The Investment Response to Imperfectly Credible Trade Liberalisation with Endogenous Probability of Reversal

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Abstract:
Many trade liberalisations and other economic reforms in developing countries, particularly in Africa, have been reversed. In addition to the loss of benefits from reform as such this tendency has led to concern that the response to reform, particularly from investment, may be weakened by the perception that it may be reversed and in turn that weak investment may itself lessen the chances of successful reform. These themes have been discussed extensively in the literature, the current paper's contribution being to develop a much more complete model of the investment response than previously available and to use it to partially endogenise the probability of reform reversal so the two are simultaneously determined. With respect to the reversal probability the argument presented is that a strong investment response in the favoured sector will of itself tend to discourage reversal of the reform (through a lobbying mechanism or simply by the existence of a larger constituency opposed to reversal) while the gradual depreciation of capital in the non-favoured sector will weaken opposition to reform continuation.

Note. This paper builds on the work presented in "Reversible reforms with irreversible capital: the investment response to imperfectly credible trade liberalisation", CSAE Working Paper WPS/97-6, 1997, by the same author.

Introduction

This paper is concerned with the investment response to trade liberalisation when agents believe that the liberalisation may be reversed. It also explores the opposite causation whereby the investment response may itself be a determinant of that probability. A large number of liberalisation episodes, particularly in Africa, have been reversed after an initial reform period[1] which gives rise to concern that the ex ante perception that the reform may not be permanent will blunt the response to the reform, giving rise to costs even while the reform continues and potentially making its collapse more likely. These issues are clearly of considerable contemporary relevance given that trade liberalisation is far from complete in many developing countries[2] and where substantial reforms have been undertaken there may still be a perception that they may be reversed. This literature also informs ongoing policy debate concerning the role of aid conditionality and "agencies of restraint" such as WTO disciplines and reciprocal trade agreements between developing countries and NAFTA and/or the EU. Of particular importance is the question of whether a reform that is unlikely to be fully credible should be postponed or whether the benefits of reform are likely to outweigh the costs of non-credibility.

A complete analysis of non-credible trade reform would be a major undertaking and comprise the consumption and investment responses, including interactions between them, together with a political economy model that endogenised both the occurrence of reform and the probability of its subsequent reversal. Given this the literature has tended to treat these components separately. A substantial literature has developed on the consumption response while that on the investment response is arguably less complete. The possible endogeneity of reform reversal tends to be discussed in general terms rather than through the development of formal models. This paper advances the literature on the investment and political economy aspects by developing a rigorous model of the investment response with capital irreversibility that exploits the advances made by the irreversibility and investment literature. This permits a much fuller and more realistic analysis of the investment response than earlier papers while also facilitating a formal analysis of some of the political economy factors that may influence the probability of reform reversal. The paper is theoretical rather than applied, a choice motivated by the relative abundance of empirical work in this area as against the gaps in the investment theory literature. It is hoped that the model and results presented will in turn inform further applied work in this area.

While the paper focuses on the investment response and political economy factors that relate to it we first put these in the context of the consumption response literature, emphasising the links between them. Calvo (1987, 1988) presented models that identified costs from temporary liberalisation due to the distortion in intertemporal prices and consumption that it induces. Consumption of non-durable importables is excessive during the liberalisation when they are temporarily cheap and there may also be an import boom in durables which are stored for later periods. In addition to the microeconomic costs from these factors, the boom in imports will tend to put pressure on the balance of payments. These papers adopted the somewhat unrealistic assumption that the duration of the trade liberalisation is known in advance but this was relaxed in Calvo and Mendoza (1994) where uncertainty over tariffs lasts one period and Calvo and Drazen (1997) where uncertainty is ongoing. A theme in these papers is that a trade liberalisation with limited credibility or known temporary duration may lower welfare compared with stable tariffs, a result that questions whether limited credibility reform is worth pursuing. Buffie

(1999), however, argues that the structure of these models tends to downplay the standard gains from trade in relation to the costs from consumption fluctuations. In a more general framework Buffie finds that tariff cuts of the order of 50%-80% of their initial values are welfare increasing. His analysis compares the gains from trade, which for standard reasons become smaller at the margin as tariffs are reduced, against the consumption distortion costs with the figures quoted being the range of tariff cuts where these opposing factors are balanced for different parameter values. A further point is that the consumption response papers have relatively little to say about investment, addressing it via the availability of savings (see Bhattacharya, 1999, for example) rather than the marked changes in the return to capital in different sectors which will result from tariff reductions. They do, however, contribute a potential reason for reform reversal in that post-reform consumption and import booms will put pressure on the balance of payments. Buffie (1995) develops a model which endogenises reform reversal through this mechanism.

With regard to the direct investment response to a reform of limited credibility, key early work was by van Wijnbergen (1985) who showed that uncertainty over trade policy (and hence the relative returns to capital in the export and import competing sectors) would encourage capital flight since it allows investors to avoid committing to one sector or the other. This argument was developed further by Rodrik (1989a) in general terms and more formally in Rodrik (1991) which shows that a positive probability of reform reversal may have strongly negative effects on investment. The latter paper is a considerable achievement but arguably the model used is less complete than is ideal for studying trade liberalisation, partly because it was designed to be general enough to also be informative about macroeconomic stabilisation. The model used in this paper is intended to bridge this gap, in particular by developing a two sector model (rather than Rodrik's one sector) that makes explicit the change in relative returns to capital across the export and import competing sectors, by making investment a continuous decision quantity (rather than a binary invest or not decision as in Rodrik's model) and by making the return to capital a function of the capital stock (again missing from Rodrik 1991, except in very general terms) as well as the tariff. We also consider the pre-reform equilibrium in more detail which permits a more precise discussion of whether the investment response is likely to be favourable even in the presence of a significant probability of reversal. The results of this paper are more optimistic on this point while confirming the overall negative relationship between reversal probability and the investment response. It should be noted that Albuquerque and Rebelo (1998) make progress along these lines but without including uncertainty which is surely desirable for the situation being considered. It is included in this paper by exploiting the methodological advances of the irreversibility and investment literature.[3]

In addition to modelling the investment response to non-credible trade liberalisation (in which the probability of reversal is initially an exogenously imposed constant) the framework of the paper is used to contribute to the political economy debate about the causes and probability of reform reversal, in particular by making the probability of reversal a function of the investment response. The likely endogeneity of this probability has been discussed at least since Rodrik (1989a) but rigorous modelling has been scarce. It appears that the political economy literature is relatively undeveloped in this area[4], especially in relation to why a government should reverse a reform that has only recently been undertaken compared to why protection may be in place to begin with[5] (though Rodrik, 1996b, also questions the depth of our understanding of the latter).

This paper does not claim to resolve the puzzles of the political economy literature but it does contribute to our understanding of the political economy factors that may be at work by highlighting their interaction with the change in the structure of the economy following reform. This is one of the benefits of a rigorous and explicitly dynamic model of the investment response at the sectoral level. In addition the use of such a framework makes it straightforward to feed the results of the political economy mechanism back into the investment model to show the simultaneous determination of investment and the reversal probability.

Two themes emerge from the literature in relation to structural change following reform, one is a time inconsistency problem whereby a vigorous investment response to reform will create a tax base (particularly in the export sector) that the government may exploit by reversing the liberalisation, the anticipation of which will prevent or at least blunt the investment response. In such a framework an increased investment response in the export sector will raise the probability of reversal which leads to the pessimistic conclusion that a modest initial increase in investment may take place but it will be limited by the increase in the perceived reversal probability. The second theme, which we emphasise below, is more encouraging in that investment in the favoured (export) sector will build a constituency or lobby for the continuation of reform and hence as investment takes place over time the probability of reversal should decline, thus encouraging further investment and so on. This point relates to the export sector and we show in addition that depreciation of the capital stock in the import-competing sector which loses from lower tariffs will gradually shrink the constituency or lobby in favour of reform reversal, thereby reinforcing the tendency for the perceived reversal probability to fall over time as that depreciation takes place.

Before turning to the analysis proper we briefly mention some related issues. The first of these concerns the role of aid conditionality and "agencies of restraint" which limit the government's ability to reverse the reform once it is undertaken. Rodrik (1989b) presents a signalling model in which the receipt of aid conditional on reform may obscure the true intentions of the government, in particular a reformist government that will try to sustain liberalisation may be mistaken for one which has undertaken reforms solely in return for aid and is likely to reverse them once the period of aid flow is over.[6] Rodrik (1989a) also suggests that reforming governments should explore ways in which they can try to lock in the reform by reducing their scope for action to reverse it in the future or the desirability of such action. These ideas have subsequently been pursued by Aizenman (1992), who suggests public investment complementary to the export sector as a signal of intent to continue reform, Gunning (1994) who advocates binding trade reciprocity with developed countries (as an agency of restraint) rather than aid as an encouragement towards trade reform, and Collier and Gunning (1994, 1995) and Collier (1998) who develop the arguments further. Aid and signalling devices are not formally modelled in this paper but we comment on the implications of the analysis for these debates. Similarly we model liberalisation as a "big-bang" reform such that tariffs are reduced immediately without considering a more gradualist approach. Finally the model is real and does not include monetary and macroeconomic effects (see Collier and Gunning 1992) which the empirical and consumption response literatures suggest may be important.

The paper is structured as follows; Section 1 sets out the investment model and the solution method when the continuation of reform is uncertain, Section 2 presents results for when the reversal probability is an exogenous constant while Section 3 considers how this probability may

be endogenised and presents the simultaneous determination of the probability and the investment response as discussed above. Section 4 concludes.

1. The Model[7]

It is assumed that there are two competitive sectors with physical output X and M of the export and import goods respectively.[8] These outputs are produced using Cobb Douglas technology given by (1) which we assume for simplicity to be symmetric in the α and β parameters. The notation is l_i for labour in sector i, K_i for the sectoral capital stock and F_i a further fixed factor in each sector (discussed below).

$$X = l_x^{\alpha} K_x^{\beta} F_x^{1-\alpha-\beta} \qquad M = l_m^{\alpha} K_m^{\beta} F_m^{1-\alpha-\beta} \tag{1}$$

The labour force in the economy is fixed but labour is assumed to be fully mobile between sectors so the wage rate in each will equalise in each period.[9] Without loss of generality we normalise the aggregate labour endowment to unity so $l_m=1-l_x$.

Capital goods are sector specific and all imported. They are assumed to be available in elastic supply from the world market at constant prices P_{Kx} and P_{Km} (non-linear adjustment costs are not considered) but irreversible once installed so the rates of depreciation, δ_x and δ_m, represent the upper limit on the speed with which the sectoral capital stocks may shrink. These assumptions imply a major asymmetry between the upward and downward flexibility of the sectoral capital stocks. Two further assumptions are that the capital goods are used in production and neither stored nor scrapped, and that there is a one period delivery or time to build lag between the decision to invest and the new capital goods becoming productive.

We also assume that the economy has access to a perfect world capital market with (real) interest rate, r^*. This assumption, together with the absence of non-tradeable consumer goods, separates production and consumption decisions in the economy and makes risk neutrality an appropriate assumption such that investment decisions will depend solely on expected returns. Hence the structure of the model is focused tightly on the investment response to changes in the sectoral returns to capital in the presence of uncertainty about the continuation of reform. The motivation for this is that these factors are missing from the current literature.

It is assumed that there is free entry to each sector which, in relation to the irreversibility and investment literature, means that there is no option value of waiting since if the irreversibility constraint is not binding expected present value net returns (carefully specified to include future states in which it may bind and losses occur) will be driven to zero. Irreversibility still matters, however, since there is an entry asymmetry between good and bad states of the world for the return to capital. In a good state firms may enter without any barriers but in a bad state not only will there be no new entry but existing firms cannot exit due to irreversibility. This asymmetry is incorporated in the equilibrium condition for the capital stock by means of taking into account the future entry of new capital in good states when calculating expected returns.

The third factor of production in each sector, given by F_x and F_m in (1), is assumed to be entirely fixed, both by sector and over time. Given the international mobility of capital this factor is necessary to avoid complete specialisation and may be interpreted as being sector specific human capital or natural resources in inelastic supply (at least over the timeframe of a few years considered here). For simplicity we choose units so $F_x=F_m$ to avoid their ratio cluttering the expressions below.

The remaining notation comprises P_x and P_m for the world prices of X and M respectively with the domestic price of M when there is a tariff, t_m, in force being $P_m(1+t_m)$ in the usual way.[10] We follow Rodrik (1991) in modelling trade liberalisation as a full removal of this tariff and reform reversal by the restoration of this initial value. The output prices determine the economy's position on its production possibility frontier while the prices of capital goods, P_{Kx} and P_{Km}, together with the other parameters determine the position of that frontier given that the sectoral capital stocks are endogenous to the model rather than being fixed endowments. We assume that the domestic prices of the capital goods are constant, implying that there is either no tariff on imported capital goods or that these tariff rates remain constant when the tariff on consumption good M is removed.[11] One of the four world prices may be normalised to unity but an assumption is required for the others. For simplicity and clarity we give all results for the variables of interest relative to the values that they would take under perfectly credible free trade (denoted by superscript f). Where this does not remove the prices from the results they appear jointly as the constant, k, which partly determines the allocation of labour where:

$$k = \left(\frac{P_x}{P_m}\right)^{\frac{1}{1-\beta}}\left(\frac{P_{K_m}}{P_{K_x}}\right)^{\frac{\beta}{1-\beta}} \tag{2}$$

Given (2) it is possible to make assumptions about each of the three relative prices but the procedure followed is to assume an initial value for the allocation of labour to the X sector under perfectly credible free trade, l_x^f, and infer the implicit assumption about k from this. For example, $l_x^f=0.5$ is assumed for the central case which implies symmetry and hence k=1. The assumption is varied to confirm that the results are not specific to this starting point.

Given (1) we have the following standard results for the return (r_i) and cost (c_i) of capital by sector. We include the term $(1+t_m)$ though note that t_m will change following trade liberalisation and its reversal. If a given tariff rate, t_m (including $t_m=0$ for free trade), is expected to be permanent r_i will be equal to c_i in each sector, at least after depreciation has enabled a steady state to be reached if a sectoral capital stock is initially above the level implied by this. Equally the free trade values of K_x and K_m are given by $r_i=c_i$ with $t_m=0$.

$$r_x = \frac{P_x\beta l_x^{\alpha}F_x}{K_x^{1-\beta}} \qquad c_x = P_{K_x}(r^*+\delta_x) \tag{3}$$

$$r_m = \frac{P_m(1+t_m)\beta l_m^{\alpha}F_m}{K_m^{1-\beta}} \qquad c_m = P_{K_m}(r^*+\delta_m) \tag{4}$$

Given that labour is assumed fully mobile between the two sectors the wage rate, w, will equalise so $w_x=w_m$ and it is straightforward to show that:

$$(\frac{l_x}{l_m})^{1-\alpha} = \frac{P_x K_x^{\beta}}{P_m(1+t_m)K_m^{\beta}} \tag{5}$$

Since we derive results relative to fully credible free trade and also want l_x and l_m separately it is helpful to change (5) to give l_x (=1-l_m) in (6) by making use of (2) to (4).

$$l_x = \frac{(1+t_m)^{-\frac{1}{1-\alpha}} k^{\frac{1-\beta}{1-\alpha-\beta}} (\frac{r^*+\delta_m}{r^*+\delta_x})^{\frac{\beta}{1-\alpha-\beta}} (\frac{K_x}{K_x^f}\frac{K_m^f}{K_m})^{\frac{\beta}{1-\alpha}}}{1 + (1+t_m)^{-\frac{1}{1-\alpha}} k^{\frac{1-\beta}{1-\alpha-\beta}} (\frac{r^*+\delta_m}{r^*+\delta_x})^{\frac{\beta}{1-\alpha-\beta}} (\frac{K_x}{K_x^f}\frac{K_m^f}{K_m})^{\frac{\beta}{1-\alpha}}} \tag{6}$$

The expressions above concern factor returns and allocations and while these are of direct interest we also want to be able to present results for welfare also. Rather than making use of a utility function for the representative agent we consider the level of real income.[12] If the sectoral capital stocks were constant changes in real income could simply be inferred from changes in the gross value of output at world prices but with those capital stocks changing we need to allow for the cost of capital also. Hence the appropriate measure of real income, Y, is given by the value of output at world prices (P_xX+P_mM) less the cost of capital ($c_xK_x+c_mK_m$). Expressing this relative to its free trade value, and using the labour and capital allocations relative to their free trade values, we have:

$$\frac{Y}{Y^f} = \frac{k(l_x^f)^{\frac{\alpha}{1-\beta}}(r^*+\delta_m)^{\frac{\beta}{1-\beta}}[(\frac{l_x}{l_x^f})^{\alpha}(\frac{K_x}{K_x^f})^{\beta} - \beta\frac{K_x}{K_x^f}] + (l_m^f)^{\frac{\alpha}{1-\beta}}(r^*+\delta_x)^{-}}{(1-\beta)\ [\ k(l_x^f)^{\frac{\alpha}{1-\beta}}(r^*+\delta_m)^{\frac{\beta}{1-\beta}} + (l_m^f)^{\frac{\alpha}{1-\beta}}(r^*} \tag{7}$$

It may be noted that (7) will take the value of unity when all factor allocations correspond to their permanent free trade values and this will also maximise the value of Y given the absence of distortions in the model other than the tariff. For standard envelope theorem reasons (7) will take a value close to unity for small deviations in those allocations. Such deviations may of course arise from the presence of a small tariff but equally they can reflect a small degree of non-credibility of a zero-tariff trade liberalisation since in the model the sectoral capital stocks smoothly approach their credible free trade values as the probability of reform reversal tends to zero. (7) is also decreasing as factor allocations diverge from their credible free trade values in either direction, reminding us that from a static gains from trade perspective what counts is as much a change in the *composition* of the capital stock across sectors (to counter the bias induced by protection) rather than necessarily an increase in its total size. This is a straightforward point but it is often lost in discussions of the credibility issue and in empirical work which usually considers aggregate investment. Over time it may be the case that a more open trade regime stimulates faster growth in investment but this is a different point.

Having laid out the core components of the model we specify the pre-reform situation, the response to reform and the subsequent adjustment if reform reversal occurs. We assume that the liberalisation is not anticipated (while commenting later on the implications of changing this assumption) and that the tariff t_m has been in place long enough before the reform for the sectoral capital stocks to adjust such that the return to capital is equal to its cost in each case.

Trade liberalisation takes the form of t_m being set to zero at the start of a given period and we follow Rodrik (1991) in assuming that reversal constitutes the restoration of this initial tariff level. By assumption investment involves a lag of one period so the sectoral capital stocks in the first period of reform are pre-determined. By contrast labour is fully mobile and hence an immediate labour reallocation towards the export sector will take place shown by (6). The removal of the tariff implies an immediate reduction in the return to capital in the import competing sector and the loss of labour exacerbates this. The gain of labour in the export sector has the opposite effect on the return to capital there. In this first period investment decisions are taken to determine the sectoral capital stocks in the following period.

If the reform was fully credible the path of these capital stocks over time would be that M sector capital would depreciate gradually down to its permanent free trade value and X sector capital would expand upwards to its free trade value, at each point earning a zero net return, the size of K_x being determined by this condition combined with the rate at which the M sector releases labour as K_m depreciates.

Turning to a trade liberalisation of limited credibility, defined by agents perceiving a probability of reform reversal at each point, the assumption of zero net returns to capital pre-reform, which seems plausible, combined with the assumption that reversal leads to the re-imposition of the same tariff rate, has an immediate and powerful implication for the investment response to reform. Taking the X sector first, trade liberalisation raise the return to X sector capital and, for a given K_x (and K_m) reversal simply implies a return to the status quo before reform. Thus even a large probability of reversal does not prevent the expected return to X sector capital from becoming positive and hence an increase in the X sector capital stock of some degree will follow. This contrasts with the analysis of Rodrik (1991) which left open the possibility that losses were incurred in this sector pre-reform in which case an increase in the expected return to capital need not imply an increase in the capital stock. Similarly in the M sector the return to capital is reduced by trade reform and its reversal would, at constant K_x and K_m, restore zero profits. Hence the expected return to capital in the M sector must become negative following reform, even if the probability of reversal is large, and thus this capital stock tend to shrink. Both these shifts in the sectoral capital stocks are welfare increasing.

Hence post-reform we anticipate increases in K_x, the key issue being how much it increases which we derive below (the innovative part of the model), and decreases in K_m which will occur gradually through depreciation until it reaches what we call the post-reform steady state (assuming that reversal has not already taken place). K_x will face a binding irreversibility constraint if reversal occurs and hence the magnitude and probability of the losses that would result must be taken into account in forward looking investment decisions while reform continues. We adopt the simplifying assumption that reversal (with the tariff returning to its pre-reform value) is, or at least is perceived to be, permanent. If reversal does take place the roles of the sectoral capital stocks are reversed in that K_x will depreciate gradually back to its pre-reform level and K_m will expand to its equivalent point, the expansion path being determined by a zero profits condition on K_m and the gradual reallocation of labour back to the M sector as K_x depreciates. Hence the post-reversal outcome is relatively simple and it is this, combined with the probability of it occurring, which determines the equilibrium expansion of K_x while reform continues.

More formally, at a given time, s, following reform but before any reversal and assuming that the initial value of K_x is low enough for the irreversibility constraint not to bind, the desired and actual capital stock in the X sector (assuming risk neutrality) will satisfy:

$$E_{s-1}[\Sigma_{t=s}^{\infty}[[r_x^t(K_x^t)-c_x](\frac{1-\delta_x}{1+r^*})^{(t-s)}] = 0 \quad (8)$$

This is the standard equilibrium condition by which the expected present value of net returns to a unit of capital invested at some time s (the decision to invest having been taken at t=s-1) is equated to zero.[13] The terms $r_x(.)$ and c_x give the return and cost of a unit of capital and hence the term $(1-\delta_x)^{(t-s)}$ appears because this gives the amount of an initial unit of capital left after s-t periods. It is helpful to separate out period s from (8) which gives:

$$\begin{aligned}(1-p_s)[r_x^s(K_x^s)|_{t_m=0}-c_x]+p_s[r_x^s(K_x^s)|_{t_m=t_m}-c_x] \\ +E_{s-1}[\ \Sigma_{t=s+1}^{\infty}[[r_x^t(K_x^t)-c_x](\frac{1-\delta_x}{1+r^*})^{(t-s)}]\ ] = 0\end{aligned} \quad (9)$$

This shows that the expected net return for period s (which depends on K_x at that time) depends on the expected net return in the periods that follow it in order that the expected net present value as a whole is zero to reflect free entry at time s. At this point the effect of the entry asymmetry discussed earlier becomes important. If reform continues at s, free entry means that equilibrium condition (8) will be repeated and hence seen from the perspective of time s-1, the expected present value of net returns if reform continues must be zero. On the other hand if reform is reversed, irreversibility implies that net returns will become negative for a number of periods before depreciation reduces K_x to the point where net returns are zero once again. This asymmetry implies that a zero should be inserted within the summation of the second line of (9) for future scenarios where reform continues. Only future losses with reform reversal, together with their associated probability, need appear. Denoting T_x^s as the number of periods when losses are made post reversal and making use of these arguments means that (9) may be transformed to:

$$\begin{aligned}(1-p_s)[r_x^s(K_x^s)|_{t_m=0}-c_x] \\ +\ p_s[\Sigma_{t=s}^{t=s+T_x^s}[[r_x^t(K_x^s(1-\delta_x)^{(t-s)})|_{t_m=t_m}-c_x](\frac{1-\delta_x}{1+r^*})^{(t-s)}] = 0\end{aligned} \quad (10)$$

In (10), p_s is the perceived probability of reform reversal in period s and the K_x term within the summation sign is given in relation to K_x at time s and the number of periods of depreciation because net losses are being made during the interval s to $s+T_x^s$ and investment in the X sector will be zero.

Equilibrium condition (10) shows that investment will take place for time s to the point where the capital stock gives an expected net return in that period equal to the present value of the losses that would be incurred after that period if liberalisation is reversed at t=s, weighted by the probability of that event. As the capital stock expands for time s, the period s return will fall and the size of future losses will rise given a higher K_x inherited at the time of reversal. Forward looking investment behaviour will balance the period s return if reform continues against

expected losses if it is reversed which implies that the current period return will not be driven to zero as would be the case if the liberalisation was fully credible.

Hence (10) confirms the intuitive idea that an expectation of reversal must weaken the investment response to reform though it also highlights the fact that an improved current period return following liberalisation will encourage investment. Given the assumption that reversal entails a return to the pre-reform situation, (10) implies that the investment response in the X sector must be positive because there is an increased current period return and the worst outcome in the future is the same as before reform. As noted above, however, a positive investment response in the X sector will not necessarily lead to a positive aggregate investment response given that investment in the M sector will be zero during the transition after reform and lower in the steady state than its initial value. In turn a higher K_x and lower K_m implies that real income will increase with liberalisation whatever the perceived probability of reversal.

In order to facilitate numerical simulations we transform (10) by assuming Cobb Douglas technology outlined above and also express K_x while reform continues relative to its credible free trade value.

$$\left(\frac{K_x^s}{K_x^f}\right)^{1-\beta} = \frac{\left(\frac{l_x^t}{l_x^f}\right)^{\alpha} + p_s \sum_{t=s}^{t=s+T_x^s}\left(\frac{l_x^s}{l_x^f}\right)^{\alpha}\left[\frac{(1-\delta_x)^{\beta}}{(1+r^*)}\right]^{t-s}}{1 + p_s\frac{(1-\delta_x)}{(r^*+\delta_x)}\left[1-\left(\frac{1-\delta_x}{1+r^*}\right)^{T_x^s}\right]} \tag{11}$$

The system is completed by the labour allocation given by (6) and the value of K_m which is given by its depreciation path from its initial value until it reaches its post reform steady state value, K_m^s given by (12) which is derived straightforwardly from a zero expected net return condition given the one period investment lag (p_{ss} denotes the probability of reversal in this steady state).

$$(1-p_{ss})[r(K_m^{ss})|_{t_m=0} - c_m] + p_{ss}[r(K_m^{ss})|_{t_m=t_m} - c_m] = 0 \tag{12}$$

Which for Cobb-Douglas technology may be expressed by:

$$\frac{K_m^{ss}}{K_m^f} = \left[(1-p_{ss})\left(\frac{l_m}{l_m^f}|_{t_m=0}\right)^{\alpha} + p_{ss}(1+t_m)\left(\frac{l_m}{l_m^f}|_{t_m=t_m}\right)^{\alpha} \right]^{\frac{1}{1-\beta}} \tag{13}$$

After reversal (6) continues to hold, K_x depreciates down to its initial pre-reform level and K_m increases to its pre-reform value, the pace of expansion being determined by a zero profits condition combined with the depreciation path of K_x which affects the return to K_m through the release of labour.

Before simulating the model above we briefly note the implications of the trade liberalisation being anticipated. Given that liberalisation increases the return to capital in the X sector and reduces it in the M sector, a positive perceived probability of reform will tend to increase K_x and reduce K_m prior to reform. In turn this implies a faster post-reform adjustment to the steady state but will not affect the latter since it depends solely on the probability of reversal.

2. Exogenous Reversal Probability

We turn now to the results from simulating the model above. For this we first assume the "central case" parameter assumptions shown in Appendix 1 and show what happens to the key variables over time. Following this we vary key parameters and demonstrate the comparative static effects of doing this on the post reform steady state. Throughout we assume for expositional purposes that reversal does not actually take place until after that steady state has been reached though agents in the model perceive that reversal may take place each period. This also reflects the fact that early reform collapse is of less analytical interest than the dynamics of what occurs if it does not collapse.

Figure 1 shows the time path of the sectoral capital stocks, starting in the pre-reform period (period 0) with reform in periods 1-8 with reversal assumed in period 9, after which agents believe that the tariff rate will remain permanently in place. The capital stocks are expressed relative to their permanent free trade values and hence a value of unity would occur in the post-reform steady state if the reform were fully credible. Using these parameter values this would not be reached until period 8 which is the time by which K_m would have depreciated from its initial very high value pre-reform. A feature of both lines is that as a result of the assumed one period investment lag the capital stocks do not respond immediately to either reform or reversal (in periods 1 and 9 respectively).

The left hand side of the chart shows that the pre-reform tariff, even though it is set at 0.3 which is by no means high for developing countries (see Dornbusch 1992), results in very marked distortions to the sectoral capital stocks which vary from their free trade levels by a factor of approximately two. Both K_m being high and K_x being low are harmful to welfare which is maximised under permanent free trade. Following reform (and the time lag) the X sector capital stock jumps up (there being no adjustment costs to slow this) and subsequently rises slowly to its post-reform steady state. During this adjustment K_x is determined by (11) which is derived from the general form shown in (10). While reform continues K_x is higher than its pre-reform level[14] but it does not reach its free trade value because of the losses that the owners of K_x will incur if reform is reversed. The initial sharp adjustment between periods 1 and 2 arises from the large initial movement of labour into the X sector after liberalisation (since the tariff abolition raises the relative marginal product of labour in the X sector at given capital stocks) and the subsequent gradual increase comes as the M sector depreciates and releases labour. The depreciation path of K_m is also shown in Figure 1 together with the post-reform steady state level. The latter exceeds unity (the free trade level) both because K_x is smaller and hence labour is cheaper for the M sector and also because the equilibrium current period net return to K_m while the reform continues is negative by (12) since reversal would give rise to a windfall gain. We impose reversal in period 9 after which K_x depreciates down to its pre-reform level and K_m rises to the equivalent point, quickly at first with a large labour reallocation and then slowly as K_x depreciates.

Figure 2 shows the return to capital in the two sectors during reform and its reversal, the main features being large immediate gains and losses to the sectors when reform occurs in period 1 and is reversed (by assumption) in period 9. These swings are very large though to be expected (see Rodrik 1998), particularly because the investment lag means that there are no dampening movements in the capital stocks. After the initial changes r_m gradually recovers as K_m depreciates

and r_x falls back as investment takes place in that sector. The positive net return in the X sector in the steady state (shown by the line exceeding unity) reflects, as noted above, the probability of sharp losses if reversal occurs. The latter is illustrated by the fall in r_x in period 9 when reversal is imposed. It may also be seen that the post-reform steady state net return in the M sector is negative reflecting its anticipation of a windfall gain if reversal takes place (again illustrated by period 9). After reversal is imposed in period 9 there are large initial swings in the sectoral returns which then return to unity (zero profits), quickly for the M sector through investment and gradually for the X sector through depreciation.

Figure 3 shows the path of real income corresponding to the same time periods. It confirms that real income (gross income net of the cost of capital) rises with reform and falls with reversal since it is maximised at permanent free trade and reform, even of limited credibility, moves resource allocations towards their free trade values. Hence real income rises with the increase in K_x during reform *and* the fall in K_m since the latter was excessively large from a welfare point of view under the tariff. The removal of the tariff and the subsequent capital adjustments also move the allocation of labour towards the X sector which is again closer to its free trade allocation. The sharp changes in real income in periods 1 and 9 show the importance of labour reallocation since the capital stocks in these periods are unchanged from the previous ones due to the investment lag.

It may also be noted that the size of the overall real income changes is small though of an expected order of magnitude for this type of model (see Dornbusch 1992, Rodrik 1998) though perhaps of greater interest is that the post-reform steady state level of real income is proportionately much closer to its free trade value than the sectoral capital stocks in Figure 1. This reflects the fact that real income rises at a decreasing rate as factor allocations move towards their free trade values, hence if the capital stocks closed, say, half the gap between their tariff and free trade levels real income will have closed more than half its gap. Hence from a static point of view the non-linear cost of distortions away from free trade means that the cost of limited credibility of reform is less than its implications for the sectoral capital stocks would imply. This point would, of course, be less reassuring if the benefits from liberalisation are regarded as being primarily dynamic from a larger export sector rather than static as measured by real income.

Comparative Statics

We turn now to comparative static results for the post-reform steady state values of the variables of interest as we change the parameter assumptions in the model. Of particular interest is what occurs as the probability of reversal changes together with the level of the tariff and also the rate of depreciation of X sector capital. It was found that other parameter changes, particularly to the interest rate and depreciation in the M sector made little difference to the results. Higher M sector capital depreciation has its major effect on the time taken to reach the post-reform steady state rather than the latter itself. This may be important if the reversal probability is endogenous since it implies that opposition to reform from the M sector will decrease faster (see below). Mash (1997) shows the relatively modest effect of changing the technological parameters.

FIGURE 1

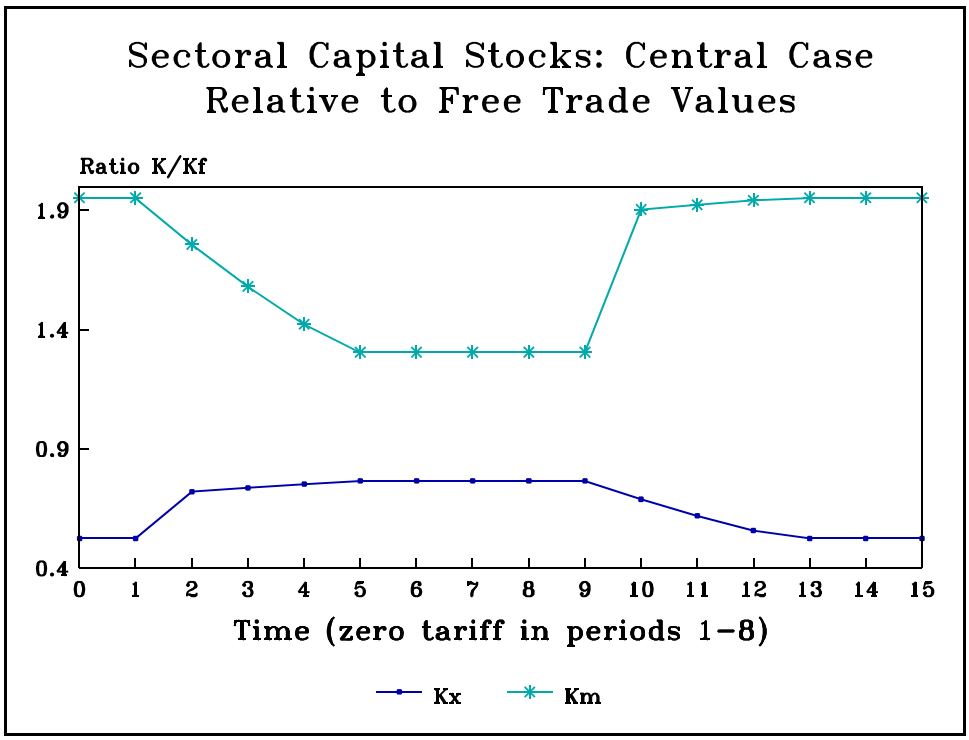


FIGURE 2

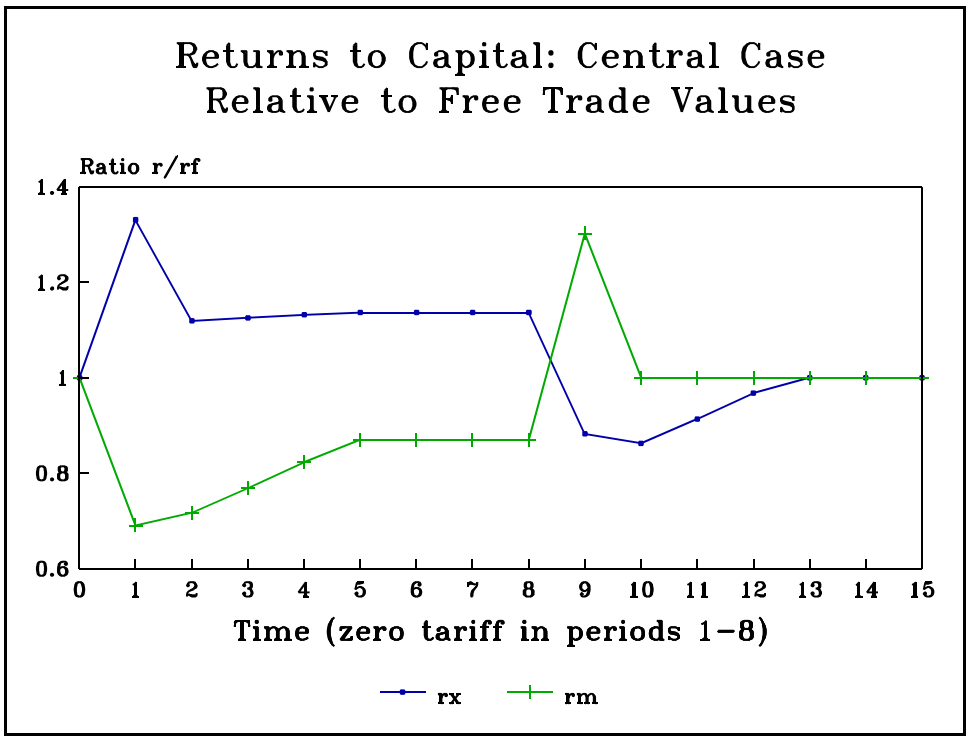
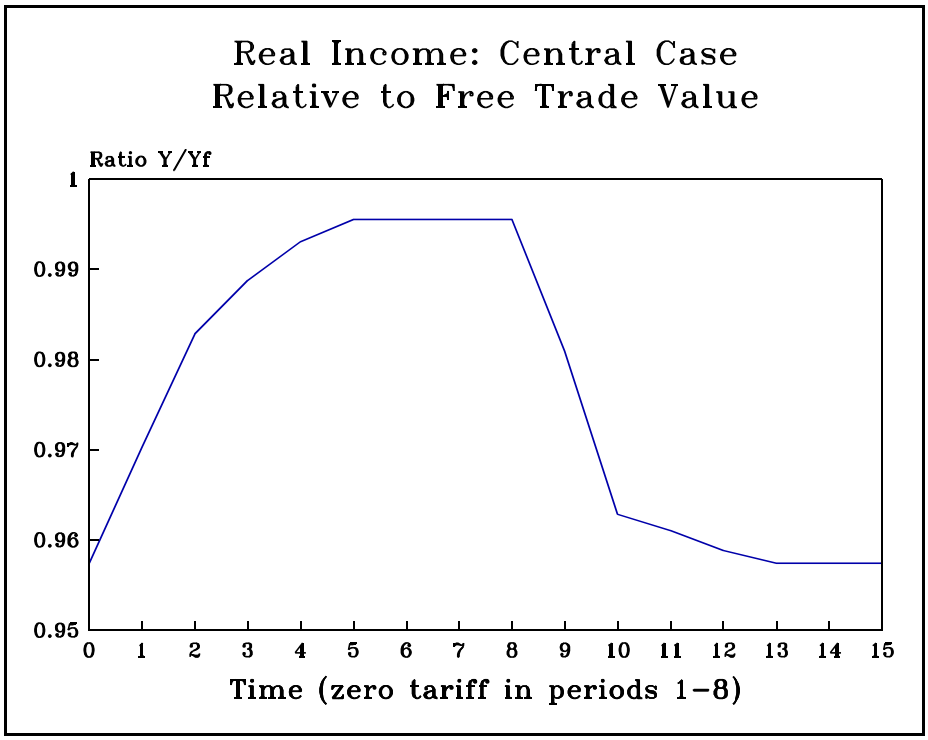


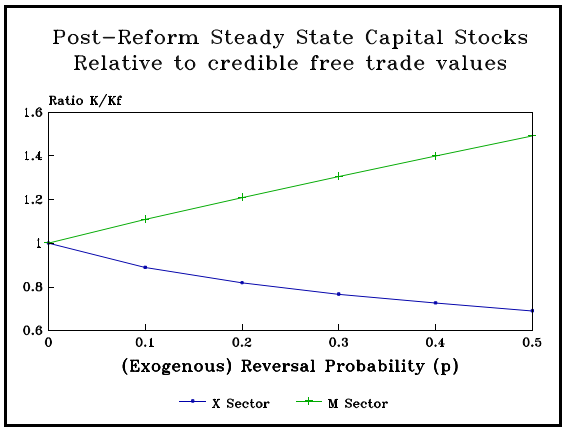
FIGURE 3

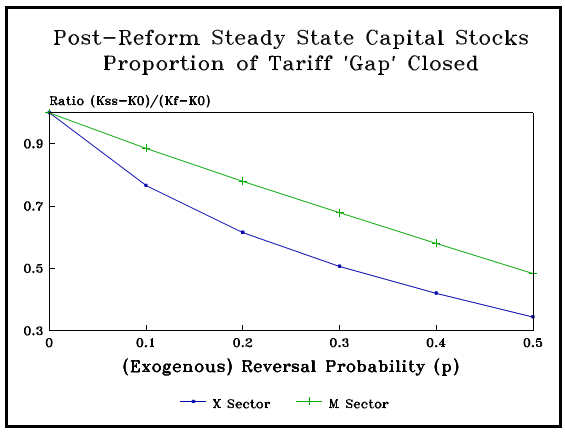


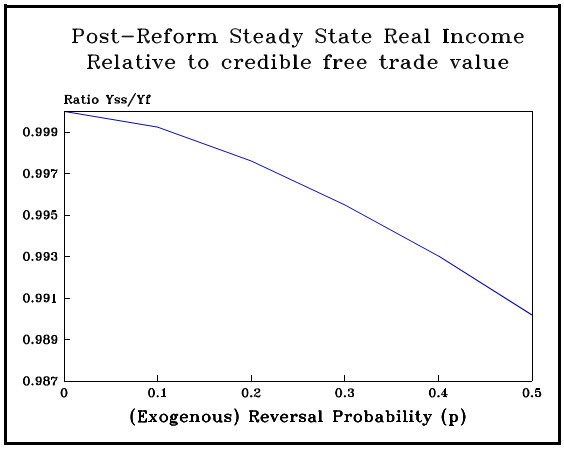
The simulation results are shown in Figures 4-6. In each figure (comprising four charts) we show what happens as the parameter is varied to the capital stocks (the upper pair of charts) and real income (the lower pair). For each variable we also show its value relative to free trade, in other words a measure of its absolute size, in the left hand charts and in the right hand charts the proportion of the "gap" between the tariff and permanent free trade levels closed by the time the post-reform steady state is reached. In addition the scales for each of the four charts across the figures is the same to facilitate visual comparisons.

Figure 4 varies the reversal probability, showing a range from zero which corresponds to a fully credible reform to 0.5 which corresponds to reform being expected to last (a point expectation) for only two years. Considering all four charts the first point to be made is that the sectoral capital stocks and real income converge to their permanent free trade, welfare maximising, levels as the probability of reversal tends to zero. Hence we have an envelope theorem effect that "small" probabilities of reversal do not matter in the same sense that small tariffs do not matter in the absence of other distortions.[15] That having been said the charts also show that the costs of limited credibility rise sharply as the perceived probability of reform reversal increases. This is most readily seen from the right hand charts which show that probabilities in a plausible range of 0.3-0.4 result in the capital stocks adjusting only about half as far as with fully credible reform. As before real income catches up more of its "gap" than the capital stocks though for the same reason it is also more non-linear in p.

FIGURE 4: VARYING THE PROBABILITY OF REFORM REVERSAL







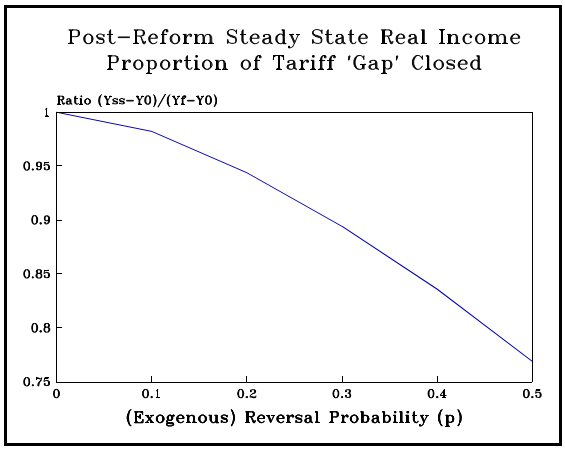
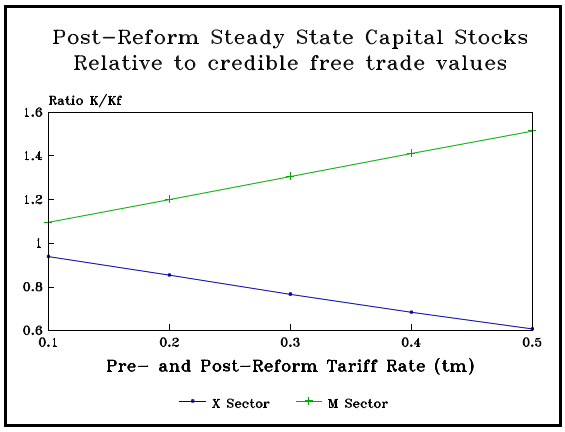
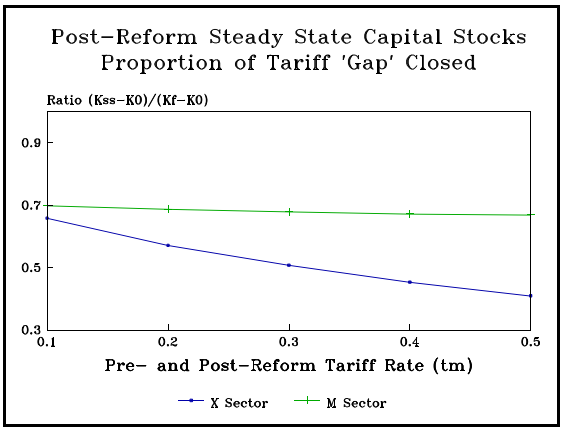
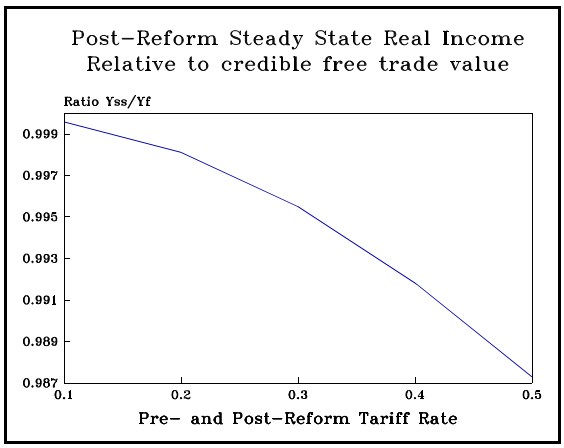


FIGURE 5: VARYING THE TARIFF LEVEL







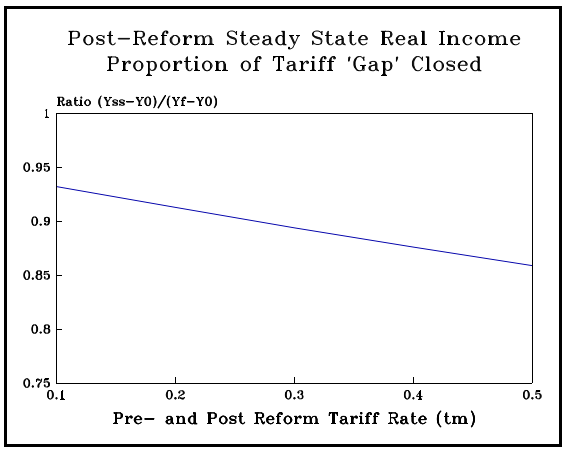
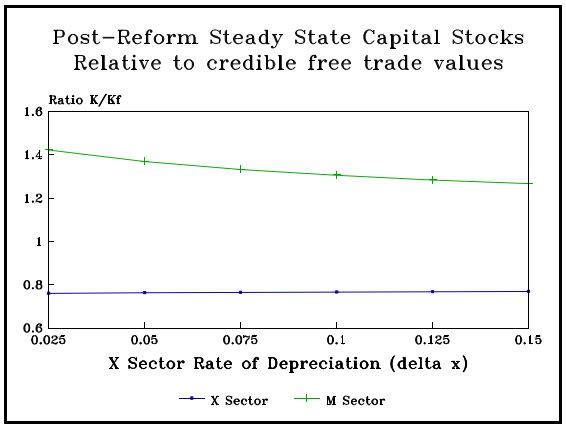
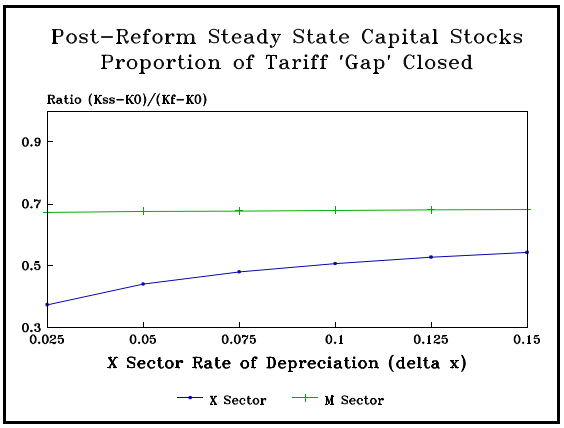
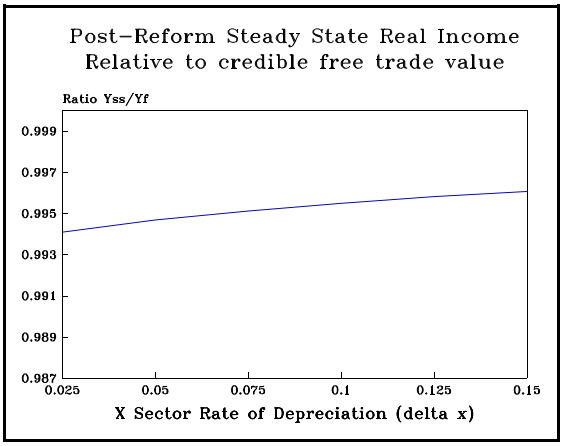


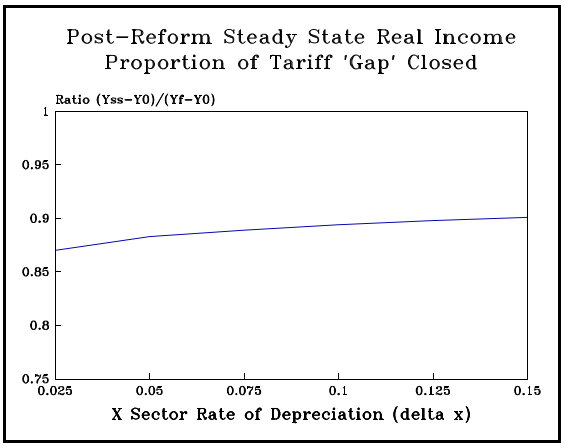
Figure 5 presents the same information for the case where the tariff level (pre-and post reform) is varied across a range from 0.1 to 0.5. From the left hand charts it may be seen that a larger tariff rate (and hence a larger swing in domestic relative prices and returns if reversal occurs) reduces the adjustment to reform, the scale of the variation being comparable to that from varying the probability of reversal in Figure 4. The right hand charts show this relative to the gaps between the tariff-induced and permanent free trade values which are of course larger with a higher tariff. As a result the effect of changing the tariff rate is less marked for these relative measures of adjustment to reform than the absolute measures of the left hand charts but it may be noted that a larger tariff rate still results in (modestly) declining relative success in the resource and income movements induced by the reform.

FIGURE 6: VARYING THE X SECTOR RATE OF CAPITAL DEPRECIATION









Finally in Figure 6 we vary the rate of depreciation in the X sector. The key role of this parameter is in affecting the desired capital stock in the X sector following reform since a very low rate of depreciation for example would mean that if the X sector has expanded it will suffer a prolonged period of low returns if reversal occurs since the sectoral capital stock will depreciate (and thereby raise the return to capital) only slowly. Hence a low rate of depreciation will tend to discourage investment in the X sector more for a given probability and size of reversal. This may be seen from the upper charts of Figure 6 though the effect is weak compared with varying the tariff rate and reversal probability above until the depreciation rate is very small. It would be important, however, for developing countries in which the export sector comprises agricultural commodities since both tree crops (the planting of which may be considered investment due to the lags involved) and agricultural investments to facilitate the production of annual crops (land improvement, drainage etc.) have low rates of depreciation. Mining investments also have low depreciation rates though they are also often capital intensive which makes the model above less applicable since the export sector is affected by trade reform through the labour market.

3. Endogenising the Probability of Reversal

The simulation results above made use of an exogenously imposed and constant probability of reform reversal. In this section we partially endogenise that probability in relation to the investment response and solve simultaneously for both the probability and investment. As noted in the introduction our understanding of the political economy determinants of trade policy is far from complete, both in a static sense of explaining prevailing tariff levels and in the dynamic sense of explaining why they change over time. This poses a particular problem in the setting of this paper since we would ideally like to know both why reforms are undertaken and why they tend to collapse. Rodrik (1996a, 1996b, 1998) and Collier (1998) give excellent surveys of this area but unfortunately there do not appear to be rigorous political economy models of trade liberalisation that we can simply "plug-in" to the model above. In this paper we do not attempt to fill this gap in any complete sense but we do make use of the innovative contribution of the investment model above, which is a rigorous treatment of the capital stock dynamics following reform of given reversal probability, to improve our understanding of the possible political economy dynamics that may follow reform.

In particular we take as exogenous the *initial* probability of reform reversal when liberalisation occurs and examine how the investment response to it may alter the subsequent evolution of that probability. Hence we implicitly assume that factors which influence the reversal probability but are constant or broadly stable over time are reflected in that initial probability, leaving the dynamic response of the economy to affect the change in the probability. In addition we focus on the dynamics of the sectoral capital stocks and their returns since these change more markedly than the other factors of production though arguably we should include the latter also.

Our approach is in the spirit of the models considered in Rodrik (1996b) which model tariffs as resulting from the relative lobbying by, and/or economic interests of, and/or political interest in the factors of production affected by them. In the current context of whether a trade liberalisation may be reversed we contrast the benefit from reversal to M sector capital with the costs of reversal to X sector capital. We assume that the reversal probability will adjust over time as the net benefit from reversal adjusts as the structure of the economy evolves in response to reform. Our modelling approach is reduced form in the sense that we do not provide a mechanism for how the sectoral interests in relation to reversal affect political choice but our formulation would be consistent with more detailed models that had a lobbying mechanism (assuming that capital owners can overcome coordination difficulties) or simply a relation between decisions over tariffs and the interests of capital owners affected by them even if the latter do not lobby directly. It is acknowledged that there are many ways in which this could be modelled but it may be argued that setting out a formal model of one way of doing so represents progress and may stimulate debate about how the analysis may be improved.

We first look at the benefit (in net present value terms) from reversal to one unit of capital in each sector (which we denote b_i) and examine how this changes over time. Hence b_i is the net present value gain from reversal to one unit of capital (measured in units of the cost of capital discounted to the period in which reversal may occur) in sector i at the time reversal takes place. For example if reversal led to a one period gain only (so future periods do not enter the calculation), b_i would simply be given by r_i/c_i if reversal takes place minus r_i/c_i if it does not. For illustration we show b_i for each sector in the upper chart of Figure 7 using the central case

simulation presented in Figures 1-3 above. That simulation assumed a constant probability of reversal and hence the outcomes will not be an accurate picture of what occurs if it becomes endogenous but for the time being our purpose is to endogenise the probability in general terms before presenting a simultaneous solution of the model as a whole. It may be seen that b_x is negative, reflecting the fact that X sector capital loses from reversal, and that it increases in absolute terms during the adjustment post-reform. This is because K_x increases during this time and a larger K_x represents greater losses during the depreciation of K_x post reversal. The upper line for b_m is always positive since M sector capital gains from reversal and declines overall. The initial decline is during the depreciation path of K_m post-reform when reversal means not only an immediate gain to r_m but also an avoidance of further losses along the depreciation path had reform continued.[16] The variable b_m falls during this time because as K_m depreciates there are fewer losses along the depreciation path still to come. Once K_m has mostly depreciated, b_m rises slightly which results from K_x becoming larger and K_m smaller which means a slightly larger immediate benefit from reversal due to relatively more labour reallocating to the M sector if reversal occurs. Overall, however, the path of b_m is downwards though the change is modest.

Having looked at the benefit from reversal to a single unit of capital in each sector, b_i, we next combine this information with the size of the sectoral capital stocks to give a measure, B_i, of the total gains from reversal to capital in each sector. B_i is given by:

$$B_i = \frac{K_i}{K_i^f} b_i \tag{14}$$

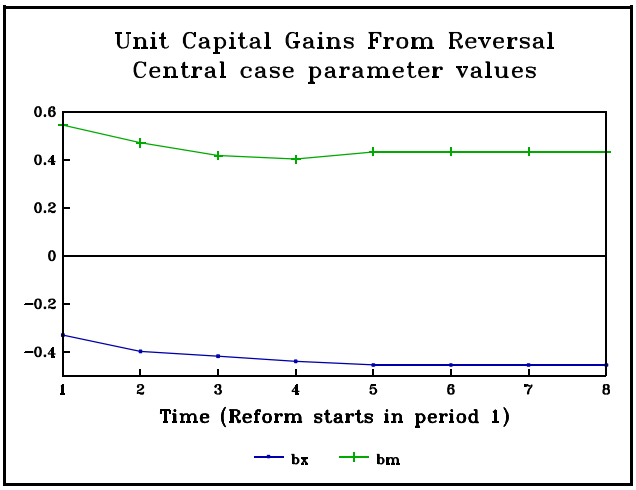
The middle chart of Figure 7 shows the evolution of B_x and B_m for the earlier simulation. Compared with the upper chart the main change is that B_m falls more strongly than b_m, the reason being that K_m falls markedly during the post-reform adjustment (as shown by Figure 1).

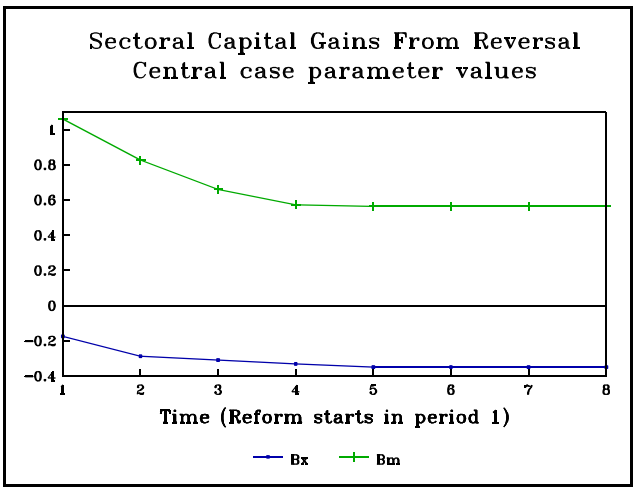
In order to generate the net effect of these sectoral gains and losses from reversal we evaluate:

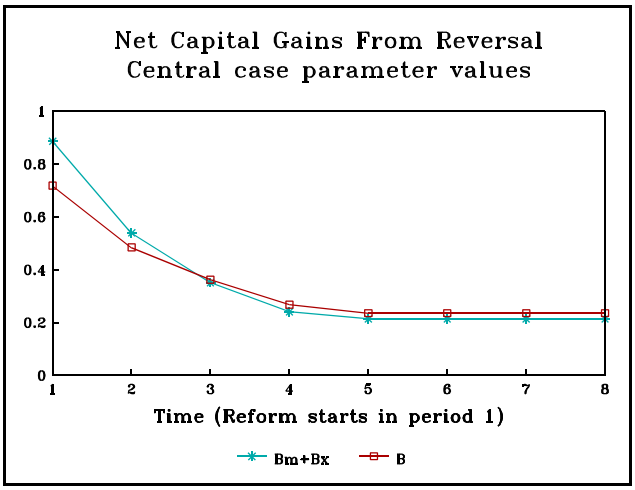
$$B = \frac{B_x + B_m}{|B_x| + |B_m|} \tag{15}$$

Equation (15) gives the net benefit to the sectoral capital stocks combined in the numerator (in which B_x is negative and B_m positive) and divides these by the sum of their absolute values which is a measure of the total interest in reversal irrespective of sign. The purpose of the denominator is to normalise the sum of B_x and B_m (such that B lies between +1 and -1) and to give an idea of the scale of the balance of interests. For example if (15) was the reduced form of a lobbying model it is plausible that the outcome would depend not only on the difference between lobbying magnitudes by the two sectors but on the size of that difference relative to the total amount of lobbying. Normalising in this way is also close to the "political cost benefit ratio" discussed by Rodrik (1998) in which decisions are expected to depend on the net benefit from reform relative to the total amount of redistribution. It may also be noted that a more general form of (15) would include weights for the two sectors'

FIGURE 7: ENDOGENISING THE PROBABILITY OF REVERSAL







interests and we comment on the effect of these below. The lower chart of Figure 7 shows the evolution of (15) in a similar manner to the middle and upper charts. For comparison we also show the simple sum of B_x and B_m from which we see that the denominator of (15) smooths the measure of net interest but does not make a major difference.

Having set out one way of quantifying and combining the interests of the two sectors over reversal we hypothesise that the probability of reform reversal is given by:

$$p_t = p_1 - \mu(B_1 - B_t) \qquad s.t.\ p_t \geq 0 \tag{16}$$

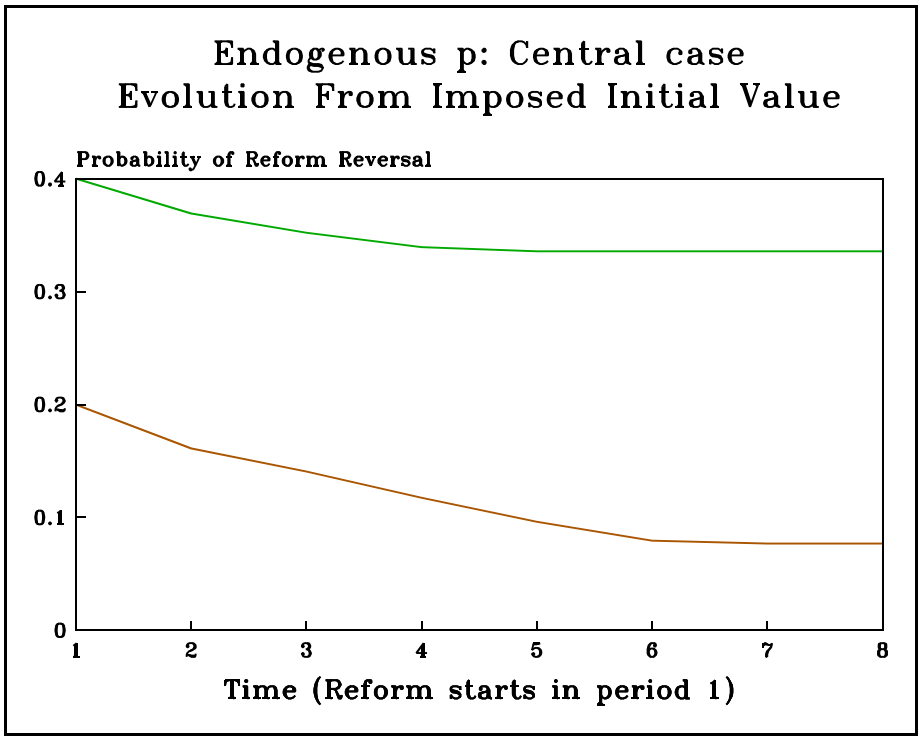
In this expression p_1 is the probability of reversal in period 1, which is still exogenous and intended to catch the factors influencing the probability that vary little over time, and B_1 the value of (15) in period 1 which is used as an anchor with which future values of B can be compared. Thus the second term in (16) is intended to capture the change in the net interest of the two capital stocks from reversal and how that change alters p_t, the magnitude of the effect depending on the constant μ. Of course if μ is zero the model collapses to the "exogenous p" one above; alternatively if it is very large the reversal probability will shrink to zero for very small falls in B. Hence it is difficult to generate a prior as to what the appropriate value of μ might be and hence our choice in the simulations below is somewhat arbitrary (μ=0.15) and intended to illustrate the dynamics of p_t over time without a trivial collapse to zero.

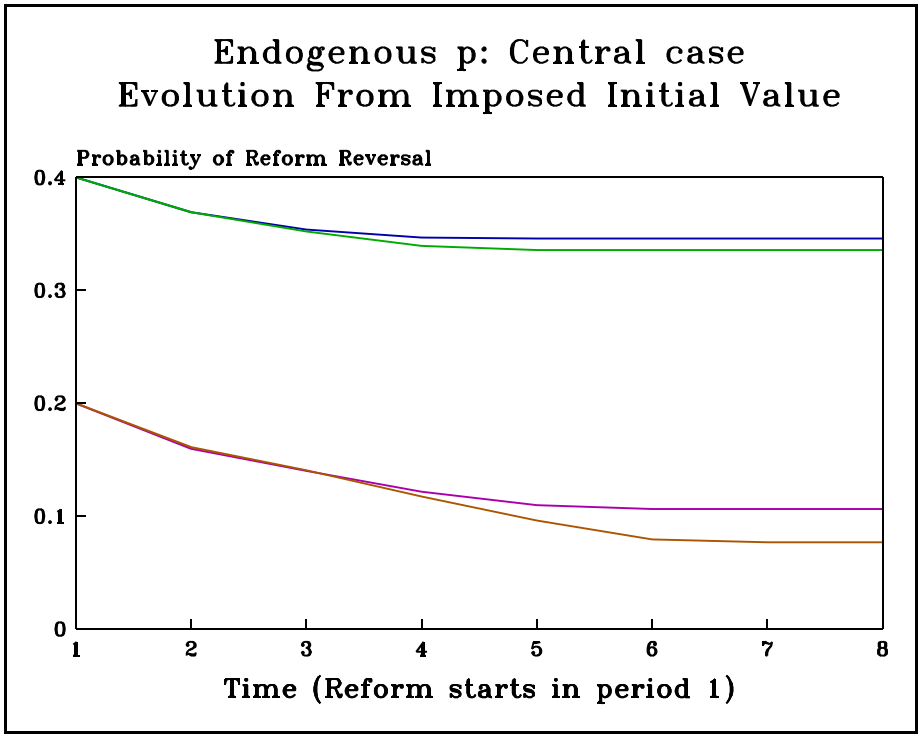
Having set out (16) above we comment briefly on the effect of including sectoral weights in (15). In general, of course, a larger weight on the interest of the M sector, for example, will make trade liberalisation less likely but Figure 7 above shows that a paradoxical outcome is possible in relation to the change in reversal probability post-reform. The middle chart of Figure 7 indicates that, at least for the simulation on which it is based, B_m changes more than B_x which means that a larger weight on B_m in an altered version of (15) would in fact make B fall more over time. In turn from (16) this would mean that the reversal probability would fall more despite the fact that the M sector is being given greater weight. This arises because (16) assumes that the change in B affects the change in the reversal probability and a higher M sector weight raises the level of B but also raises the rate at which it falls post-reform.[17]

Simultaneous Determination of Investment Responses and the Reversal Probability

We turn now to simultaneous simulation results of the investment model using the central case parameter assumptions of Appendix 1 and the probability of reform reversal evolution model of (14)-(16). We assume that agents know the structure of the model and in particular that the probability of reversal evolves according to (16). Figure 8 shows the time paths of the reversal probability from initial values of 0.4 and 0.2 respectively. Most significantly, the reversal probability falls in both cases as the structure of the economy adjusts and the value of B in (15) falls as it did in Figure 7. In addition, however, the fall from the initial value of 0.2 is more pronounced, both in absolute size and in relation to its starting point, than that from 0.4.[18] The reason for this is that a lower initial probability brings forth a greater investment response from the X sector which in turn builds a greater interest in, or constituency for, continued reform in which case B falls further by (15) and p more from (16), thus encouraging a further investment response and so on.

FIGURE 8: TIME PATHS FOR ENDOGENOUS REVERSAL PROBABILITY

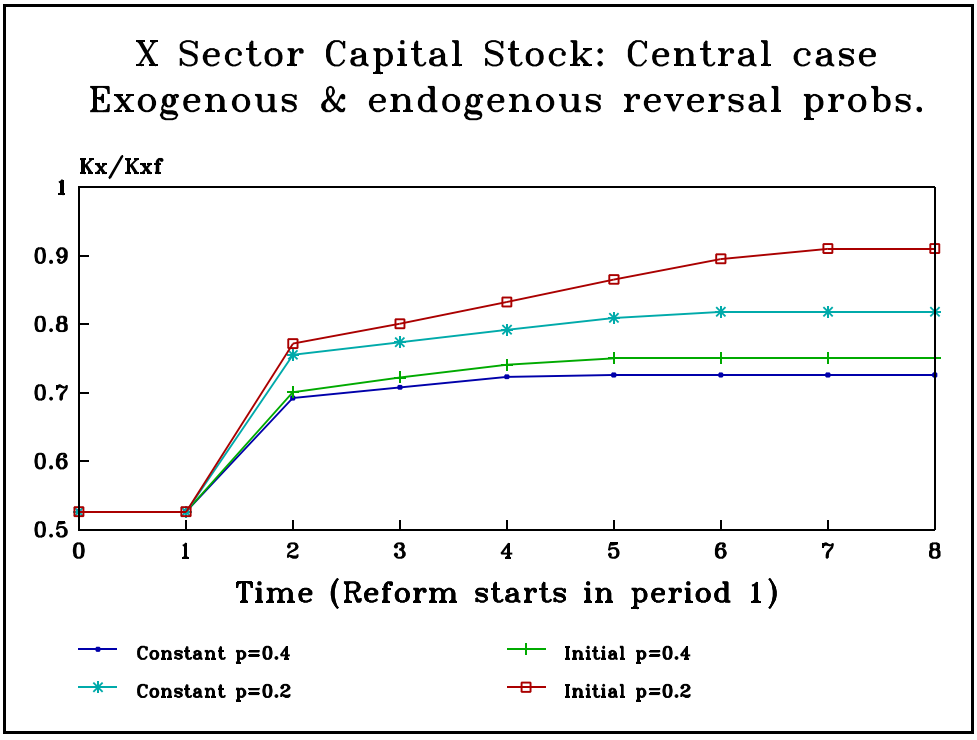




The lower chart of Figure 8 divides the change in the probability into two components to show the importance of the simultaneous determination of the investment responses and p. The lower of each pair of lines repeats the lines from the upper figure while each of the lines just above it shows how the reversal probability would have evolved had investment not responded to the lowering of the reversal probability (in other words if the perceived probability of reversal has remained at 0.2 or 0.4). Hence the greater part of the reduction in the reversal probability comes from the structural change that would have occurred had the probability remained constant but the extra reduction in p from the extra investment in response to the lowering of p is not insignificant, particularly for the 0.2 initial probability case.

Figure 9 shows the simulation results for investment in the X sector when it and the reversal probability are simultaneously determined. The lower pair of lines corresponds to an initial probability of 0.4, the upper pair to 0.2. Of each pair the lower line is the adjustment that occurred under the earlier simulation when the reversal probability was kept constant, the upper line of each pair being the outcome of the simultaneous simulation with p endogenised. It may be seen that the extra investment from the reductions in p are particularly significant for the initial probability of 0.2. As before a low starting reversal probability gives rise to a more vigorous investment response which in turn leads to further reductions in p through the endogenous p effect.

FIGURE 9: ENDOGENOUS p AND THE X SECTOR CAPITAL STOCK



4. Conclusion

This paper has provided a rigorous model of the sectoral investment responses to a trade liberalisation that may be reversed and shown how the probability of reform reversal may be partially endogenised based on those responses. Its contribution is partly technical, especially by advancing our understanding of irreversible investment decisions under uncertainty in the trade liberalisation context, but it also sheds light on a number of policy issues in the literature and we conclude by discussing these.

First, and perhaps most important, the model provides much more optimistic results about the investment response to reform than is implicit (but rarely explicitly modelled) in the literature. The probability of reform reversal still matters a great deal for investment but the investment response is always positive. The comparative static results show this strongly: with reasonable reversal probabilities, half or more of the investment that would occur under full credibility is discouraged; but at the same time small reversal probabilities only have a small effect and, at the other end of the spectrum, even very large reversal probabilities still give rise to some investment response. These results are important for policy reasons since they suggest that policymakers should not avoid reform simply because it is not fully credible (unless waiting may provide a more credible time for reform at some point in the future), but at the same time any steps that can be taken to enhance the credibility of reform are likely to be highly beneficial.

In this regard the paper is strongly supportive of the desirability of agencies of restraint as mechanisms for reducing the perceived probability of reversal if domestic political economy factors make that probability significant. In the absence of agencies of restraint the analysis of the possible determinants of that probability over time was encouraging in so far as the political pressures to reverse reform are likely to ease as the economy adjusts and the sector with an interest in continued reform expands and that in favour of reversal shrinks. The strength of this effect, however, was sensitive to the probability of reversal at the start of the process: a high initial chance of reversal means little investment response and little benefit from the "endogenous probability" effect whereas a lower initial probability falls even further with stronger investment responses.

The paper also supports the literature in that an effective agency of restraint is likely to strongly dominate aid conditionality as a promoter of effective reform, chiefly because conditionality may obscure the preferences of government and aid is time limited. That having been said the political economy analysis of the reversal probability may partially restore the case for modest amounts of aid to facilitate reform. If there is no effective agency of restraint available, temporary aid which permits reform to continue may have a long lasting benefit from preventing reversal during the early years when opposition to reform is highest. Clearly this "aid supports structural change" argument must be set against the "weaker signal of government intent" effect for a balanced assessment. It seems plausible that small amounts of aid, committed over relatively long periods, which might compensate for no more than lost tariff revenue (so non-reformist governments would not be attracted to the package) would enhance the prospects of success. Large amounts of aid are more likely to bring about a pooling equilibrium (in the terminology of Rodrik, 1989b) such that non-reformist governments reform (temporarily) as well and the perceived reversal probability is high across all governments.

APPENDIX 1

Parameter		Central Value
Probability of reform reversal in period t	p_t	0.3
Credible free trade X sector labour share	l_x^f	0.5
Pre- and post-reform tariff on imports of M	t_m	0.3
K_m rate of depreciation	δ_m	0.1
K_x rate of depreciation	δ_x	0.1
World real interest rate	r^*	5%
Share of labour in output (both sectors)	α	0.6
Share of capital in output (both sectors)	β	0.2
Share of permanently fixed factor (both sectors)	$1-\alpha-\beta$	0.2

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Endnotes

1. See, for example, Dean et al. (1994), Krueger (1993), Oyejide et al. (1999), Papageorgiou et al. (1991), Reinikka (1996) and Rodrik (1992, 1996a).

2. The analysis of non-credible trade liberalisation is also likely to be informative about other structural reforms that involve changes in relative returns between sectors and to similar reforms in transition economies.

3. See Dixit and Pindyck (1994) for a general introduction, Mash (1998) for a model and solution procedure similar to that used here.

4. See Alt et al. (1996) and Rodrik (1996a and 1996b) for summaries, and Rodrik (1998) for a recent assessment; earlier work includes Rodrik (1989a, 1992, 1993), Engel and Kletzer (1991), Fernandez and Rodrik (1991) and Krueger (1993). Interesting related work not directly applicable to the current paper includes Horowitz and Just (1995), Ozler and Rodrik (1992) and Rodrik (1995).

5. Though Buffie (1995) amongst others highlights the risk of self-fulfilling reform failure through the consumption boom/balance of payments mechanism noted above.

6. Rodrik suggests that reforming governments might choose to overshoot their desired long run outcome as a signalling device, in the trade liberalisation context by having an import subsidy for a time. This may act as a good signal of reforming intent but its desirability may be sensitive to the risk of exacerbating the balance of payments problems from an import boom if full credibility is not achieved.

7. The model is based on that in Mash (1997) but with a one period investment delivery lag imposed throughout.

8. It would be desirable to include non-traded capital goods as well. These are analysed in Collier and Gunning (1996) who analyse the effect of trade liberalisation on the composition of investment between traded and non-traded capital but not its overall size.

9. This follows Albuquerque and Rebelo (1998) and is the standard assumption for a sector-specific capital model; see Caballero and Hammour for a model of labour adjustment difficulties.

10. We could of course also represent trade liberalisation by the abolition of an export tax rather than import tariff.

11. The temporary removal of a tariff on capital goods could give rise to a Calvo type *investment* boom in imported capital goods, either for immediate production or storage.

12. Hence the consumption distortion caused by the tariff is not considered.

13. See Mash (1998) for further discussion of this expression and a solution procedure close to that which follows (though in a context of ongoing volatility). It may also be noted that for clarity the returns and cost of capital are discounted to period s rather than s-1, given that the expression is equated to zero this makes no difference to the solution obtained.

14. This confirms the earlier general argument that if K_x earns zero profits prior to reform, that reform raises its return and reversal means a return to the previous tariff level, reform even of very limited credibility will induce a positive investment response in the favoured sector. As noted this is a point of difference from Rodrik (1991).

15. It may be noted that the conclusion that small probabilities of reversal do not matter is contingent on the reform being the complete abolition of the tariff. If the post-reform tariff is still positive a small reversal probability that results in a small deviation of resource allocation from that which would occur if the reform was fully credible will have first order effects on welfare.

16. These losses are weighted by the probability that reform does continue since even if reversal does not take place in a given period, it may still do so the following period.

17. A similar paradox or ambiguity is present in relation to whether it is desirable for the political system to be responsive to the interests of capital in the two sectors. A static answer to this is clearly "no" since the net interest is against reform and peaks at the start of reform so if decisions are too sensitive to lobbying etc. reform is unlikely to occur at all. However, assuming that reform has occurred, greater sensitivity (a higher value of μ) would mean a faster fall in the reversal probability.

18. This outcome is not sensitive to our choice of μ, except in so far as a much higher value leads to both reversal probabilities converging on zero.