}F_{KL}^2\dot{K}^2\frac{L^2}{\lambda^2} - p^{2A}F_{KL}^2\dot{K}^2\frac{L^2}{\lambda^2}\right) \\
&= \left(p^{2A}F_{KK}^2\dot{K}^2 k + p^{2A}F_{KL}^2\dot{K}^2\frac{L^2}{\lambda^2}\right) + \left(p^{2A}F_{KL}^2\dot{L}^2 k + p^{2A}F_{LL}^2\dot{L}^2\frac{L^2}{\lambda^2}\right) \\
&\quad - \left(p^{2A}F_{LL}^2\dot{L}^2\frac{L^2}{\lambda^2} + p^{2A}F_{KL}^2\dot{K}^2\frac{L^2}{\lambda^2}\right) + t^1\dot{M}^{1A} + M^{1A} \\
&= t^1\dot{M}^{1A} + M^{1A},
\end{aligned}$$

using Euler's theorem two times.

Finally, recall that there is no income from a state A contingent tariff in states B or C. Thus, in states B and C, $y^{is} = w + r^{is}k$. Hence

$$\dot{y}^{is} = p^{is}F_{KL}^i k\dot{L}^i + p^{is}F_{KK}^i\dot{K}^i k = 0, \quad s = B, C$$

by Euler's theorem. □

Proof of Proposition 2

As above, we will proceed by analyzing a state A contingent tariff. Recall that

$$\frac{\partial V^{iA}}{\partial t^1} = V_y^{iA}\dot{y}^i + V_1^{iA}\mathrm{P}^{1A}, \quad i = 1, 2,$$

and that

$$\begin{aligned}
M^{1A} - \mathrm{P}^{1A}C^{11A} &= \mathrm{P}^{1A}(\lambda^2(C^{12A} - C^{11A}) - F^1), \\
M^{1A} - \mathrm{P}^{1A}C^{12A} &= \mathrm{P}^{1A}(\lambda^1(C^{11A} - C^{12A}) - F^1).
\end{aligned} \tag{A9}$$

Using Roy's identity, Lemmas 3 and 4, and equation (A9) we have

$$\begin{aligned}
\left.\frac{\partial W^A}{\partial t^1}\right|_{t^1=0} &= \lambda^1\frac{\partial V^{1A}}{\partial t^1} + \lambda^2\frac{\partial V^{2A}}{\partial t^1} \\
&= \mathrm{P}^{1A}F^1\lambda^2(V_y^{1A} - V_y^{2A}) + \mathrm{P}^{1A}\lambda^1\lambda^2(C^{12A} - C^{11A})(V_y^{1A} - V_y^{2A}) > 0.
\end{aligned} \tag{A10}$$

The last expression is positive. To see this, note that $y^{1A} < y^{2A}$; hence the first term on the right-hand side is positive because of diminishing marginal utility of income. The second term is positive because, whether or not $y^2 > y^1$, the terms $C^{12A} - C^{11A}$ and $V_y^{1A} - V_y^{2A}$ always have the same sign.

The only remaining step is to show that $dW^s/dt^1 = 0$ for $s = B, C$. But this is simple enough, since we have shown in Lemma 3 that $\dot{y}^{is} = 0$, $i = 1, 2$, for all states $s = B, C$. Since a state A contingent tariff has no direct effect on prices in the other states, it follows that

$$\frac{\partial V^{is}}{\partial t^1} = V_y^{is}\dot{y}^{is} + \sum_i V_y^{is}\frac{\partial p^{1s}}{dt^1} = 0, \quad i = 1, 2, \quad s = B, C. \qquad \square$$

Proof of Proposition 3

Let u or c subscript indicate a uniform or a contingent policy, respectively. Note that using (A6) in (5) we get

$$\dot{W}_u^A = (V_y^{1A} - V_y^{2A})\{\lambda^2 \mathrm{P}^{1A} F^1 + \lambda_1\lambda_2 \mathrm{P}^1(C^{12A} - C^{11A}) - \lambda_1 \mathrm{P}^{2A} F^2 + \lambda_1\lambda_2 \mathrm{P}^2(C^{22A} - C^{21A})\};$$

that is:

$$\dot{W}_u^A = (V_y^{1A} - V_y^{2A})\{\lambda^2 \mathrm{P}^{1A}(F^1 + \lambda^1(C^{12A} - C^{11A})) + \lambda_1 \mathrm{P}^{2A}(-F^2 + \lambda_2(C^{22A} - C^{21A}))\}.$$

Consider the difference $\Delta\dot{W}^A \equiv \dot{W}_c^A - \dot{W}_u^A$. We have

$$\Delta\dot{W}^A = (V_y^{1A} - V_y^{2A})\lambda_1 \mathrm{P}^{2A}\{(F^2 - \lambda^2(C^{22A} - C^{21A})\}.$$

We know that the terms outside the brackets are positive. Thus

$$\begin{aligned}\operatorname{sgn}(\Delta\dot{W}^A) &= \operatorname{sgn} \mathrm{P}^{2A}(F^2 - \lambda^2(C^{22A} - C^{21A})) \\ &= \operatorname{sgn}(\mathrm{P}^{2A}C^{21A} - M^{2A}) > 0\end{aligned}$$

because of our assumption that $M^{2A} < p^{2A}C^{21A}$. A similar proof applies in state B, with the corresponding condition. Finally, in the case $s = C$, both mechanisms do nothing, so that $E\Delta\dot{W} > 0$. $\square$

Proof of Lemma 5

Differentiating (10):

$$\begin{aligned}\dot{y}^1 &= \mathrm{P}^1 F_K^1 k + p^1 F_{KK}^1 \dot{K}^1 k + p^1 F_{KL}^1 \dot{L}^1 k + \lambda^2(\sigma^1\dot{\rho}^1 + \rho^1) + \dot{\lambda}^2\sigma^1\rho^1, \\ \dot{y}^2 &= \mathrm{P}^2 F_{KK}^2 \dot{K}^2 k + \mathrm{P}^2 F_{KL}^2 \dot{L}^2 k - \lambda^2(\sigma^1\dot{\rho}^1 + \rho^1) - \dot{\lambda}^2\sigma^1\rho^1.\end{aligned}$$

Adding and subtracting $p^i F_{KL}^i \dot{k}^i(L^i/\lambda^i)$ and $p^i F_{LL}^i \dot{L}^i(L^i/\lambda^i)$, using the fact that $\dot{w} = 0$, and using Euler's theorem gives the desired expression. $\square$

Proof of Proposition 4

Recall that consumers face world prices, so the subsidy does not change the prices they face. Hence $dV^i/d\sigma^1 = V_y^i\dot{y}^i$, and the total change in welfare in state A due to a small contingent production subsidy is

$$\begin{aligned}\left.\frac{dW^A}{d\sigma^1}\right|_{\sigma^1=0} &= \lambda^1 V_y^1\left(\frac{\rho^1}{\lambda^1} + \lambda^2\rho^1\right) - V_y^2\lambda^2\rho^1 \\ &= ((1 + \lambda^1\lambda^2)V_y^1 - \lambda^2 V_y^2)\mathrm{P}^1 F^1 > 0. \qquad \text{(A11)}\end{aligned}$$

Note also that $dW^B/d\sigma^1 = 0$, as in the previous section. The negative shock implies that $V_y^{1A} > V_y^{2A}$ and hence the effect of the subsidy is always positive. $\square$

Proof of Proposition 5

Recall from equation (A10) that

$$\left.\frac{\partial W^A}{\partial t^1}\right|_{t^1=0} = \mathrm{P}^{1A}F^1\lambda^2(V_y^{1A} - V_y^{2A}) + \mathrm{P}^{1A}\lambda^1\lambda^2(C^{12A} - C^{11A})(V_y^{1A} - V_y^{2A}) > 0.$$

Similarly, from equation (A11), we have

$$\left.\frac{dW^A}{d\sigma^1}\right|_{\sigma^1=0} = \lambda^2(V_y^{1A} - V_y^{2A})\mathrm{P}^{1A}F^1 + \lambda^1(1+\lambda^2)V_y^{1A}\mathrm{P}^{1A}F^1;$$

so that

$$\left.\frac{dW^A}{d\sigma^1}\right|_{\sigma^1=0} > \left.\frac{\partial W^A}{\partial t^1}\right|_{t^1=0}$$

if

$$\mathrm{P}^{1A}\lambda^1\lambda^2(C^{12A} - C^{11A})(V_y^{1A} - V_y^{2A}) < \lambda^1(1+\lambda^2)V_y^{1A}\mathrm{P}^{1A}F^1.$$

Since $(C^{12A} - C^{11A})$ and $(V_y^{1A} - V_y^{2A})$ have the same sign and $(V_y^{1A} > V_y^{2A})$, we can write the condition as

$$\lambda^2\mathrm{P}^{1A}(C^{12A} - C^{11A})V_y^{1A} < (1+\lambda^2)V_y^{1A}\mathrm{P}^{1A}F^1.$$

Since $V_y^{1A} > 0$ the condition becomes

$$\lambda^2\mathrm{P}^{1A}(C^{12A} - C^{11A}) < (1+\lambda^2)\mathrm{P}^{1A}F^1.$$

Recall equation (A9):

$$M^{1A} - \mathrm{P}^{1A}C^{11A} = \mathrm{P}^{1A}(\lambda^2(C^{12A} - C^{11A}) - F^1).$$

So the inequality holds if

$$M^{1A} - \mathrm{P}^{1A}C^{11A} < 0,$$

because $\mathrm{P}^{1A}F^1 > 0$. Analogously for a shock to state B. □

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Notes

1. See Jackson (1969) for a description of the legal foundations for exceptions. Staiger (1995) discusses some economic issues relating to GATT rules and institutions.
2. The idea that trade policy might act as insurance was informally discussed for many years (Corden, 1974; Baldwin, 1982).
3. Consider the case where insurance against market shocks is expensive, owing to the existence of a monopoly in insurance. The first best would be to eliminate the monopoly, in which case it might not be necessary to have contingent protection. If this is impossible, contingent protection can be used as a second-best way to avoid the cost of not being able to insure against trade shocks.
4. Staiger and Wolak (1994) find that many US antidumping complaints are not primarily aimed at winning duties, but rather at hindering the foreign rival during the investigation (in their terminology, many industries are "process filers").
5. The results can be easily extended to the case of n import competing sectors.
6. By assumption, shocks never make an import good become an export good.
7. Good X also enters the utility function, but since it is the *numéraire* good it is convenient if we suppress it in the indirect utility function.
8. The effect of a uniform tariff when the tariff is unanticipated is similar. This is somewhat surprising since in general the tariff alters the return in each of the possible states of nature, which in turn means that the allocation of capital could depend on whether the tariff is anticipated. In the case of a uniform tariff, however, this effect does not exist. This rather surprising result is explained by the fact that the relative price of the import goods p^1/p^2, remains the same with or without the tariff. Given that *ex ante* investment in each sector provides the same expected utility, we find that anticipated and unanticipated protection has the same effect on income.
9. We note that the sufficiency conditions can be relaxed at the cost of more complexity.