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ABSTRACT

Protectionism and the US Trade Deficit: An Empirical Analysis*

The persistence of large trade and budget imbalances has led to increasing demands for protectionist policies. Despite a substantial theoretical literature there appears to be no empirical literature on the use of tariffs as a macroeconomic policy instrument. This paper fills that gap, using the multicountry econometric model (MCM) in a dynamic framework where full employment is not assured. We simulate the effects of using protectionist policies for solving the major imbalances in five major industrialized countries, while preserving growth, over 1986-92. These policies are contrasted with coordination of fiscal and monetary policies and orchestrated realignment of national currencies. We find that tariffs would be a rather ineffective policy instrument; but cooperative management of exchange rates based on suitable adjustments of the fiscal/monetary mix would resolve most imbalances. On the other hand, the probability of a general tariff war is fairly low and its costs would be small.

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NON-TECHNICAL SUMMARY

The unprecedented size of the US trade deficit and the belief that the United States may be subject to unfair competition has led to increased political interest in protectionism. The conventional prescription for restoring a current account balance involves lower government expenditure in order to reduce domestic spending, lower imports and, through a currency depreciation, increase exports. The drawback of this policy is the risk of recession; and if monetary expansion were combined with fiscal contraction there would also be a risk of inflation. Alternative policies that might reduce the external and budget deficits include currency devaluation and trade policy; but devaluation may take a long time to work and requires a fiscal and monetary policy mix that can cut the deficits while maintaining growth levels.

Trade policy could also be used to correct the deficits. Economic theory suggests that higher tariffs would increase import prices, permitting current account balance with a higher exchange rate and an unchanged fiscal position. Tariffs increase the demand for domestic goods rather than imports, leading to higher output and an improved current account. But this positive effect on output may be offset by the income effect of higher prices; and, under flexible exchange rates, an appreciating currency would also tend to offset that expansion (especially if wages are indexed to prices). Therefore, a tariff sufficiently high to eliminate the large trade deficit could also cause domestic output and employment to contract, unless it were combined with fiscal and monetary policies to induce a currency depreciation.

Economists have devoted considerable attention to the theoretical analysis of the welfare losses associated with trade restrictions, but the literature contains no quantitative analyses of the macroeconomic impacts of trade restrictions. We analyse the effects of a policy package consisting of a general US import tariff and macroeconomic policies to induce dollar depreciation. We conduct our empirical analysis using the Federal Reserve Board's Multi-Country Model (MCM) for the United States, Canada, the United Kingdom, West Germany and Japan over the period 1986-92. The MCM system consists of quarterly macroeconometric models for each of the five countries, linked by equations modelling trade in goods, services, flows of investment income, and exchange rates. We employ a dynamic game-theory framework to capture the repercussions of US trade restrictions on economic activity in the rest of the world and the possibility of retaliation by foreign policy-makers. We explore whether there exists a US tariff level that is small enough to avoid triggering inflation but large enough to clear the trade deficit; whether the rest of the world would find it in their interest to retaliate; and whether the possibility of a tariff war increases the gains from international cooperation to preserve free trade.

We assume that each country uses three policy instruments (government expenditure, the rate of monetary growth and tariffs) to pursue four policy goals: annual output growth of 3-4%, inflation rates of 1-2%, current account balance and substantially reduced government budget deficits. Exchange rates float freely in the model, and are treated as neither an instrument nor a target of policy. We assume that policy-makers wish – ideally – to maintain free trade and that they minimize a welfare loss function that reflects the deviations of policy targets and of policy instruments from their 'ideal' values. We assign 'plausible' values for each country's preferences for policy instruments, including the maintenance of government spending as a constant proportion of GNP (except the US, which acts in line with the Gramm-Rudman balanced-budget restrictions) and constant money supply growth. The policy problem is specified for each country, taking into account consequent policy changes by other countries, and the outcomes for the whole system are calculated under both non-cooperative (open-loop Nash) and cooperative decision-making.

The most striking feature of these simulations is that the tariff levels are rather low; averaging 23.3% for the US and 1.5% elsewhere. They are also more variable for the US; falling from a plateau of between 28% in 1986 and 34% in 1989, to zero by 1992. The non-US countries follow the reasonable strategy of no tariff to start with (1986-88), and a 3.5% tariff thereafter when it becomes clear that the US tariff is there to stay. Thus tariffs would be used very little, except briefly by the US during 1986-9 when its current account deficit is removed. But it must be remembered that these tariff figures are *in addition* to any tariffs currently in force.

The target outcomes are all satisfactory, though the United States must grow rather slowly (1.7% p.a.) in order to correct its current account deficit; its budget deficit is halved over the first two years. In the other countries GNP growth is in the range 3.0-3.5% p.a.; inflation runs at 5.5% in Canada and less than 2.8% elsewhere. The most striking result is the near elimination of Germany's trade surplus and the halving of Japan's, while the UK current account worsens. The strong impact of tariffs on trade balances is the result of the important role played by interest rate differentials in the MCM, where they are the major determinant of capital flows and hence of exchange rate adjustments. Tariff levels have only a small effect on the twin US deficits, because policies are also designed to maintain output growth: the deficits are reduced not by tariffs but by the accompanying changes in the fiscal and monetary policy mix.

The limited use of tariffs in this exercise and the comparatively poor US growth rate arise from the trade-off facing US policy-makers between growth and current account targets. If a tariff is imposed, the twin deficits are reduced, but so is domestic output growth – the income effects of a tariff outweigh the substitution effects. With no tariff, growth is maintained but the deficits are not reduced. The

United States can reduce this conflict by using a conventional combination of fiscal contraction and monetary expansion to achieve the same results, supplemented by a small tariff to increase the effectiveness of the package for correcting the deficits. The other countries do not face such a trade-off: in the absence of large trade or budget deficits they have no incentive to use a tariff except as a means to protect their trade positions against the US tariff.

Finally a tariff policy would 'cost' the US a loss of about 0.2% of GNP each year (with similar figures for Germany and Japan). This is remarkably close to the casual estimate suggested by Krugman. These estimates show that the crucial growth/trade-deficit trade-off is steeper under a tariff regime, in that a given improvement in the trade deficit will require a greater growth sacrifice. This negative impact on growth is certainly a disadvantage if the trade improvements can be obtained in some other way such as through international cooperation.

A comparison of these results with those of a simulation when tariffs are assumed to be unavailable to policy-makers reveals that there is little difference between the outcomes with and without tariffs. The costs of the tariff war are also quite low: US and Canadian inflation rises a little, and output growth is reduced by around 0.2% p.a. for the United States, Germany and Japan. Given this, how likely is a tariff war to develop, what costs would it impose, and on whom? We calculate the outcomes for Germany, Japan and the United States (represented by the values of each country's optimized objective functions) under the four permutations generated by the US choice and the others' choice of whether or not to implement the optimal tariff. We find rather small (proportional) differences for all G3 countries between the pay-offs under the four scenarios. Small though they are, however, the effects are not negligible: the G3 countries and especially the United States all gain from the war, while Canada and the United Kingdom lose.

Examination of the pay-off matrix also shows that the US would believe that tariffs would increase its welfare and that Japan would agree, while Germany would have some preference for free trade. More importantly, the US would minimize its potential losses – given some uncertainty about which policies other countries may adopt – by opting for the tariff strategy. Germany on the other hand can minimize its potential losses by picking the no-tariff strategy – while Japan would prefer to have tariffs on this criterion. A tariff policy by the US is in fact a stable outcome, implying small gains (worth between 0.2% and 0.8% extra GNP growth) for all. Thus US protectionism would not impose costs compared to a non-cooperative free trade solution; but it would impose huge losses compared to the cooperative free trade solution.

It is tempting to speculate that these results may explain the strong pro-protectionism lobby in the US, the generally anti-protectionism sentiment in the other OECD countries, and the agnostic views adopted by Japan. What we

can say is that a tariff war is unlikely, and the costs of such a war (if it were to break out) would be noticeable but not large. It seems likely that disagreement between the non-US countries would actually lead them not to adopt tariffs even when the US goes for trade restrictions.

Finally, we explore the implications of the choice of tariff policy for the gains from international cooperation over fiscal and monetary policies. The gains to cooperation are significant, but unevenly distributed. Cooperation in the absence of tariffs benefits Germany and Japan more than the United States and Canada, whereas if tariffs are allowed, cooperation benefits the United States and Canada more.

The simulations reveal that both cooperation and tariffs lead to similar shifts in the policy mix, that is fiscal expansions balanced by monetary contractions. Are cooperation and tariffs partial substitutes for each other? We find that they are not: although they individually produce instrument changes in the same direction, they have very different effects on policy targets. Cooperation increases US growth and reduces it elsewhere, whereas tariffs reduce growth in all the G3 countries. Cooperation reduces inflation and worsens trade imbalances, while tariffs produce the opposite effects. The choice between cooperation and tariffs must therefore depend on policy priorities.

In all the scenarios, we find that it is dollar depreciation, resulting from fiscal and monetary policies, that bears most of the burden of adjustment, not protectionist measures. Under all assumptions about cooperation and protection, the dollar will have to fall to around DM 1.25 or ¥ 95 by 1992 if the US trade deficit is to be eliminated and its budget deficit halved.

1. Introduction

This paper studies the macroeconomic implications of using protectionist policies to reduce the US external deficit under flexible exchange rates. Political interest in protectionism as a policy tool has been growing because of the unprecedented size of the US trade deficit, and because of the belief that the United States has been subject to unfair foreign competition. As a result protectionist measures are now appearing in both political rhetoric and legislation. At the same time, fear of protectionism triggered the policy reassessments which lay behind the Plaza and Louvre Agreements of 1985 and 1987 and the Baker initiative on LDC debt (Group of Thirty, 1988). A trade war would make most (if not all) trading economies worse off.

Although there are many theoretical models of the welfare losses associated with trade restrictions, the economics literature contains no quantitative analyses of the macroeconomic implications of such restrictions.[1)] To study that issue, this paper considers the following questions:

(a) Would US tariffs in fact imply lower growth and employment for the rest of the world? What are the substitution and the income effects of an import tariff in the US – and which would dominate?

(b) Can the US introduce a tariff which is small enough not to trigger retaliation and still clear the US trade deficit? Would other OECD countries find it in their interest to retaliate?

(c) Conventional analyses of the US trade deficit point to the need for further dollar devaluations and to the fact that countries must change their fiscal/monetary policy mix to achieve this. The theoretical literature moreover suggests that the favourable effects of protectionism on trade balances may well be outweighed by unfavourable indirect effects on output,

prices and the exchange rate (Krugman (1982), Dornbusch (1987a)). Would a policy of deliberate dollar depreciations be more effective than tariffs for achieving growth with external balance?

(d) Comparing cooperative and noncooperative policies, can we say that the gains from cooperation come from creating the conditions for free trade rather than from just picking the right combination of fiscal/monetary interventions? If so, the GATT is an important vehicle for promoting international cooperation, and the gains from cooperation are in reality much greater than those reported in previous studies (which have all assumed the continued existence of free trade arrangements in their noncooperative policy calculations).[2)]

(e) Would the contractionary effects, which tariffs in one country will impose on another, actually reduce the potential benefits of international policy cooperation?

To answer these questions we have used the Federal Reserve's MCM model in a dynamic game theory setting for 5 countries over the period 1986–92. The game theory approach is important for several reasons. First trade restrictions have international repercussions that are central to evaluating the efficacy of protectionism. Specifically, a contraction in US imports lowers economic activity abroad, which in turn reduces the demand for US exports. Depending on the values of the income elasticities, the loss of exports might outweigh the reduction in imports without any beneficial effect on the trade deficit or even domestic growth. Curiously all the theoretical models ignore these international repercussions as well as the implications of potential foreign retaliations. Neglect of these different repercussions from abroad mean that the theoretical results are more or less useless from the policy makers point of view (there is no way that we can pretend that the US and other G5 countries are 'small'), but the complications introduced by taking account

of them mean that numerical policy evaluations are the only way to proceed. Second, it is possible to examine how sensitive the policy outcomes are to the stance of monetary policy. If monetary policy seeks to control monetary aggregates, then a protectionist policy could generate counter–productive results because of the resulting appreciation of the dollar following an increase in interest rates. Finally, a game theory framework makes it possible to examine the degree to which foreign retaliation might eliminate the gains from protectionism, as well as the strategic interdependencies facing the policy makers.

2. Protectionist Measures in the US

2.1 The Policy Options

Over the next few years the US will want to shift its current account deficit of about 3% of GNP to balance, and also reduce a fiscal deficit of a similar magnitude, while also maintaining steady output growth and employment. The conventional prescription would be a reduction in government expenditure to reduce domestic spending levels and imports and (through a depreciation of the currency) to increase exports. The disadvantage of this policy is the risk of recession. Fiscal contraction might be supplemented with monetary expansion to accelerate the external correction via depreciation, although the accompanying expansionary tendency could start to weaken the external correction and could induce a new round of inflation.

If recession is unacceptable but the external and budget deficits must nevertheless be cut, then the US needs additional instruments. The obvious candidates are commercial policy and currency devaluation. The case for depreciation is illustrated in Figure 1 (see Dornbusch, 1987a). The US is currently near the internal balance (full employment) line II in Figure 1 – at a point like A which shows a trade deficit (EE being the external balance line). To maintain

employment, budget cutting must be accompanied by an exchange rate depreciation to reach B. But that goes too far, yielding a current account surplus. In other words,

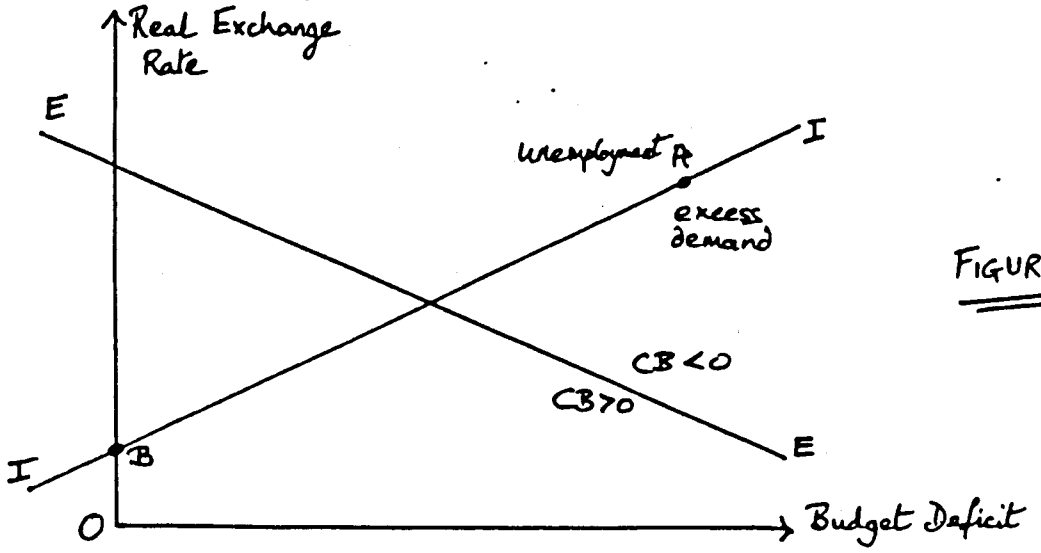

FIGURE 1

depreciation cannot, by itself, cut both deficits while also maintaining output levels. It would have to be accompanied by some other domestic policy changes which have the effect of shifting EE down to the left and II up to the left, so that points B, A, and the EE/II intersection coincide. Equilibrium would then hold on all accounts.

Can changes in fiscal and monetary policy be found which will shift EE and II by enough and in the right direction? Fiscal contraction would produce movements along II and EE, but only small shifts (analogous to the effects of balanced budget multiplier) in those lines. If the budget deficit is reduced, incomes and interest rates (hence the exchange rate) would start to fall. But the movements towards trade surplus and unemployment will hold the exchange rate up. The net result is a smaller budget deficit, a stable exchange rate and some unemployment at external balance; EE shifts left, and we get movements along EE above II. Hence monetary/crowding in effects shift EE; income effects produce movements along it. Meanwhile monetary expansion (with a fixed budget) would push II down (falling interest and exchange rates) while taking us below II and shifting EE left (lower interest rates and higher incomes imply depreciation is needed for external balance).

This looks hopeful if the shifts in, and departures from, II can be limited.

Another difficulty is that depreciation might take a long time to work. The US budget deficit may now have stabilised, but the dollar has fallen by 50–60% against the mark and the yen while the current account deficit continues. Thus point A has moved down II without reducing the underlying trade deficit – so that EE must have shifted left at the same time. That is consistent with the fact that, although the US deficit started to improve in 1988, the forecasts are that it will worsen again in 1989 for debt servicing reasons (Bryant et al, 1988). Finally, and not least, there is the practical problem of how to get the central banks to cooperate on managing dollar depreciations in a suitably controlled manner.

An obvious remedy is to introduce tariffs in order to drive a wedge between the trade and consumption price of imports, and hence enable a current account balance to be maintained at a higher exchange rate and an unchanged fiscal position. That would shift EE upwards reducing the trade deficit but worsening the budget if internal balance is maintained. In this case the EE rather than the II curve is moving the wrong way. We need to shift II to the left at the same time, so that the EE/II intersection ends up on the vertical axis. That could be done by using tariff revenues, and any additional tax revenues from increased domestic activity due to the tariff's substitution effects, to cut the budget deficit.

Of course a tariff policy is not actually as straightforward as this analysis suggests. For example, given growth targets, it is not clear that a government would want to choose tariff revenues large enough to clear both deficits, since with flexible exchange rates such a tariff is likely to contract rather than expand domestic output. In that case we would end up with unemployment and insufficient shifts in II and EE. Output could, however, still be maintained by combining those tariffs with a suitable monetary/fiscal policy mix to induce a currency depreciation. Most of the adjustments would now be internal. Fiscal contraction/monetary

expansion would move EE left, but tariffs move it up. The net result might be rather little change. But monetary expansion would move the II curve down, while tariffs shift the whole curve to the left. Thus combining tariffs with changes in the fiscal–monetary mix can prevent the loss of internal balance and either EE or II moving the wrong way, which means the monetary and fiscal interventions will be smaller than in the absence of tariffs. Moreover tariffs actually force the relative price changes of a depreciation to appear right from the start, while the main domestic adjustments are achieved through the fiscal/monetary policy mix (and depreciation) as before. Hence, in what follows, it is convenient to focus separately on the tariff and the depreciation aspects of the policy package.

2.2 The Legislative Programme

The most comprehensive trade policy measure considered during recent legislative sessions is the Omnibus Trade Bill which became law in August 1988. The Bill expands the definition of unfair trade practices to include "export targeting" by foreign governments, violations of workers' rights, and the toleration of foreign governments of systematic anticompetitive activities among private firms that have the effect of restricting the access of US goods to these markets. It transfers from the President to the US Trade Representative (USTR) the authority to decide whether a foreign practice is unfair under US law, and to determine and implement any action against an unfair practice. The Bill requires the USTR to take retaliatory action against violations of existing trade agreements or any trade practice that is "unjustifiable" and burdens or restricts US commerce. The Act broadens the coverage of trade adjustment assistance to secondary firms and workers that supply goods and services to firms directly affected by imports, and to workers in the oil and gas industry.

There have also been several trade policy actions proposed or taken to protect specific industries. Bills to impose quotas on steel products from Canada, Taiwan,

and Sweden have been introduced in both the House and the Senate. Several legislative actions have been proposed to impose import fees on crude oil and products. The Administration has negotiated so–called voluntary restraint agreements (quotas) with Japan on automobilies and motorcycles. Furthermore, in 1985 the administration began investigations regarding (1) Japanese import quotas on tobacco and leather goods, (2) Brazilian laws limiting imports of computers, (3) EEC subsidies on canned fruit, (4) South Korean laws prohibiting participation by foreign insurance companies, and (5) South Korea's inadequate protection of intellectual property rights. Implicit in these investigations is the threat of trade reprisals if the countries do not open up their markets.[3)]

3. Theoretical Models of Protectionism

There is by now a large literature on the macroeconomic consequences of protectionism. This literature goes back to the early 1940s and contains a wide variety of results describing the likely impacts of a unilaterally declared import tariff (or quota) on that country's own output, prices, trade balance, interest rates or exchange rate. Broadly speaking the most important results can be grouped under two headings. First there are results on the impacts of tariffs or quotas on the targets of domestic economic policy in the absence of retaliation from abroad. Secondly there are models of optimal tariff levels, and their outcomes, when other countries do retaliate.

In contrast there are *no* empirical results on the macroeconomic impacts of tariffs; and none assessing the probability or likely costs of a tariff war.[4)] The few studies which do include tariff barriers in a macroeconomic framework (eg Whalley [1985]) have all been computable general equilibrium models which *assume* full employment. They are therefore concerned with various distributional effects, and not with demand management, disequilibria and the dynamics of growth and

employment.[5)]

3.1 Single Country Tariffs

The argument for protectionism is straightforward: tariffs lead to higher demand for domestic goods at the expense of imports, leading in turn to higher output, incomes, and an improved current account. Unfortunately it is not clear that output would actually increase. Mundell (1961), Boyer (1977) and Krugman (1982) all show that tariffs lead to higher domestic output under fixed exchange rates; but under flexible exchange rates an appreciating currency would offset that expansion. If, in addition, wages are indexed, as implied by a wage contracting model for example, then output would not rise (van Wijnbergen, 1987).

It is also vital to specify what will happen to the tariff revenues. Tariffs have two domestic output effects: the (positive) substitution effect of increased relative import prices, and the (negative) income effect since a higher domestic price level means lower real incomes. Output rises if the substitution effect dominates. In theory we can always offset the income effects by rebating the tariff revenues in full. But under flexible exchange rates that will only be effective if exports and wages/prices are not much affected. Thus, in order to determine the effect of a tariff on output, employment and the current account it is necessary to establish not only which exchange rate and redistribution regimes apply, but also the relations between a number of price elasticities and model parameters and whether the substitution effects dominate income effects That means that the results of this literature have to be evaluated empirically (for particular countries) before they can be applied to policy design or policy prescription.

3.2 Optimal Tariffs and Retaliation

The results quoted above assume that a tariff will be introduced as an isolated

policy act. No other country is allowed to introduce its own tariff at the same time, whether for national advantage or in retaliation to the first country's tariff. If the effects of tariffs introduced by other countries (whether retaliatory or based on national interest) are also included, the results are likely to be quite different. As Krugman (1982) has concluded in response to the argument that British unemployment could be reduced by imposing import controls,[6] 'trade restrictions may succeed if there is only one England; but in a world of Englands, they must fail'. In fact Johnson (1953) had shown that the simultaneous use of tariffs by several countries may make one of them better off, but it must make another worse off – even when optimal tariff rates are used. If this is true with optimal tariffs, a country which gains individually from a tariff war (if there is such a country) is much more likely to lose if its tariffs are in fact chosen on the assumption that it is acting alone. Similarly a losing country will be even worse off if it does not use its tariff instrument when other countries do.

The failure to allow for interactions with other countries is a major restriction which almost certainly makes the standard theoretical model and its extensions useless from the policy maker's point of view. It is of course necessary to learn about certain components of the problem (i.e. the domestic responses to a domestically imposed tariff). But since, by hypothesis, the rest of the world is not unimportant to the success of a tariff, we also need to identify the consequences of responses elsewhere in the trading system. And responses, whether passive or active, must be expected because some countries are bound to lose by more if they do not respond to the tariff imposed by the first country than if they do respond. Secondly, history has shown that countries do in fact retaliate. Nearly all the US trading partners retaliated to the Smoot–Hawley tariff act in 1930, and tariffs (and other restrictions) on a whole range of products have been met with retaliation in the 1980s.[7] In a study of 36 countries, Deardorff and Stern (1985) find that existing

tariff structures are heavily influenced by foreign tariffs.

Finally, even if there is no retaliation, the 'spillover' effects of changes in the balance of trade following a tariff will cause adjustments in output and incomes in other countries and hence 'spillovers' back onto the first country which change the domestic responses considered in isolation. Such passive responses might be thought to be small. But, in response to the Smoot–Hawley tariff act, the Japanese government (for example) argued that Japanese purchasing power depended in large measure on exports to the US and that any reduction of exports to the US would inevitably reduce the demand for American products and hence US income.[8)] If that mechanism was important in the conditions of 1930, it will surely be even stronger 60 years later. Of course it may be true that retaliation becomes a significant factor only in the face of large tariffs, 'unfair' trading restrictions, or changes in the rules of the game. In other cases retaliation may be negligible or absent, as was the case in the 1920's and the 1950–75 period. This has been used as an argument against models of retaliation; if one country sees a foreign tariff raising incomes and hence trade levels, it will have no reason to retaliate (Cripps and Godley, 1978). But it is most unlikely that foreign tariffs would raise domestic incomes, and, even if they did, it remains to check that the spillover effects onto domestic income (via extra trade due to higher world incomes) sufficiently outweigh the trade lost to that tariff. To do that requires an analysis of the passive responses, and also of retaliation, even if it then turns out that to do nothing is the best strategy.

The difficulty here is that there is very little literature on foreign responses on which to base one's analysis. There are also various levels at which retaliation may appear. The simplest case is where foreign policy makers do not react but there are the passive responses of the previous paragraph to worry about. There is, as far as we know, literally no analysis of this case – although the present paper does provide some examples with the 'no retaliation' excercises in section 5. Secondly, countries

may recognise those feedback effects but not anticipate deliberate policy reactions to their own tariffs – the 'first step' optimal tariffs of Kahn (1947) and de Graaf (1949) – and this case is studied in Section 6.

Thirdly, countries may choose optimal tariffs which allow for optimal reactions by others – the Nash (noncooperative) equilibrium. Johnson (1953) and Gorman (1957) look at that case for a 2–country 2–good model, and show that although one country could possibly gain by such a tariff war (compared to free trade), the other must lose.[9] The optimal bilateral tariff for country i is $t_i=1/(e_j-1)$, for i,j=1,2 and $j\neq i$, where e_j is the price elasticity of country j's import demand. Naturally, except for the case of constant elasticity import functions, t_i will be a nonlinear function of model parameters, activity levels and the other country's choice of tariffs. Hence these results are effectively impossible to use in even the simplest (linear) models unless they are simulated numerically. This paper provides the first empirical estimates based on a world econometric model.

Finally tariffs might be set cooperatively if it is recognised that certain countries face special difficulties and that cooperation may limit the need to use tariffs on an individual base. This possibility raises the interesting question of whether organisations such as GATT actually provide the means for negotiating cooperative policies that reduce tariff levels. If bargaining has driven tariffs down to their present low levels, then the gains from international policy cooperation are actually much larger than current estimates suggest. On this argument, GATT would –in game theory language – be the reputation device which gives a cooperative policy equilibrium (or a superior noncooperative one) credibility and prevents the participants from reverting to the inferior 'war' equilibrium.

4. Policy Design Techniques

4.1 Optimal Policies

The noncooperative policies in this paper are derived from a simple Nash equilibrium. Consider first the case of 2 countries. Define y_t^A as the vector of deviations of country A's targets from their ideal values at time t; y_t^{Ad}. Then $y^{A'} = (y_1^{A'} \ldots y_T^{A'})$ is the vector of deviations over the decision periods 1...T. Similarly let $x^{A'} = (x_1^{A'} \ldots x_T^{A'})$ be the vector of deviations of country A's instruments from their ideal values.

We can now define a loss function:

$$w^A = (y^{A'} C^A y^A + x^{A'} E^A x^A) \tag{1}$$

where C^A and E^A are positive definite symmetric matrices. This loss function will be minimised subject to a set of linear constraints:

$$y^A = R_{AA} x^A + R_{AB} x^B + s^A \tag{2}$$

where R_{AA} and R_{AB} are matrices containing submatrices of dynamic multipliers, and s^A represents the sum of noncontrollable (exogenous and potentially random) influences on y^A. If the instrument values of the other player, B, are treated as given, the first order conditions yield a set of linear reaction functions:

$$x^A = -(R_{AA}' C^A R_{AA} + E^A)^{-1} R_{AA}' C^A (R_{AB} x^B + s^A) \tag{3}$$

Meanwhile country B will have a loss function $w^B = (y^{B'} C^B y^B + x^{B'} E^B x^B)$ and face the constraints $y^B = R_{BA} x^A + R_{BB} x^B + s^B$. Hence a reaction function for B, analogous to (3), can be solved simultaneously with (3) to yield the Nash equilibrium values x^A and x^B. This solution is, in general, not optimal although it is an equilibrium in the sense that, if each player presumes the other policy maker will continue what he is currently doing, then no-one has any incentive to change policy instruments.

What if policy makers believed that their opponents would change policy as a result of their own policy changes? That is only what each player should expect since that is exactly what he himself is doing. Player A would now conceive of his policy problem as finding the values of x^A such that:

$$\partial w^A/\partial x^A + \left[(\partial y^A/\partial x^B)(\partial x^B/\partial x^A) + \partial y^A/\partial x^A)\right]' \partial w^A/\partial y^A = 0 \qquad (4)$$

Of course equation (4) depends on the values of x^B, and player A must recognise that his rival will simultaneously be choosing x^B to satisfy the first order conditions (for x^B) corresponding to (4). Solving this pair of first order conditions will then lead to an equilibrium which is not unique, but which in general has a solution which is Pareto–superior to the simple Nash equilibrium. Let $\partial x^B/\partial x^A$ be estimated by D^B_j and $\partial x^A/\partial x^B$ by D^A_j at step j. Then (4) implies:

$$\begin{bmatrix} I & -D^A_{j+1} \\ -D^B_{j+1} & I \end{bmatrix} \begin{bmatrix} x^A_{j+1} \\ x^B_{j+1} \end{bmatrix} = \begin{bmatrix} F^A_{j+1} s^A \\ F^B_{j+1} s^B \end{bmatrix} \qquad (5)$$

where $F^A_{j+1} = -(G^{A'}_j C^A R_{AA} + E^A) G^{A'}_j C^A$ and $G^A_j = R_{AA} + R_{AB} D^B_j$, with $D^A_{j+1} = F^A_{j+1} R_{AB}$. In the absence of any preassigned 'rules of the game' it is not clear which equilibrium concept should be used. The Nash concept is adopted here as the conventional one. It is obvious from (3) that the Nash equilibrium is a special case of (5) in which j=0 and $D^A_0 = D^B_0 = 0$.[10)]

Finally cooperative outcomes can be calculated by minimising the 'collective' loss function:

$$w = \alpha w^A + (1-\alpha) w^B \quad 0 < \alpha < 1 \qquad (6)$$

subject to the constraints represented by (2) and its counterpart for y^B. The extension of both this cooperative and the noncooperative decision making framework to the case where there are 5 interdependent countries is straightforward. It is summarised in Hughes Hallett (1987).

4.2 The MCM Econometric Model

The Federal Reserve Board Staff's MCM model is a linked system of 5 quarterly national macroeconometric models of the United States, Canada, West Germany,

Japan and the United Kingdom. With the exception of France, it therefore covers the G5 group of countries plus Canada.

The MCM system contains individual country models which vary in size from 150 to 250 behavioural equations and identities, plus a set of equations representing the rest of the world to close the system. The country models are linked to each other by equations modelling trade in goods, services, investment income flows and exchange rates. A substantial respecification was undertaken in 1985, and a detailed description of that specification, its properties and a full listing have already been published by Edison et al (1987).

4.3 The Policy Scenario

In line with previous (theoretical) studies of protectionism, we take real output growth (GNP), inflation, the current account balance and the central government budget deficit in each country to be the targets of policy. It is assumed that policy makers in each country will aim for growth in the 3–4% per annum range, inflation rates of approximately 1–2% p.a., an external balance on the current account, and substantially reduced budget deficits. The detailed numerical description of these targets of policy will be found – for each country – in the appendix to this paper. Assuming that countries aim to balance their current accounts will clearly dampen the incentive of any surplus country to retaliate to restrictions imposed by a deficit country. This dampening is consistent with the formulation of the problem as one of finding cooperative policies to reduce international imbalances.

The policy instruments to be investigated are fiscal (central government expenditures), monetary (the rate of growth of the national money stocks), and protectionist (tariffs). Taxes would be an alternative fiscal instrument, although they provide relatively inflexible instruments and the policy debate has focussed mostly on government expenditures (especially in the US with the Gram–Rudman

legislation). Finally exchange rates are not treated as either a target or instrument of policy; they float freely throughout as the foreign exchange markets and policy dictate. It is assumed here that policy makers aim to maintain government spending as a constant proportion of GNP (except in the US where it should fall to clear the budget deficit by 1992, in line with the Gram–Rudman restrictions), a constant growth rate in money supply, and – ideally – free trade. For Canada, however, it is assumed that Canadian interest rates follow US rates. The precise numerical specification of these various ideal values is set out in Appendix A.

The relative priorities (objective function weights, C^i, E^i for i=1...5) used in these exercises are also set out in Appendix A. These weights represent a 'plausible' specification of national preferences, normalised for convenience on the priority for growth in the US. The weights specify that a 1% (or percentage point for growth rates) deviation from the ideal path in any variable would be penalised equally. However the view at recent G7 ministerial meetings has been that Germany and Japan need to increase their growth and that is therefore given a higher priority. The familiar German aversion to inflation also leads to a higher penalty on that variable. The two US deficits are given priorities which increase over time, so it becomes more important to clear these deficits the longer they remain uncorrected. Finally, the use of an anti–US tariff is highly penalised in the initial three years but is fairly free in 1989–92. The idea here is that OECD countries, who generally oppose trade restrictions elsewhere, would not wish to give the US the excuse to impose tariffs as a retaliation – but they reserve themselves the right to retaliate should the US be the one to introduce *and maintain* a tariff.

All the policy values reported in subsequent sections are 'open loop' values computed using the initial (1986) information set. They therefore represent the policy options as they would appear when policy makers have to choose their fundamental strategy – and whether to go for trade restrictions in particular.

Revisions to the selected strategy would then follow as new information becomes available.

5. Results: Optimal Tariffs

5.1 The Tariff Impacts

Table 1 summarises the optimal instrument values, and the corresponding expected outcomes for the targets, for the 5 countries in our benchmark exercise. That exercise uses the model, information set and objective function as described in the previous section. It allows both the US and the non–US countries to impose a general tariff on their respective imports,[11] and also to use that tariff in retaliation for the actions of their rival. Since these tariff levels are optimally chosen, together with the fiscal and monetary instruments, from a purely noncooperative point of view, this exercise represents the 'tariff war' scenario. To simplify matters, the results quoted in Table 1 are values averaged over the period 1986–92. The full year–by–year figures are reproduced in Appendix B.

The most striking feature of these results is that the tariff levels are relatively low; averaging 23.3% for the US and 1½% elsewhere.[12] They are also more variable for the US; falling from a plateau of between 28% in 1986 and 34% in 1989, to zero by 1992. The non–US countries follow the reasonable strategy of no tariff to start with (1986–88), and a 3½% tariff thereafter when it becomes clear that the US tariff is there to stay. Hence tariffs would be used very little, except briefly by the US during 1986–9 when its current account deficit is removed. But it must be remembered that these tariff figures are *in addition* to any tariffs currently in force.

Apart from a disappointing growth performance by the US, the target outcomes are all satisfactory. Output in the non–US countries grows at between 3 and 3½% pa; while inflation runs at 5.5% for Canada, 2½% for the UK, and 1.5% for Germany and Japan. The current account balance in Canada is largely unchanged over the

period; in the UK it deteriorates after 1987, whereas Germany's large trading surplus is nearly eliminated and Japan's is halved all within the first three years. That seems to be the strongest consequence of this policy package. Government expenditures remain fairly constant at their initial level. As a consequence of that Germany's budget deficit doubles over the 1986/8 period, while Japan and Canada show no change, and the UK moves to a budget surplus. All of these results match current trends.

On the US side, output grows more slowly (1.70% p.a.) partly because tariff revenues are not rebated back to consumers, a sensible assumption in view of the fiscal imblance in the US. Lower income and higher relative prices are necessary to correct the current account deficit; it takes the first three years to make any serious impression on that deficit, but once it starts to fall (in the third year) it drops quite rapidly and the current account deficit is reduced to just $10 billion in 1992. The US is also able to cut its budget deficit in half (to $60–70 billion) over the first two years – government expenditures are reduced from their historical position of 20% of GNP to below 18% (in line with the Gram–Rudman–Hollings legislation) in the first year. That confirms that current government spending is too high in the US for long term growth, but since the improvements in the budget deficit appear *after* 1986 the deficit reductions must be due in part to something other than lower government expenditures. But, as we shall see, this budget improvement is maintained almost unchanged in the absence of tariffs. So that other source of the budget improvements must be improved tax revenues; the tariff revenues are too small and come too late to change the budget position very much.

5.2 The Role of Tariff Policy

The reason for the limited use of tariffs in this exercise, and the comparatively poor US growth performance, are easy to see. Since tariffs have a negative impact

on output almost everywhere – as would be predicted by most theoretical models when tariff revenues are neither redistributed nor spent[13] – but a positive impact on the external and budget deficits (see Table 2), the US is faced with an awkward trade–off. If it uses a tariff, it improves those deficits (which it must do) but reduces growth; the income effects outweigh substitution effects. If it does not use the tariff, growth will be maintained but the deficits are not reduced – compare Table 3 which shows the figures corresponding to Table 1 when no country may use a tariff policy. Policy makers have to pick a point on that trade–off. But they can also try to reduce this conflict by using a conventional combination of fiscal contraction and monetary expansion to achieve the same results, and supplement this with a small tariff to increase the effectiveness of that package for deficit correction (thus modifying the need for fiscal contraction/monetary expansion while improving their ability to maintain output growth at the same time).

It is exactly this alternative which we see in operation here (comparing Tables 1 and 3). When the US tariff is not used, output growth is slightly better but the two US deficits are somewhat worse (mainly the external deficit which is rather slower to be corrected). But when it is used, the contractionary fiscal policies are less contractionary, the expansionary monetary growth less expansionary, and the interest rate reductions smaller. These differences may be small, but they are quite clear in the year–by–year figures. In fact the main effect of a tariff is to improve the external balance but to worsen output growth in 1986–9.

The non–US countries, by and large, do not face this kind of trade–off since Germany and Japan are running large surpluses on their external accounts, and only moderate deficits with their budgets. They therefore have no incentive to use a tariff since that would increase the existing surpluses on both external accounts while damaging their output growth. In fact the only reason to use a tariff would be to protect their rather weak trade positions, in later years, in the face of an American

tariff – and this is exactly what we see happening in the annual trade figures underlying Table 3.

Apart from the changes referred to in the last two paragraphs, the introduction of tariffs have remarkably little impact on the economic prospects of the 5 countries. (We return to this point in Section 7.) There is some increase in Canadian (and American) inflation, but a decrease elsewhere. Also Canadian and US growth is quicker to pick up, while German output expands slower to start with. The adjustments to the instrument values are likewise small.

Finally a tariff policy would "cost" the US a loss of about .2% of GNP each year (with similar figures for Germany and Japan). This is remarkably close to the casual estimate suggested by Krugman (1987), and is similar to the estimate given in Abraham et al (1987). These estimates show that the crucial growth–trade deficit trade–off is steeper under a tariff regime, in that a given improvement in the trade deficit will require a greater growth sacrifice. This negative impact on growth is certainly a disadvantage if the trade improvements can be obtained in some other way (eg international cooperation).

5.3 Relations to the Literature

How do these optimal tariff results compare to the results on optimal tariffs and retaliation already available in the literature? The MCM's trade weighted import price elasticities are 1.278 for the US and 0.705 for the 4 other countries (Edison et al, 1987). According to the usual formulae for an optimal tariff, the US should therefore impose a tariff of 360% and the other countries a negative tariff.

As far as the US is concerned, this is very much larger than our computed results. That is not surprising since the optimal tariff formulae are derived by treating the tariff level as the only policy instrument in a static problem, whereas the values computed in Table 1 are 5–year averages optimised jointly with fiscal

and monetary instruments. Tariff levels will be lower when they are part of a policy package than when they are the sole instrument of policy. The negative non–US tariff reflects the inelasticity of US import demand. A negative tariff shows that these countries should therefore help the US out with its trade deficit – and, interestingly, that is exactly what we observe in the cooperative solution (but not in the noncooperative one); see Table 7.

5.4 Interest Rates and Interest Rate Differentials

The behaviour of interest rates, or more precisely interest rate differentials, is very important to the performance of the MCM model. This is because the model's performance is sensitive to stock levels, while interest rate differentials are the major determinant of short and long term international capital movements and hence exchange rate adjustments. Changes in interest rates therefore have an important effect on both the current and capital accounts in each country, and hence a strong influence over the interactions (in terms of output, financial links and policy responses) between those countries.

The importance of interest rate changes can be seen in our policy results. Section 3 argued that tariffs would not contribute much to correcting the twin US deficits if growth is to be maintained at the same time. Instead those results would have to come from a dollar depreciation induced by suitable changes in the fiscal and monetary policy mix adopted in each country. It is convenient therefore to emphasise this point by examining the behaviour of interest rates, and the key role of the exchange rates, separately from the other policy variables which appear in this exercise. This is done in Section 7 below. Nevertheless it is worth noting the low level of the US short term interest rate in Table 1. Germany and Japan likewise have low interest rates on average, but their rates are not much different from those which prevailed at the start of the exercise: 3½% and 4% respectively.

For the US, the rate has been halved from about 7% to 3¼%. Thus the interest rate differentials between the US and Japan or Germany have been eliminated. That in itself would lead to a capital outflow from the US, a dollar depreciation and hence a correction in the trade deficit. But it would do nothing to correct the budget deficit, except in so far as lower interest rates mean an existing deficit will be cheaper to finance. All these results duly appear: Appendix B shows the US trade deficit is largely eliminated by 1991, but the budget deficit is not. Table 9 shows the sharp dollar depreciations involved in achieving this result.

6. Retaliation

6.1 The Probability and Costs of a Tariff War

Given the rather small difference between the tariff and no tariff results in Tables 1 and 3 respectively, how likely is a tariff war to develop? What costs would it impose, and on whom?

The payoff matrix in Table 4 shows the outcomes, as represented by the optimised objective function values, of the G3 countries under the two alternative decisions of whether to implement their optimal tariffs or not. The top left cell corresponds to Table 3 and the bottom right to Table 1. The two off–diagonal cells report the outcomes when one side imposes an optimal tariff assuming the other will not (the policy details are not given since they hardly differ from Table 1). The rather small *proportional* differences between each country's 4 entries in Table 4(a), reflect the small impacts of the tariff instruments on the policy problem as a whole. However, small as those proportional differences may be, they are certainly not negligible. Those changes are 'worth' the equivalent of between a loss of 4% GNP growth per year for 7 years for Canada, and a gain of an extra 2% growth pa for the US – see Table 4(b), column 5, where the G3 countries all gain from this war while Canada and the others lose.[15)] We are therefore observing the war outcome

described by Johnson (1953); some countries may gain from a tariff war while others are bound to lose.

Examination of the payoff matrix in Table 4(a) also shows that the US would believe that tariffs would increase its welfare and that Japan would be happy to go along with that, while Germany would have some preference for free trade. More importantly, the US would minimise its potential losses – given some uncertainty about which policies other countries may adopt – by opting for the tariff strategy whatever the response. Germany on the other hand can minimise its potential losses by picking the no tariff strategy – while Japan would prefer to have tariffs on this criterion. A tariff policy by the US is in fact a stable outcome, implying small gains (worth between .2% and .8% extra GNP growth) for all. The same would not be true of a European tariff. Thus US protectionism would not impose costs compared to a noncooperative free trade solution; but it would impose huge losses compared to the cooperative free trade solution (Table 4(b), penultimate column).

Hence, based on the assumptions underlying this study, a tariff war is unlikely, and the costs of such a war (if it were to break out) would be noticeable but not large. Moreover it seems likely that disagreement between the non–US countries would actually lead them not to adopt tariffs even when the US goes for trade restrictions.[16] Thus in answer to two of the questions posed at the start: there is indeed an equilibrium tariff level for the US which would trigger no response abroad (about 23%); and, in combination with suitable monetary and fiscal policies, that tariff would succeed in clearing nearly all of the external deficit by 1992. Note that these two findings rest on the assumption that the US and its trading partners target their external balances.

6.2 The Incentive to Retaliate

The most striking result so far is that tariffs should be used only sparingly.

This follows because tariffs were found to reduce output while improving the current account deficit. In other words, the income effects of these tariffs outweigh the substitution effects. That is a result which would be predicted by most theoretical models since to rebate none of the tariff revenues gives a contractionary impulse to fiscal policy and that will, in itself, reduce an external deficit. Any improvements in the current account will, in its turn, reduce the need to use tariffs or to retaliate.

However it is important to realise that it is the offset between substitution and income effects which is the key here, not the fiscal contraction as such, since the substitution effect will create extra output and incomes. If the substitution effect were strong enough, tariffs would end up be being *net* expansionary. That does not happen here, but the (expansionary) substitution effects nearly make up for the (contractionary) income effects with the result that the *net* loss of output and the current account improvement are only small. Similarly there is a small increase in the budget deficit because the extra tariff revenues are offset by falling tax revenues (and some extra government expenditures) caused by those contractions. Moreover the relatively small changes in the trade balances mean that Germany and Japan continue to run surpluses even when the US introduces its tariff. As a result those countries have no incentive to retaliate with an instrument which would merely increase their trade surpluses yet further.

Our conclusions may therefore be fairly robust to likely variations in the model and the problem specification. But how robust is it to increases in the desire to use the tariff instrument? The desire for tariffs might rise with domestic lobbying and political pressure, a commitment to economic independence, or because the ability to follow an independent fiscal and monetary policy is too limited. And if the US were to prefer a much higher tariff, would the non–US policy makers be provoked into a strong retaliation? Tables 5 and 6 report results for the G3 countries of an increasing US desire for some tariff. Table 5 increases the priority for using tariffs

over fiscal and monetary policy, while Table 6 considers increasing the *ideal* tariff level from zero to 20%. From these results, we see that raising the priority on using a tariff policy has more effect than raising the level you would like to see if such a policy were introduced. In Table 5, the average US tariff rises from 23% to 77% as the relative priority on that instrument rises by a factor of 60. Raising the ideal US tariff from zero to 20% produces an optimal tariff of just 38%. Apart from this result, the differences between Tables 5 and 6 and Table 1 are small and predictable. US growth rates are reduced by up to ½ of a percentage point; there is a slight reduction in the US money growth and fiscal contractions, while the US current balance is somewhat improved. These results just confirm the analysis advanced in sections 2 and 5.2.

The final columns of Table 5 show the results of a temporary increase in the US tariff – announced and executed as such. It runs at 38%, 50% and 22% in 1987/8/9, and 10% thereafter. However such a temporary scheme has no impact – the results are effectively the same as those at the start of the table.

The interesting thing about all these results is that *in no case* would the non–US countries wish to retaliate. The non–US tariff stays at its average optimal value of 1.5% or a little higher, irrespective of the US tariff level. Even if the US tariff rises to 77%, the non–US counter tariff is just 4%. This confirms that it is not in the other countries' interest to retaliate significantly. One reason is that the trade surpluses in those countries would be made worse by tariffs. A second reason is that the pre–intervention US import price elasticity was 1.3, but for the non–US countries it was 0.7. This means that the US can exploit trade restrictions by acting as if it were a monopolist. It can reduce expenditures on imports by increasing its tariff rate. The non–US countries, whose imports are price *in*elastic, do not have this opportunity and can make no effective use of their tariff. Moreover, the US targets are more responsive to individual policy changes than their non–US

counterparts (Table 2). This is particularly marked for the tariff instrument in the short term and for all instruments on the external and budget deficits, although the degree of dominance by the US multipliers obviously fades with the passage of time. That dominance means that if the other countries did retaliate to the US tariff, damaging US prospects in the process, the US would have a short term advantage in responding to the retaliation and would be able to force further losses on other countries. This and the low inelasticity of imports therefore limit the usefulness of an anti–US tariff barrier.

7. International Policy Coordination

(*a*) *The Gains from Cooperation:* Table 4(b) gives the objective function value for each country under this cooperative policy programme, and also the 'GNP growth rate equivalents' calibration of the implied policy gains. These gains are significant, but unevenly distributed, ranging from the equivalent of 0.7% extra GNP growth for the US and 1% for Germany and Japan, to only ¼% for Canada. If tariffs are allowed these figures are reversed; the US and Canada make gains of 1¼% and 2½% respectively, while Germany and Japan only make gains of 1% and 0.7%. Interestingly cooperation includes a 6% negative non–US tariff to help the US out of its difficulties, while the 23% US tariff is unchanged (Table 7).

Thus the threat of protection does reduce the likely benefits of cooperation for Germany, Japan and the UK, but not for the US and Canada. For the US, cooperation with tariffs produces the best outcomes, while tariffs on their own clearly produce greater gains than the introduction of cooperation. Similarly cooperative gains are larger for the UK, Germany and Japan than the gains they could make by introducing tariffs into a noncooperative regime. Hence, by presuming free trade and the continued existence of GATT, previous studies have not underestimated the gains of policy coordination for countries like the UK,

Germany and Japan, since no gains follow from agreeing not to use tariffs in the noncooperative policies. Nor, in fact, have they underestimated the gains for the US because the danger is not that tariffs would cause the cooperation implicit in a free trade regime to unwind (ie that the noncooperative plus tariff solution would be worse than the free trade noncooperative solution), but that a country with a large trade deficit may lack sufficient instruments to correct that problem without damaging itself and its partners in the process. Thus, international agencies like GATT and the IMF should first concentrate on creating the conditions for cooperation. That might have to include tariffs as a temporary expedient for those countries with severe external deficits.

(*b*) *Cooperation and Tariffs are not Alternative Strategies*: Tables 7 and 8 show that cooperation leads to a shift in the policy mix. Fiscal expansions balanced by monetary contractions are exactly what one would have expected had tariffs been introduced (Section 5.2). On the face of it, therefore, cooperation has the same effect as introducing protectionist policy instruments. Are cooperation and tariffs partial substitutes for each other?

Comparing first Tables 3 and 8, and then Tables 3 and 1, shows that cooperation and tariffs do individually produce instrument changes which go in the same direction. But, among the target changes cooperation increases growth in the US but reduces it elsewhere, whereas tariffs reduce growth in all the G3 countries. Cooperation reduces inflation, tariffs increase it. Cooperation worsens the trade imbalances, tariffs improve them. Hence the choice between tariffs and cooperation must depend on particular priorities and that is why, in certain cases, international cooperation may have to permit tariffs for countries in severe external difficulties.

(*c*) *Policy Efficiency: Tariffs vs Currency Depreciations*

What is the importance of exchange rate adjustments in all this? Table 9 summarises the exchange rate movements which underlie each of our four main scenarios and confirms that exchange rate changes do indeed do most of the work here. The US dollar falls against the Pound, and rather more sharply against the DM and the Yen. These calculations show the dollar will have to fall to DM 1.25 or 95 Yen by 1992, if the US is to clear its trade deficit and halve its budget deficit but still maintain reasonable growth. Those projections are broadly in line with the calculations made by other economists, although they may lie below current market expectations. Feldstein (1988) has argued that balanced trade in the US requires the dollar to fall to DM 1.20 and below 100 Yen, with a big drop at the start and a 2–3% depreciation thereafter. That is in line with what appears in Table 9. Dornbusch (1987b) suggests slightly stronger dollar depreciations will be needed (15–20% on the December 1987 figures, whereas Table 9 implies 10% against the DM and 20% against the Yen).

It is clear from all this that the burden of adjustment is carried by the fiscal/monetary/depreciation policy package rather than by protectionist measures. The dollar's depreciation is, if anything, larger in the absence of tariffs – exactly as predicted in Sections 2 and 5. Similarly cooperation also reduces the exchange rate movements slightly, reflecting the elimination of any temptation to engage in competitive depreciations. Thus tariffs or cooperation can substitute for a depreciation policy, but their capacity to do so is very limited.

8 Conclusions

This paper investigates the extent to which US tariffs can play a decisive role in eliminating the external imbalance of the United States. To examine this issue we make the following assumptions. First, international interdependencies can be represented by the structure of the Federal Reserve Board Staff's Multicountry

Model. Second, the industrialised countries are assumed to agree that the elimination of world external imbalances is a policy objective. Finally, that tariff revenues collected by the US Government are used to reduce fiscal imbalances in the United States.

Based on these assumptions, the analysis suggests several conclusions. First, reliance on US tariffs to eliminate the external imbalance without reducing real income is not feasible. Intuitively, the use of tariff revenues to reduce fiscal imbalances, a reasonable assumption in the present context, amounts to undertaking a contractionary policy. A better approach involves a change in the US policy mix to produce a further controlled depreciation ranging between 10% and 20% relative to the 1988 value of the dollar. Second, if tariffs were chosen as the policy tool, then they would have to increase by 23% relative to current levels. This increase in protectionism would reduce significantly US external imbalances but would also lower growth prospects for the United States. The *net* effect of tariffs on both the internal and external US positions is therefore not large: the expenditure switching effects of tariff increases are offset by the contractionary fiscal policy associated with the use of tariff revenues to eliminate fiscal imbalance.

Finally, the model simulations suggest that the introduction of tariffs by the United States does not necessarily initiate retaliation by foreign countries. Both the assumption that all countries seek to eliminate their external imbalances and the MCM estimates of the differential in price elasticities between the United States and other countries account for this lack of incentive to retaliate. The conclusion that the probability (and costs) of a tariff war are fairly small is therefore robust to changes in the pressure for using protectionist policies. On the other hand, if tariffs actually represent the loss of a cooperative regime underwritten by the free trade arrangements of GATT, then the costs could be quite serious.

FOOTNOTES

1 Hamilton and Whalley (1983) claim there are just 3 numerical examples in the literature, all of them being illustrative calculations with no pretence of being representative of actual situations. (One exception is Petersen (1988).) There are of course several quantitative analyses of the welfare losses to be expected from trade restrictions (see Section 3), but these are all based on a general equilibrium approach with fully employed resources. The emphasis is distributional, rather than on disequilibria and the dynamics of growth and employment.

2 See, for example, Oudiz and Sachs (1984), Hughes Hallett (1986a,b;1987), Canzoneri and Minford (1986).

3 In April 1987, the Reagan administration imposed 100% tariffs on some Japanese electronics products as a result of such investigations.

4 This paper considers only tariffs as the protectionist instrument. There are two reasons for this. First, Rodriguez (1977) has shown that a quota war would eliminate trade altogether, and in this sense quotas are inferior to tariffs. Second, Young (1980) established that the best strategy, given the uncertainty of world demand, is either a fixed tariff or a tariff which varies systematically with targetted income. In neither case is it a quota.

5 See Whalley (1984), Deardorff and Stern (1985), Hamilton and Whalley (1985), or Baldwin and Clarke (1987). An exception is the study by Abraham, Deardorff and Stern (1987) which simulates the effects on sectoral trade, employment, the trade and budget deficits under fixed and flexible exchange rates, of a *given unilateral* import surcharge. Hence there is no analysis of alternative strategies or policy choices, nor of the consequences of a tariff war, which is our focus here.

6 Cripps and Godley (1978). There are a number of other conditions which must be met; prices and wages must be flexible in response to costs but not to excess demand or supply; tariff revenues must be redistributed and economies of scale must exist in the protected sector or economy. Hence the validity of this proposition is once again an empirical issue, not an analytic truth.

7 Mann (1987); the most publicised recent cases involving steel, agricultural products, aeroplanes, semiconductors, electronics, machine tools, cars, etc, with the principal players being the US, the EEC and Japan.

8 Mann (1987).

9 The extension of this result to an arbitrary number of countries (and goods) was provided by Kuga (1973), who established the existence of a general tariff equilibrium at which trade still continues.

10 Brandsma and Hughes Hallett (1984). Empirical applications of (5) appear in Hughes Hallett (1986a). Although the model used here contains no rational expectations terms, the dynamic game generates rational expectations of future/current decisions being adopted by other countries. This raises the possibility of time–inconsistent behaviour in that one country might announce

a certain strategy and, having got its rivals to act on that information, it could then revise its strategy to is own advantage. However, the decisions studied here represent a 'reputation' equilibrium (as noted in Hughes Hallett, 1986a) and we do not look at the consequences of reneging on a previously announced strategy. To do so would be to prejudge the role of GATT as a reputation device. In particular, with 5 countries, punishment strategies by forming coalitions will make reneging by any one of them unattractive (Hughes Hallett, 1986b).

11 General tariffs are necessary to prevent trade simply being switched to pass through the Rest of the World block and thus avoid any trade restrictions. The non–US countries operate as a block, with tariffs against everyone else but *not* among themselves.

12 The US tariff is relatively small compared to the 50% "best guess" offered by Hamilton and Whalley (1983), the 360% of the optimal tariff formula (see Section 5.3), and the 100% which has been used by the Reagan administration (see footnote 3). It is, however, not small as a change in overall US policy.

13 See Section 3. Since Germany and Japan have no compelling budget restrictions, a more interesting exercise would be one where the US retained its revenues but Germany and Japan redistributed theirs. However, Germany's budget cuts in January 1988, which were designed to prevent an emerging budget deficit very similar to that predicted in this exercise, suggest that this scenario is unlikely to come about for domestic political reasons.

14 The calculation of GNP 'growth rate equivalents' is due to Oudiz and Sachs (1984). It measures what rate of extra GNP growth would, on average with all other policy variables held constant at their benchmark values, produce the observed change in the objective function values.

15 This result suggests that it was indeed to Canada's advantage to negotiate a free trade treaty with the US.

16 It is important to note that these conclusions are of course dependent on the particular model and objective function chosen. However they do seem to be insensitive to the desire for a protectionist policy which has been assumed here – see Section 6.2

TABLE 1

The Base Case: Average Noncooperative Policy Values (Targets and Instruments) for 5 Countries Using Tariffs, 1986-1992

	CDN	UK	GER	JAP	USA
$\dot{GNP}$	3.57	3.18	2.99	3.31	1.70
$\dot{P}$	5.49	2.52	1.17	1.56	2.81
CB	-12.25	-6.98	37.92	8.40	-57.70
GDEF	17.35	-2.37	43.65	11.93	78.58
RS	7.09	7.75	2.90	3.42	3.17
G	20.17	19.85	21.57	9.80	18.75
M	5.0	2.93	3.75	4.49	4.16
T	1.014	1.014	1.014	1.014	1.233

KEY:
- GNP = real gross national product (% growth p.a.)
- P = annual % increase in consumer price index
- CB = current account balance (billions (Japan trillions) of domestic currency units)
- GDEF = central government budget deficit (units as for CB)
- RS = short term interest rate (3 month Treasury Bills or equivalent)
- G = government current expenditures as % of GNP
- M = rate of growth of money stock (M1)
- T = average tariff index (normalised at 1.00 for zero tariff level)

NOTE: The non-US countries are constrained to operate a unified tariff bilaterally with the US.

Table 2: Impact and Cummulated (4 Year) Policy Multipliers from

Instr / Target	Canada G	Canada T	UK G	UK M	UK T	Germany G	Germany M	Germany T	Japan G	Japan M	Japan T	USA G	USA M	USA T
(a) Impact														
GNP	1.2	.07	.5	.4	.09	1.3	.4	.1	1.2	.7	.2	1.2	.4	-.8
P	.2	2.3	-.00	.07	.00	.09	.3	.3	.2	.04	.2	.06	.00	1.5
CB	-1.8	1.7	-1.5	.4	1.4	-10.3	2.5	2.5	-.6	.4	.5	-13.5	.8	25.9
GDEF	2.2	-6.5	3.3	-1.8	-.7	5.8	-.4	-5.7	2.1	-.7	-.8	11.0	-7.9	-16.8
(b) Cummulated														
GNP	1.2	2.2	.3	.3	-.2	.8	.2	-.4	.4	.9	-.2	.8	.4	-1.9
P	2.55	9.1	.5	.2	.5	.9	.4	.5	.9	.5	.4	1.6	.6	2.4
CB	-3.0	1.3	-1.6	-.4	.7	-9.5	2.4	1.1	-.6	.04	.4	-25.9	.3	29.9
GDEF	4.8	-9.7	4.8	-2.6	.02	8.0	-4.1	-2.9	3.3	-1.1	-.5	45.7	-6.8	9.6

Units: as Table 1

TABLE 3

AVERAGE NONCOOPERATIVE POLICY VALUES IN THE ABSENCE OF TARIFFS, 1986-92.

	CDN	UK	GER	JAP	USA
GNP	2.90	3.14	3.22	3.45	1.87
P	2.95	2.44	1.27	1.60	2.13
CB	-7.86	-7.31	38.18	8.26	-66.42
GDEF	10.44	-2.57	42.26	12.07	75.82
RS	5.82	7.69	2.79	3.43	2.55
G	19.19	19.85	21.74	9.91	18.68
M	5.0	2.93	4.09	4.72	4.25

Symbols and Units as in Table 1.

TABLE 4

The Costs of a Tariff War and the Gains to Coordination

(a) Payoff Matrix for a Tariff War

Outcomes of GER, JAP, USA respectively

		USA : No Tariff			USA : Tariff		
Non-US:	No Tariff	142.03,	35.05,	177.50	135.09,	33.38,	171.48
	Tariff	149.23,	33.09,	163.19	139.86,	30.98,	155.16

(b) Costs of Tariff War and Gains to Cooperation

	NASH (Nonco-op)		COOP		Compared to Nash/Free Trade (approx. % GNP growth equivalents):		
	Free Trade	Tariff War	Coop (No Tariffs)	Coop (Tariffs)	Gains/ Losses in Tariff War	Gains from Cooperation (No Tariffs)	Gains from Cooperation with Tariffs
CDN	29.74	96.59	29.49	74.20	-4.37	.27	2.53
UK	17.03	15.88	15.94	15.25	+ .57	.56	.42
GER	142.03	139.86	131.98	131.24	+ .56	1.20	1.11
JAP	35.06	30.98	27.98	27.46	+ .76	1.01	.71
USA	177.50	155.16	175.72	148.74	+2.53	.71	1.35

N.B. The Nash Bargaining Solution is used to compute the Cooperative Solutions here, with weights (α_i) on the national objectives of 0.2 for Canada, 0.2 for UK, 0.15 for Germany, 0.2 for Japan, and 0.25 for the US.

TABLE 5

OUTPUT AND CURRENT ACCOUNT BALANCES WITH INCREASINGLY PROTECTIONIST POLICIES:

AVERAGE NONCOOPERATIVE POLICY VALUES FOR THE G3 COUNTRIES

	US Tariff Weight 15			US Tariff Weight 5			US Tariff Weight 0.5			Temporary Tariff Policy		
	Germany	Japan	US	Germany	Japan	US	Germany	Japan	US	Germany	Japan	US
	2.96	3.26	1.54	2.92	3.18	1.29	2.88	3.09	1.04	2.97	3.22	1.45
	37.36	8.19	-54.41	36.42	7.85	-48.96	35.48	7.52	-43.66	36.97	8.15	-52.92
	44.15	11.98	79.15	44.96	12.06	80.03	45.73	12.13	80.79	44.39	12.03	79.69
	21.54	9.80	18.80	21.50	9.79	18.88	21.46	9.79	18.94	21.54	9.81	18.81
	3.79	4.49	4.10	3.85	4.48	3.99	3.91	4.47	3.89	3.80	4.48	4.17
	1.020	1.020	1.363	1.030	1.030	1.572	1.039	1.039	1.767	1.021	1.021	1.414

TABLE 6

OUTPUT AND CURRENT ACCOUNT BALANCE WITH AN INCREASING LEVEL OF US TARIFFS : AVERAGE NONCOOPERATIVE POLICY VALUES FOR THE G3 COUNTRIES

	US:T^d = 1.05			US:T^d = 1.10			US:T^d = 1.15			US:T^d = 1.20		
	GER	JP	USA	GER	JP	USA	GER	JP	USA	GER	JP	USA
GNP	2.98	3.30	1.66	2.97	3.28	1.63	2.96	3.27	1.59	2.95	3.25	1.56
CB	37.80	8.34	-56.84	37.67	8.28	-55.98	37.55	8.22	-55.12	37.43	8.16	-54.26
GDEF	43.79	11.95	78.62	43.92	11.96	78.66	44.05	11.98	78.69	44.19	11.99	78.73
G	21.56	9.80	18.76	21.55	9.80	18.78	21.54	9.80	18.79	21.54	9.79	18.81
M	3.76	4.49	4.13	3.77	4.49	4.11	3.77	4.48	4.08	3.78	4.48	4.05
T	1.016	1.016	1.269	1.017	1.017	1.305	1.019	1.019	1.341	1.020	1.020	1.377

TABLE 7

The Nash bargain Cooperative Policy Outcomes with Tariffs, Averages over 1986-92 : α_i = 0.05 (CDN), 0.2 (UK), 0.15 (GER), 0.3 (JAP), 0.3 (USA).

	CDN	UK	GER	JAP	USA
$\dot{GNP}$	3.69	3.19	3.03	3.22	1.72
$\dot{P}$	3.85	2.65	1.07	1.60	2.60
CB	-12.77	-6.59	34.62	8.34	-56.78
GD	18.56	-1.24	47.73	11.63	80.14
RS	7.03	7.91	3.29	3.46	3.24
G	20.50	20.02	21.68	9.66	18.78
M	5.0	2.83	2.94	4.25	3.79
T	0.941	0.941	0.941	0.941	1.234

TABLE 8

The Nash bargain Cooperative Outcomes without Tariffs

Averages 1986-92

National weights 0.2, 0.2, 0.15, 0.2, 0.25 as in table 4.

	CDN	UK	GER	JAP	USA
$\dot{GNP}$	3.06	3.16	3.08	3.32	2.00
$\dot{P}$	2.87	2.59	0.97	1.59	2.03
CB	-8.08	-6.76	35.29	8.43	-67.89
GD	11.16	-1.30	46.68	11.45	78.72
RS	6.03	7.90	3.25	3.49	2.69
G	19.34	20.02	21.75	9.70	18.76
M	5.0	2.81	2.96	4.36	4.01

TABLE 9

SUMMARY OF THE EXCHANGE RATE CHANGES

	Actual Value in 1985	Calculated Value for 1986	Average Value for 1986-92	Final Value in 1992	Policy Strategy
US $/C $	.73	.73	.75	.69	Nash + Tariff
US $/£	1.28	1.65	2.41	2.71	
DM/US $	2.94	1.97	1.42	1.29	
Y/US $	238.6	150.3	108.3	94.1	
US $/C $	.73	.73	.78	.76	Coop + Tariff
US $/£	1.28	1.59	2.27	2.60	
DM/US $	2.94	2.00	1.43	1.26	
Y/US $	238.6	154.8	113.7	97.6	
US $/C $	.73	.73	.77	.76	Nash - No Tariff
US $/£	1.28	1.66	2.48	2.84	
DM/US $	2.94	1.96	1.40	1.28	
Y/US $	238.6	156.2	110.8	94.9	
US $/C $	.73	.73	.77	.76	Coop - No Tariff
US $/£	1.28	1.61	2.37	2.77	
DM/US $	2.94	1.99	1.39	1.20	
Y/US $	238.6	153.8	110.3	92.33	

REFERENCES

Abraham, F, A V Deardorff and R M Stern (1987) 'The Economic Consequences of an Import Surcharge' *Journal of Policy Modelling*, 9, 285–309.

Baldwin, R E and R N Clarke (1987) 'Game–Modelling Multilateral Trade Negotiations' *Journal of Policy Modelling*, 9, 257–84.

Bryant, R, Holtham, G H and Hooper, P (1988) (eds) *External Deficits and the Dollar: the Pit and the Pendulum*, The Brookings Institution, Washington DC.

Brandsma, A S and Hughes Hallett, A J (1984) 'Economic Conflict and the Solution of Dynamic Games' *European Economic Review*, 26, 12–32.

Boyer, R S (1977) 'Commercial Policy under Alternative Exchange Rate Regimes' *Canadian Journal of Economics*, 10, 218–32.

Canzoneri, M and Minford, P (1986) 'When International Policy Coordination Matters: An Empirical Analysis' Discussion Paper 119, Centre for Economic Policy Research, London.

Cripps, F and Godley, W (1978) 'Control of Imports as a Means to Full Employment and the Expansion of World Trade: the UK's Case' *Cambridge Journal of Economics*, 2, 327–34.

Deardorff, A V and R M Stern (1985) 'The Structure of Tariff Protection: Effects of Foreign Tariffs and Existing NTBs' *Review of Economics and Statistics*, 67, 539–48.

Dornbusch, R (1987a) 'External Balance Correction: Depreciation or Protection?' *Brookings Papers on Economic Activity* (1), 349–69.

Dornbusch, R (1987b) 'The EMS, the Dollar and the Yen' Discussion Paper No 216, Centre for Economic Policy Research, London.

de Graaf, J (1949) 'On Optimum Tariff Structures' *Review of of Economic Studies*, 17, 47–59.

Edison, H, Marquez, J and Tryon, R (1987) 'The Structure and Properties of the Federal Reserve Board Multicountry Model' *Economic Modelling*, 4, 115–315.

Feldstein, M (1988) 'At the Mercy of the Investors: Economic Forecasts for 1988' *Financial Times*, 4 January 1988.

Group of Thirty (1988) *International Macroeconomic Policy Coordination* Group of Thirty Report, New York and London.

Gorman, W M (1957) 'Tariffs, Retaliation and the Elasticity of Demand for Imports' *Review of Economic Studies*, 25, 133–62.

Hamilton, B and J Whalley (1983) 'Optimal Tariff Calculations in Alternative Trade Models and Some Possible Implications for Current World Trading Arrangements' *Journal of International Economics*, 15, 323–44.

Hamilton, B and J Whalley (1985) 'Geographically Discriminatory Trade

Arrangements' *Review of Economics and Statistics*, 67, 446–55.

Hughes Hallett, A J (1986a) 'Autonomy and the Choice of Policy in Asymmetrically Dependent Economies' *Oxford Economic Papers*, 38, 516–44.

Hughes Hallett, A J (1986b) 'International Policy Design and the Sustainability of Policy Bargains' *Journal of Economic Dynamics and Control*, 10, 467–94.

Hughes Hallett, A J (1987) 'The Impact of Interdependence on Economic Policy Design: The Case of the US, EEC and Japan' *Economic Modelling*, 4, 377–96.

Johnson, H G (1953) 'Optimal Tariffs and Retaliation' *Review of Economic Studies*, 21, 142–53.

Kahn, R (1947) 'Tariffs and Terms of Trade' *Review of Economic Studies*, 15, 15–19.

Krugman, P (1982) 'The Macroeconomics of Protection with a Floating Exchange Rate' *Carnegie–Rochester Series on Public Policy*, 16, 141–82 (Amsterdam, North–Holland).

Krugman, P (1987) 'Comments and Discussion' in *Brookings Papers on Economic Activity* (1), 346–7.

Kruga, K (1973) 'Tariff Retaliation and Policy Equilibrium' *Journal of International Economics*, 3, 351–66.

Mann, C (1987) 'Protection and Retaliation: Changing the Rules of the Game' *Brookings Papers on Economic Activity* (1), 311–35.

Mundell, R A (1961) 'Flexible Exchange Rates and Employment Policy' *Canadian Journal of Economics*, 27, 509–17.

Oudiz, G and Sachs, J (1984) 'Policy Coordination in Industrial Countries' *Brookings Papers on Economic Activity* (1), 1–64.

Petersen, C E (1988) 'Dynamic Bilateral Tariff Games: An Econometric Analysis' PhD Dissertation, University of Pennsylvania, Pa.

Poole, W (1970) 'Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Macromodel' *Quarterly Journal of Economics*, 84, 197–216.

Rodriquez, C (1974) 'The Nonequivalence of Tariffs and Quotas under Retaliation' *Journal of International Economics*, 4, 295–8.

Van Wijnbergen, S (1987) 'Tariffs, Employment and the Current Account: Real Wage Resistance, and the Macroeconomics of Protectionism' *International Economic Review*, 28, 691–706.

Whalley, J (1984) 'The North–South Debate and the Terms of Trade: An Applied General Equilibrium Approach' *Review of Economics and Statistics*, 66, 224–34.

Whalley, J (1985) 'Trade Liberalisation Among Major World Trading Areas' MIT Press, Cambridge, Ma.

Young, L (1960) 'Optimal Revenue Raising Trade Restrictions Under Uncertainty' *Journal of International Economics*, 10, 425–39.

APPENDIX *A*. The Ideal Policy Values (1986–92)

	Policy Variable	Canada	UK	Germany	Japan	US
Targets:	$\dot{GNP}$	4.0	4.0	4.0	4.0	4.0
	$\dot{P}$	2.0	2.0	1.0	1.0	2.0
	CB	0	0	0	0	0
	GDEF	10.0	3.0	15.0	5.0	75.0
Instruments:	G	20.0	20.0	20.0	9.0	20.0/18.0[a]
	$\dot{M}$	5.0	3.0	3.0	3.0	3.0
	T	1.0	1.0	1.0	1.0	1.0

Key: Legend:

GNP = real gross national product (% growth p.a.)

P = annual % increase in consumer price index

CB = current account balance (billions of domestic currency, trillions for Japan

DF = central government budget deficit (units as for CB)

G = government current expenditures as % of GNP

$\dot{M}$ = rate of growth of money stock (M1)

T = average tariff index (normalised at 1.00 for zero tariff level)

a) The annual figures are 20.0, 19.6, 19.2, 18.9, 18.6, 18.3, 18.0

The Objective Function Weights 1986–92

	Policy Variable	Canada	UK	Germany	Japan	US
Targets:	GNP	1.0	1.0	2.0	2.0	1.0
	P	1.0	1.0	2.0	1.0	1.0
	CB	0.08	0.05	0.01	0.01	0.0035/0.01[a]
	GDEF	0.01	0.01	0.01	0.01	0.0035/0.01[a]
Instruments:	G	1.0	1.0	1.0	1.0	2.0
	M	1.0	1.0	1.0	1.0	1.0
	T	100/30[b]	100/30[b]	100/30[b]	100/30[b]	30.0

a) The annual figures are: .0035, .005, .007, .01, .01, .01, .01

b) The annual figures are: 100, 100, 100, 30, 30, 30, 30

The baseline trajectories used for linearising the model in the multiplier calculations is just the baseline simulation (central projection) of the MCM model described in Edison et al (1987). The 1986 and early 1987 figures are historical, but for the second half of 1987 to 1992 forecasts obtained from the OECD Economic Outlook (1986) are used as far as they go and those figures extrapolated on where no forecasts have been published. This baseline gives the kind of model–free projection of the main aggregates which would be available to policy makers, at the start of the exercise when they have to make up their minds about protectionism and the strategy they wish to follow.

APPENDIX B: The Main Solutions in Detail (see Tables 1, 3, 8, 9)

COOPERATION with TARIFFS

OPTIMISED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992
CGNP	2.04624	3.19370	3.86203	4.71373	4.49597	4.02294	3.48058
CCPI	3.83467	3.24402	2.62298	2.33271	2.39310	2.66435	2.72113
CCB	-13.2651	-13.5321	-14.5077	-15.5703	-14.1635	-11.6359	-8.33917
CGDEF	20.0403	16.7739	16.3717	21.4033	20.9897	19.1212	15.6170
EGNP	2.72442	3.33121	3.13545	2.96936	3.20471	3.39973	3.53732
ECPI	3.15131	3.14567	3.35932	2.73090	2.37766	2.31535	2.47846
ECB	-3.54467	-3.78077	-7.21162	-8.61586	-7.96086	-8.10590	-7.88426
EGDEF	3.51544	3.64830	1.91076	0.645765	-2.43096	-6.13646	-3.83098
GGNP	3.56033	3.85534	2.75944	2.81469	3.06301	3.30004	2.86132
GCPI	-2.08328	-0.1490815	0.8095571	1.26182	1.99484	2.71752	3.29510
GCB	62.6300	51.2659	42.2978	31.3834	25.0134	18.9190	10.8492
GGDEF	32.9332	42.3021	51.9543	54.2959	51.9604	50.0971	50.7341
JGNP	2.17500	2.34428	3.14311	3.39202	3.60754	3.69922	3.69702
JCPI	0.8562492E-01	0.2382267E-02	1.73255	2.13721	2.33403	2.42670	2.49831
JCB	13.0291	9.05574	7.95936	8.18134	7.30014	6.70641	6.14869
JGDEF	12.0106	10.7496	11.2499	11.7254	11.4252	11.8081	12.4585
UGNP	-0.287693	0.5332616	1.50554	1.85503	2.36638	2.74077	3.22190
UCPI	2.55776	4.10167	3.59732	2.79811	2.23904	1.68266	1.22425
UCB	-99.1467	-108.561	-79.0329	-47.4434	-36.2031	-21.1658	-8.92546
UGDEF	156.196	74.9032	66.8122	69.1585	66.1595	66.0022	61.7124

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992
CG	19.8534	19.6936	21.0073	21.6195	21.2324	20.5547	19.5086
CM	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000
EG	19.3512	19.5197	19.9574	20.3331	20.4371	20.3208	20.2421
EM	2.53322	2.40957	2.71294	3.05497	2.94608	3.10152	3.05928
GG	21.3588	21.6524	21.5517	21.6527	21.7106	21.8625	21.8373
GM	1.66822	2.40991	2.62060	3.26152	2.53244	3.03766	3.29919
JG	13.3992	9.83574	8.59741	8.55831	8.50859	8.20675	9.76195
JM	6.11107	4.95571	4.41139	3.37059	3.63311	3.11156	3.09388
FT	0.9877221	0.9447041	0.9233263	0.9236759	0.9196659	0.9585578	0.9876266
UG	18.3701	18.4557	18.4050	18.5822	18.6584	19.1199	19.1713
UM	5.55427	3.98152	3.96421	3.71320	3.23552	3.65207	3.09690
UT	1.38916	1.35193	1.35270	1.31792	1.21458	1.09083	0.928493

COOPERATION, NO TARIFFS

OPTIMISED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.
CGNP	1.60356	3.21324	3.06526	3.46533	3.43873	3.44117	3.49113
CCPI	3.63689	3.23328	2.54359	1.79559	2.27954	2.73221	3.61602
CCB	-7.39676	-7.17775	-8.86305	-9.31301	-8.75724	-7.76952	-6.29289
CGDEF	14.3407	10.8632	9.41230	11.8641	11.7325	11.1836	9.58531
EGNP	2.78698	3.38625	3.11194	3.02781	3.12279	3.23623	3.46850
ECPI	3.10224	3.01173	3.26379	2.55771	2.31552	2.29910	2.49102
ECB	-2.43892	-3.65674	-7.32507	-8.83915	-9.36900	-8.56036	-8.13482
EGDEF	3.85080	2.78685	2.00536	0.693615	-2.65385	-6.56720	-9.19715
GGNP	3.66440	2.94327	2.92755	2.86974	3.07709	3.29812	2.87786
GCPI	-2.20918	-0.5320330	0.6473112	1.09694	1.90715	2.69081	3.30506
GCB	63.3449	52.1538	43.1112	31.7776	25.2705	19.4762	11.9007
GGDEF	30.5332	40.4186	50.4615	53.2548	51.6949	50.0714	50.3740
JGNP	2.18989	2.35417	3.32896	3.53414	3.75195	3.76457	3.66813
JCPI	-0.2890308E-01	-0.1535595	1.62910	2.08794	2.37032	2.53074	2.64920
JCB	13.7262	9.57596	8.24239	8.16627	7.10037	6.41246	5.78474
JGDEF	11.0837	9.96383	10.6091	11.6632	11.6724	12.2613	13.1959
UGNP	0.2237707	1.12318	1.94595	1.96868	2.46877	2.86309	3.53782
UCPI	1.97117	3.44198	2.83488	2.01295	1.55955	1.22845	1.15273
UCB	-113.297	-119.511	-93.0077	-60.9481	-47.7065	-28.8456	-11.9212
UGDEF	163.765	75.0793	62.9713	66.8281	62.9202	62.2041	57.2433

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.0
CG	18.7650	18.5211	19.4088	19.7310	19.7344	19.6887	19.4998
CM	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
EG	19.2838	19.4815	19.9495	20.3756	20.4891	20.3500	20.2365
EM	2.43599	2.37235	2.67984	3.01637	2.93558	3.11722	3.05365
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
GG	21.3637	21.6325	21.7174	21.7548	21.8186	21.9580	21.9227
GM	1.73258	2.45938	2.59745	3.13779	3.56524	3.63866	3.25954
T	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
JG	13.1734	9.14223	8.31796	8.72556	8.59817	8.21232	10.0202
JM	6.11255	4.95268	4.56729	3.93255	3.60246	3.50661	3.00595
FT	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
UG	13.4503	13.4749	18.3315	18.7732	16.9735	15.0983	19.2665
UM	6.43216	4.40706	4.25763	3.93256	3.16753	3.56343	3.05454
UT	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

No Cooperation, No Tariffs

Optimal Strategies for player: CDN

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
CGNP	1.76258	3.18216	3.07777	3.07763	3.11864	2.96678	3.08930
CCPI	3.72667	3.40029	2.85409	2.26143	2.43780	2.73800	3.21108
CCB	-6.28035	-7.97374	-8.66166	-8.82210	-8.49267	-7.73882	-7.06064
CGDEF	11.4563	8.86797	7.43991	10.9843	11.6660	11.7163	10.9755

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
CG	18.5382	18.3620	19.2264	19.3931	19.5537	19.5822	19.6470
CM	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000

Optimal Strategies for player: UK

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
EGNP	2.99936	3.51033	3.02713	2.76461	3.00304	3.24370	3.44782
ECPI	2.91861	1.84254	3.13882	2.45427	2.15619	2.16950	2.38845
ECB	-3.85407	-3.85808	-8.02803	-9.31832	-8.63960	-8.87456	-8.61404
EGDEF	5.74074	3.00058	0.844087	-1.52184	-5.21682	-8.98703	-11.8774

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
EG	19.5101	19.5403	19.7195	19.9170	20.0836	20.0997	20.1049
EM	2.80952	2.59121	2.85646	3.13739	2.98664	3.01667	3.09466

Optimal Strategies for player: GER

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
GGNP	4.18112	3.28978	3.02641	3.10390	3.10048	3.15302	2.67199
GCPI	-2.37985	-0.555632	0.913463	1.50230	2.35985	3.14697	3.92505
GCB	67.1170	53.6692	45.8766	34.9148	29.2838	21.6823	14.6891
GGDEF	24.0139	36.4660	46.1664	48.1002	46.1588	47.2739	47.6650

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
GG	21.4558	21.7418	21.7135	21.8005	21.7195	21.9164	21.8521
GM	2.36370	3.33816	3.83238	4.76118	4.98836	4.90140	4.41140

Optimal Strategies for player: JP

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.0
JGNP	1.05665	3.35109	3.61472	3.89472	4.24723	4.15224	3.84852
JCPI	-0.260777	-0.173817	1.66063	2.09283	2.43272	2.67669	2.80152
JCB	12.8581	9.45311	8.07305	8.06856	6.97833	6.47424	5.93732
JGDEF	12.3220	11.4535	10.9579	11.9519	12.1503	12.5514	13.1355

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.0
JG	10.3529	9.80721	9.51075	9.90389	9.94346	9.92607	9.93919
JM	5.87301	5.30784	4.90362	4.74086	4.38559	4.08307	3.74585

Optimal Strategies for player: US

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
UGNP	0.357263	1.52581	1.96417	1.80459	2.18670	2.45587	2.81577
UCPI	1.96150	3.53258	3.00386	2.19702	1.74244	1.36089	1.11637
UCB	-109.016	-115.978	-91.9860	-60.6642	-47.2822	-28.8408	-11.1632
UGDEF	147.656	58.1086	53.6032	65.2886	66.5545	70.8778	68.6654

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
UG	18.2290	18.2834	18.2292	18.6762	18.9619	19.1211	19.2242
UM	8.16715	5.13840	4.63291	4.18899	3.06736	2.34123	2.18823

Optimal Strategies for player: CDN

No Cooperation, Tariff Solution

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
CGNP	3.31856	4.53534	3.68825	3.50923	3.18819	3.36901	3.39990
CCPI	4.09212	4.13936	4.37132	4.73425	5.79118	6.97699	8.29360
CCB	-11.9861	-13.5079	-13.8615	-13.6251	-11.9786	-11.2103	-9.56416
CGDEF	17.9266	14.9851	14.2755	18.8499	18.6341	19.0627	17.6900

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
CG	20.4391	20.0387	20.4213	20.4649	20.0175	20.0743	19.7505
CM	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000	5.00000

Optimal Strategies for player: UK

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
EGNP	2.96224	3.51753	3.05342	2.82946	3.06596	3.29928	3.56407
ECPI	2.97071	1.93298	3.24056	2.56739	2.24492	2.22132	2.44922
ECB	-3.74386	-3.65371	-7.76495	-8.97866	-8.33102	-8.45329	-7.90118
EGDEF	9.38361	2.77503	0.827849	-1.23409	-4.61180	-8.27883	-11.4086

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
EG	19.3636	19.3576	19.7342	19.9177	20.0389	20.0630	20.0644
EM	2.84872	2.62679	2.87757	3.13938	2.97098	2.99082	3.06935

Optimal Strategies for player: GER

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
GGNP	3.97771	3.03500	2.62234	2.51700	2.87136	3.12960	3.75348
GCPI	-2.24753	-0.439346	0.903484	1.32624	2.15270	2.92678	3.56770
GCB	68.9585	55.3436	46.2785	34.9064	27.8227	20.7390	11.3881
GGDEF	23.9085	36.0747	47.3616	50.7648	49.1078	48.1438	50.0064

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
GG	21.2810	21.5345	21.4991	21.5281	21.6085	21.7546	21.7726
GM	2.31446	3.27703	3.51536	4.07346	4.43766	4.62376	3.99827

Optimal Strategies for player: JP

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
JGNP	1.32564	2.99603	3.03573	3.43316	4.13845	4.15347	4.11339
JCPI	-0.134466	-0.637722E-01	1.68507	2.02336	2.28470	2.50952	2.64404
JCB	12.4201	9.23271	8.14431	8.33533	7.17341	6.77307	6.68690
JGDEF	13.0038	11.6062	10.9944	11.7811	12.0270	11.9961	12.1270

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
JG	10.5934	9.70916	9.30283	9.67970	9.86610	9.75611	9.70201
JM	5.69460	4.97346	4.55936	4.45507	4.24604	3.92348	3.58842

Non-US Tariff:-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
FT	0.985103	0.993884	1.00494	1.03392	1.03098	1.02632	1.01911

Optimal Strategies for player: US

PREDICTED TARGETS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
UGNP	0.426779E-01	1.22640	1.66868	1.64870	2.10251	2.44151	2.74761
UCPI	2.39824	4.04419	3.72550	3.08044	2.62869	2.16004	1.61887
UCB	-93.4739	-104.166	-81.4482	-51.1165	-40.1600	-23.1120	-10.4495
UGDEF	139.628	96.2439	96.2654	69.6013	72.2696	76.6819	79.4030

OPTIMISED INSTRUMENTS :-

	1986.00	1987.00	1988.00	1989.00	1990.00	1991.00	1992.00
UG	18.0906	18.2612	18.3338	18.8379	19.1408	19.2526	19.3089
UM	7.92657	4.71601	4.35703	4.17671	3.38054	2.72333	2.26478
UT	1.28499	1.25717	1.32812	1.34544	1.27164	1.16891	0.977884