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On the Robustness of Short Run Gains from Trade Reform

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ABSTRACT

The long run gains from reductions in distortionary tariffs are robustly positive in neoclassical economies. In the short run, however, depending on the prevailing exchange rate and tax regimes, a combination of producer price deflation and nominal wage stickiness can cause trade liberalisation to be contractionary. Because trade liberalisation, taken alone, reduces the home prices of foreign goods, there is a substitution away from home produced goods and a real depreciation. Under the explicit and *de facto* fixed exchange rate regimes adopted by many developing countries this necessitates a contractionary producer price deflation. Under the floating exchange rate regimes of the larger industrialised economies, if lost tariff revenue is replaced via a consumption tax increase, contractionary producer price deflation can also occur. This paper examines the implications of these and other policy combinations for the short run gains from trade reform using a comparative static numerical model of a generic, two-sector, "almost small" open economy with asset markets and forward looking agents

Keywords: Trade reform, short run, exchange rate regimes, fiscal policy

JEL Classifications: E63, F13, F17 and F41

1. Introduction

In the two-sector Heckscher-Ohlin-Samuelson model, where one industry is protected and production is diversified, the gains from trade liberalisation are robust. This fundamental result is the foundation for most economic intuition about trade liberalisation. The conditions under which it generalises have been explored for extensions to many goods, factors and countries (Ethier 1984), specific factors (Mussa 1974, Jones 1971 and Krueger 1977) and imperfect competition (Krugman 1995).[1] The emphasis in all this literature is on long run comparative statics. While extensions to the short run have been explored in the trade literature, these have tended to be idiosyncratic in that they examine either the implications of the nominal rigidities, the fiscal implications of lost tariff revenue or the particular policy environments in individual, usually developing, countries.

Corden (1997) identifies the key roles of the nominal and real exchange rates, concluding that there is a case for border protection where trade liberalisation is combined with a fixed nominal exchange rate and nominal wage rigidity.[2] He emphasises the balance of payments, however, ignoring fiscal implications. In the largely separate literature on the fiscal implications of lost tariff revenue a particularly thorough contribution is by Keen and Ligthart (2002), who examine the welfare implications of revenue replacement via alternative taxes. Theirs is a long run analysis, however, assuming full employment throughout and ignoring the roles of exchange rate regimes and the nominal rigidities common in the short run. They do generalise, however, the Dixit (1985) result that welfare is improved by the replacement of distortionary tariffs with destination-based consumption taxes. The country-specific numerical modelling literature spans balance of payments and fiscal policy issues, although emphasis is usually placed on idiosyncrasies such as the revenue implications of liberalising quota-ridden trade regimes[3] or the rationing of foreign exchange in developing country regimes with capital controls.[4]

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[1] Although Mayer (1974) also contributes to this classical trade literature with specific reference to the short run, his focus is on otherwise long run models with sector-specific physical capital.

[2] See Corden (1997): 15.7. Mehlum (1998) uses a related real model with real wage rigidity to advocate gradualism in trade reform.

[3] Bevan (1999) explores the relaxation of import quotas in Kenya in a model with monetized fiscal deficits, emphasising the ambiguous fiscal implications when quotas are the primary trade policy instrument. Feltenstein (1992) examines trade reform and fiscal policy in a real dynamic model of Mexico.

[4] Davies et al. (1998) and Mabugu (2001) focus explicitly on the short run but use real models with rationed export earnings applied to Zimbabwe. Meller and Solimano (1987) model the Chilean economy, also with a binding external constraint. They use a more sophisticated macroeconomic model but address monetary policy issues rather than trade reform.

There is now also a growing literature on the dynamic numerical modelling of the global economy that gives considerable emphasis to near-term behaviour following shocks that include trade reforms. Amongst these are real models that focus on the allocative effects of the reforms and their implications for investment and growth patterns (Ianchovichina and Martin 2002, Walmsley et al. 2001). Yet more sophisticated are the global, multisectoral, macroeconomic models of the type constructed by McKibbin and Wilcoxen (2002). Their model includes financial assets and mixes of forward-looking and myopic agents. Using that model, McKibbin (1999) conducts global trade reform experiments that account for both nominal rigidities and tax-switching. His broad canvas does not permit a detailed exposition of short run effects for individual countries, however. Our objective is to examine the short run implications of trade liberalisation for the generic small open economy[5] and to do this without resort to the scale these dynamic global models require. Indeed, while we also depend on numerical analysis, we avoid dynamic simulations altogether, employing instead comparative statics with the incorporation of forward-looking agents facilitated by different lengths of run.

Our particular interest in these short run effects stems from a study of the implications of China's accession to the WTO (Chang and Tyers 2003, Rees and Tyers 2004). That country's rate of economic growth, while remaining impressive, had slowed since the mid-1990s following the integration of its exchange rate and the beginning of its now famous *de facto* peg to the US dollar. Moreover, since 1997 and unusually for China's stage of development, not only did the rate of uptake of new workers in China's industrial sector slow, but the share of industrial employment declined and the rural share rose.[6] While this apparently aberrant economic behaviour might have many explanations, we postulated that a contributing force was the comparative stickiness of industrial sector nominal wages in the face of continuous deflation, and that the deflation was due to the defence of China's *de facto* peg following a series of real depreciations. In turn, the real depreciations were due to economic reforms that included significant trade liberalisation, which switched domestic demand away from home goods, cheapening the home production bundle relative to the foreign one.

Our purpose in this paper is to explore more generally the conditions under which trade liberalisation can be contractionary in the short run. The model we use is described in Section 2. The effects of trade reform at different lengths of run, with and without

[5] In fact, our model will turn out to be "almost small" following Harris (1984), with some allowance for export market power.
[6] See Chang and Tyers, *op cit*.

forward looking agents, are explored in Section 3 for both fixed and floating exchange rate regimes. The interaction between the exchange rate regime, nominal wage stickiness and fiscal policy is discussed in Section 4 while Section 5 reviews the sensitivity of our results to the degree of wage rigidity, product price rigidities, the factor proportions contrast between sectors and the international mobility of financial capital. Finally, Section 6 offers conclusions.

2. The model

Overview

The structure we adopt has a clear lineage back to the original Heckscher-Ohlin-Samuelson two-sector, two-factor small open economy model. We retain the two sectors and the two factors but recognise that an undistorted economy with a fixed external terms of trade and home and foreign goods that are homogeneous can never exhibit observed departures from purchasing power parity or intra-industry trade. So the first step is to differentiate home from foreign products, increasing the number of products to four (two home-produced and two foreign). While, by itself, this differentiation allows intra-industry trade, the strict interpretation of the "small" economy would require that both import and export prices be fixed. The rigidity of export prices would lock down the producer terms of trade and, once again, ensure that there is no flexibility in the real exchange rate. We have therefore adopted the "almost small" characterisation of Harris (1984), whereby the collective foreign household substitutes between home exports and corresponding foreign products with a finite elasticity of substitution. This makes the demand curves for exports downward sloping. Then, when trade liberalisation causes domestic substitution away from one home good, its increased exports push down its export price, shifting the producer terms of trade and changing the relative cost of the home production bundle and therefore the real exchange rate.

The real exchange rate is, in practice, also strongly influenced by the magnitude of net inflows on the capital account – the difference between investment and domestic saving. Investment creates demands on home industries. It depends positively on the average return on home physical capital and negatively on the real cost of finance or the home real interest rate. To capture this, an open home capital market is required in which not only investment but also consumption and private saving are dependent on the home interest rate. Since uncovered interest parity is not observed in practice we allow for some differentiation of home from foreign corporate bonds, so that financial capital is imperfectly mobile internationally. Private net inflows on the capital account then

depend on the ratio of the home and (exogenous) foreign interest rates. But the government's fiscal policy also plays a key role in determining the home interest rate. If its expenditure is constant in real terms, trade liberalisation reduces revenue and crowds out domestic investment, driving up the home (real) interest rate. To capture the alternative of increased taxation in other forms, the model requires a raft of tax instruments including income taxes on labour and capital income, a consumption tax, import tariffs and export taxes. Once these additions are made to the basic two-sector, two-factor model we have the essential ingredients of our real "long run" analysis.

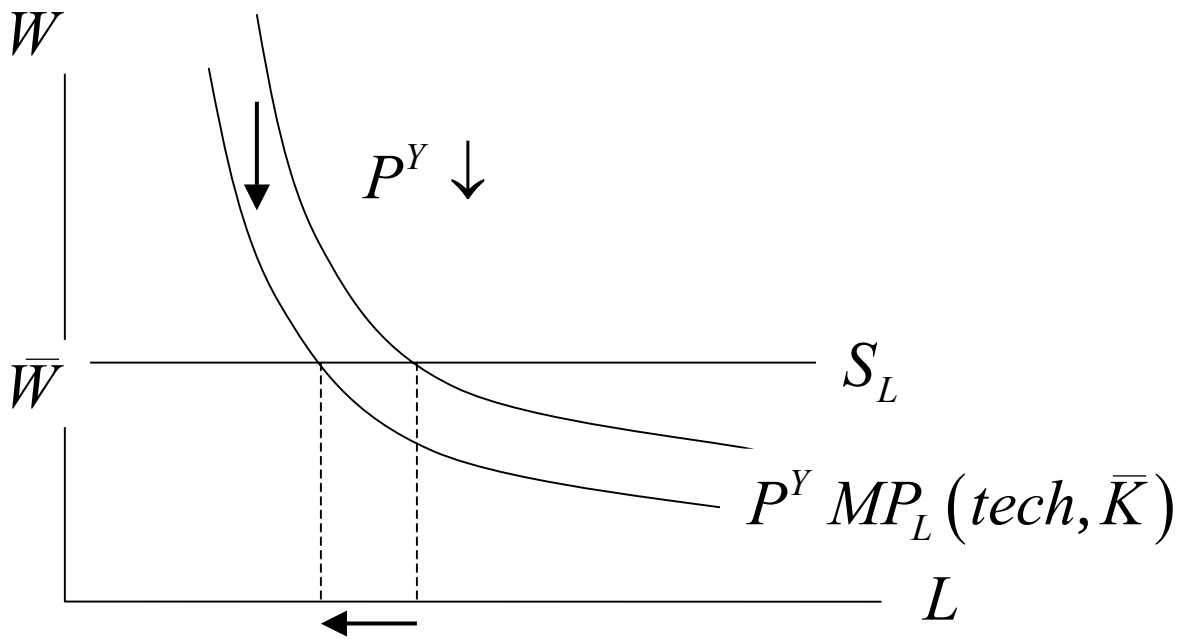
In the short run, however, physical capital is not mobile between sectors and nominal rigidities are important. Their representation requires the addition of domestic and foreign money as portfolio substitutes for home and foreign bonds. We do this in text book fashion, assuming money demand is driven by a "cash in advance "constraint with portfolio adjustments responsive to the home nominal interest rate. Money market equilibrium is incorporated through the addition of an *LM* curve wherein real money demand is equated to the real money supply; the latter defined as the ratio of the nominal money supply, a policy variable, and the consumer price level.[7]

Nominal wage rigidity is the key to the model's short run behaviour. In its presence the effects on GDP depend on whether the trade liberalisation causes producer (or GDP) price deflation.[8] If the nominal exchange rate is fixed there is both consumer and GDP price deflation. If the nominal wage is also rigid, then the labour market is as depicted in Figure 1. Firms equate the nominal wage to the money value of the marginal product of labour. When the producer price falls the resulting labour demand curve shifts down and to the left and employment contracts. The model accommodates varying degrees of nominal wage stickiness, though full rigidity is assumed in the experiments discussed in the following section, with varying degrees of wage indexation illustrated in Section 5.

Figure 1: The labour market with fixed nominal wage

[7] In most applications presented here the nominal money supply is endogenous while the central bank is presumed to target either the consumer price level or the exchange rate.

[8] The interplay between the consumer and GDP (producer) price indices proves important in our results, as recognised by Marston (1984).



With these additions we have the foundation of our short run model. All that remains is to incorporate financial flows on the capital account. These contribute to the financing of domestic investment and have a substantial impact on the real exchange rate. Net inflows depend on a "parity ratio" (the ratio of the after-tax home nominal bond yield plus the expected exchange rate change to the exogenous foreign nominal bond rate). Home consumption depends on expectations over future real disposable income and the future real bond yield, while home investment depends on expectations over the future net real return on installed capital. These expectations are then derived from corresponding long run solutions. In forming them, agents in our model see the long run effects of current shocks and adjust their behaviour accordingly.

Expectations over the rate of nominal exchange rate change and the inflation component of the nominal bond yield are annualised. To make these meaningful in this comparative static context, short run behaviour is considered to represent a single-year response while long run equilibria apply following an explicit number of elapsed years.[9] The short run response is within the gestation period of new investment, so that the effective physical capital stock is constant and immobile between sectors. Long run closures allow intersectoral mobility of capital and its stock can change depending on the level of net investment. They are constructed purely to allow the formation of expectations about the price level, the exchange rate, nominal disposable income, the real

[9] This time period, T_{LR}, is 10 years in this analysis.

bond yield and the real return on installed physical capital in the home economy.[10] Sufficient time is considered to have elapsed for all prices to adjust (full employment). The initial equilibrium of the economy lies in a steady state with no net investment and no labour force or productivity growth. Responses to shocks in both the short and long runs are considered to indicate departures from this underlying steady state and so in neither case need the *ex post* real net return on installed physical capital equal the real bond yield.

As in the standard HOS model, there are two primary factors in fixed supply nationally. Labour (L) is variable in both lengths of run, while physical capital (K) is sector specific in the short run. There are four financial assets: home money, H$, and bonds with nominal yield, i, and foreign money, F$, and bonds with risk-adjusted, after-tax nominal yield, i^*. Two home products are supplied in quantities Y_1 and Y_2 using Cobb-Douglas technology. The home and foreign countries produce both products though the respective goods are differentiated by region of origin. The four products are demanded at home for final consumption via a CES (constant elasticity of substitution) nest. Government consumption and investment demand both use home goods only. Import prices are fixed in F$ while foreigners substitute between foreign goods and home exports at elasticity of substitution, σ^*. There is, therefore, a downward sloping foreign demand curve for home exports in their F$ prices. This behaviour notwithstanding, home products have so small a share of foreign markets that the foreign price level, P^* is fixed in F$. Similarly, the home economy has negligible effect on the foreign capital market, so that the risk-adjusted after-tax nominal yield on foreign bonds, i^*, is also exogenous.

The supply side

The supply side of the model follows the standard HOS two-factor, two-sector structure with perfect competition in both product and factor markets. The production levels Y_1 and Y_2 are both Cobb-Douglas in the two primary factors:

$$(1)\qquad \begin{aligned} Y_1 &= A_1(L_1)^{\eta_{L1}}(K_1)^{(1-\eta_{L1})} \quad \textit{where } \eta_{K1} = 1-\eta_{L1} \\ Y_2 &= A_2(L_2)^{\eta_{L2}}(K_2)^{(1-\eta_{L2})} \quad \textit{where } \eta_{K2} = 1-\eta_{L2} \end{aligned}.$$

Total primary factor demands are therefore $\bar{L} = L_1 + L_2$ and $\bar{K} = K_1 + K_2$. Given perfectly competitive profit maximisation, the unit factor rewards in each industry j are the respective H$ values of the marginal products at producer prices. Because labour is

[10] Better representation of the underlying growth trend is possible in the long run version of the model by making the capital stock endogenous and dependent on net investment over 10 years.

mobile between sectors we have $W_1 = p_{H1}MP_{K1} = W_2 = p_{H2}MP_{K2}$. Correspondingly, the H$ rental per unit of physical capital is $R_{KGj} = p_{Hj}MP_{Kj}$, which only equates across sectors in the long run. Unit factor demands also stem from the technology, via the firms' cost minimisation problem.[11] These are:

$$(2) \qquad l_j = \frac{1}{A_j}\left[\left(\frac{\eta_{Lj}}{W}\right)\left(\frac{R_{KGj}}{\eta_{Kj}}\right)\right]^{1-\eta_{Lj}}, \quad k_j = \frac{1}{A_j}\left[\left(\frac{W}{\eta_{Lj}}\right)\left(\frac{\eta_{Kj}}{R_{KGj}}\right)\right]^{\eta_{Lj}}.$$

Producer prices follow as $p_{Hj} = Wl_j + R_{Kj}k_j \quad \forall\ j = 1,2$.

The GDP price, P_Y, is a constant-weight index of the producer product prices p_{Hj}:

$$(3) \qquad \frac{P_Y}{P_Y^0} = \left(\frac{Y_1^0}{Y_1^0 p_{H1}^0 + Y_2^0 p_{H2}^0}\right)p_{H1} + \left(\frac{Y_2^0}{Y_1^0 p_{N1}^0 + Y_2^0 p_{H2}^0}\right)P_{H2}.$$

In the absence of intermediate inputs our aggregate measure of economic activity is real GDP at producers' prices

$$(4) \qquad Y = \frac{1}{P_Y}\sum_{j=1}^{2} p_{Hj}Y_j,$$

which is linked to the demand side of the model by the volume accounting relation:

$$(5) \qquad Y_j = C_{Hj} + I_{Sj} + \left(I_{Vj} - I_{Vj}^0\right) + G_{Sj} + X_j,$$

which sums the sectoral product demands for the consumption of home products, investment (including inventory adjustments applying in the short run only), government consumption and exports.

The demand side

Consumption volumes are derived in three stages. First, an aggregate volume of consumption is determined, along with corresponding savings, in an intertemporal optimisation. For this purpose the utility of the collective household is assumed to be concave in this aggregate of current consumption. Second, this aggregate is assumed to be CES in the consumption of the two goods. To achieve the differentiation of home from foreign products, however, the third stage is needed. Aggregate consumption of each product type is then assumed to be CES in the volumes consumed of the home produced and imported varieties.

In the first stage, the collective private household is forward-looking, consuming volume C in the current year and C_F in *every* subsequent year. They observe their current

[11] Minimise factor cost, $Wl_j + R_{KGj}k_j$, subject to $1 = A_j l_j^{\eta_j} k_j^{1-\eta_j}$.

nominal disposable income, which includes net income flows from abroad, N and excludes direct taxes, T_Y ($Y_D = P_Y Y - T_Y + N$). They also observe the current aggregate consumer price level P_C, and the current real interest rate net of capital income tax $r_N = r/(1+\tau_K)$. Correspondingly, they form expectations about the future consumer price level, P_C^F, the future level of their nominal disposable income, Y_D^F, and the future real interest rate net of capital income tax, r_N^F, all of which are presumed to prevail in *every subsequent* year. The optimal current consumption volume is derived in the appendix as:

$$(6) \qquad C = \frac{\frac{Y_D}{P_C} + \frac{Y_D^F}{P_C^F r_N^F} - \Delta W(1+r_N)}{1 + R_2\left(\frac{R_2}{R_1}\right)^{\frac{1}{1-\beta}}}, \text{ where } R_1 = \frac{1-\left(\frac{1}{1+\rho}\right)^{T-1}}{\rho} \text{ and}$$

$$R_2 = \frac{1-\left(\frac{1}{1+r_N^F}\right)^{T-2}}{r_N^F}.$$

Here ΔW is the real change in wealth present value over a finite horizon, T, ρ is the rate of time preference and β is the elasticity of utility to current consumption. To calibrate these equations we first choose ρ and T for an initially stable consumption path ($C=C_F$, implying that $R_1=R_2$ initially) consistent with the assumed underlying steady state. We then obtain ΔW from initial conditions and equation (6).

Since consumption C is a CES composite of the two goods, the collective household is assumed to select the two volumes C_{S1} and C_{S2} to minimise the cost of the aggregate.

$$(7) \qquad C_{S1} = s_1 C\left[\frac{p_1}{P_C}\right]^{-\sigma}, \qquad C_{S2} = (1-s_1)C\left[\frac{p_2}{P_C}\right]^{-\sigma},$$

where σ is the elasticity of substitution between the two goods, s_1 is the initial expenditure share on good 1 and the composite consumer price is:

$$(8) \qquad P_C = \left[\sum_{j=1}^{2} s_j p_j^{1-\sigma}\right]^{\frac{1}{1-\sigma}}.$$

In the third stage, the consumption of each product is divided between the home and imported varieties. A similar cost minimisation takes place for each *j* but this time the expenditure minimised is:

$$(9) \qquad p_j C_{Sj} = p_{Hj}(1+\tau_C)C_{Hj} + \frac{p_j^*}{E}(1+\tau_{Mj})(1+\tau_C)M_j \,, \quad \forall j \,,$$

where E is the exchange rate in F$/H$, τ_C is the consumption tax rate, τ_M is the import tariff rate and M is the volume of imports. The optimal volumes are then:

$$(10) \qquad C_{Hj} = s_{Hj} C_{Sj} \left[\frac{p_{Hj}\left(1+\tau_C\right)}{p_j} \right]^{-\sigma_S}, \quad M_j = \left(1-s_{Hj}\right) C_{Sj} \left[\frac{\frac{p_j^*}{E}\left(1+\tau_{Mj}\right)\left(1+\tau_C\right)}{p_j} \right]^{-\sigma_S}, \quad \forall j \,,$$

and the composite price of good *j* is:

$$(11) \qquad p_j = \left[s_{Hj} \left(p_{Hj}(1+\tau_C) \right)^{1-\sigma_S} + \left(1-s_{Mj}\right) \left(\frac{p_j^*}{E}(1+\tau_{Mj})(1+\tau_C) \right)^{1-\sigma_S} \right]^{\frac{1}{1-\sigma_S}} .$$

Private saving is the residual after consumption (gross of consumption tax) is deducted from disposable income $Y_D = P_Y Y - T_Y + N$. Direct tax applies to labour income and capital income net of depreciation (at a common depreciation rate, δ).

$$(12) \qquad T_Y = \tau_W W \bar{L} + \tau_K \left[B^* i^* / E + \sum_{j=1}^{2} \left(R_{KGj} - \delta P_K \right) K_j \right] \,, \text{ where } B^* \text{ is domestic holdings}$$

of foreign bonds and P_K is the price of capital goods, behaviour for both of which is introduced later. Nominal private saving is then:

$$(13) \qquad S = Y_D - P_C C = Y_D - \sum_{j=1}^{2} \left[p_{Hj}(1+\tau_C)C_{Hj} - \frac{p_j^*}{E}(1+\tau_{Mj})(1+\tau_C)M_j \right] .$$

Indirect tax revenue stems from both import and export taxes:

$$(14) \qquad T_M = \sum_{j=1}^{2} \tau_{Mj} \frac{p_j^*}{E} M_j \,, \quad T_X = \sum_{j=1}^{2} \tau_{Xj} p_{Hj} X_j \,, \text{as well as from consumption tax, which}$$

is levied at rate τ_C on both home goods and imports,

$$(15) \qquad T_C = \tau_C \sum_{j=1}^{2} \left[p_{Hj} C_{Hj} + \left(1+\tau_{Mj}\right) \frac{p_j^*}{E} M_j \right].$$

Government saving is defined as the surplus of current revenue over current expenditure: $S_G = T_Y + T_C + T_M + T_X - P_G G$.[12] Real government expenditure, *G*, is split between the two goods, once again, by CES disaggregation, yielding:

$$(16) \qquad G_{Sj} = s_{Gj} G \left[\frac{p_{Hj}}{P_G} \right]^{-\sigma_G} , \quad \forall j ,$$

where σ_G is the elasticity of substitution in government demand between the two home goods and the composite price is:

$$(17) \qquad P_G = \left[\sum_{j=1}^{2} s_{Gj} p_{Hj}^{\,1-\sigma_G} \right]^{\frac{1}{1-\sigma_G}} .$$

The final two sources of demand are investment and exports. On the open capital account net inflow is the difference between investment and total domestic saving, $S_D = S + S_G$. The balance of payments, here measured in H$, then requires that:

$$(18) \qquad KA = I - S_D = \frac{S_{NF} - \Delta R}{E} = -CA = -\left(NX + N \right) ,$$

where *I* is investment, *ΔR* is the annual addition to official foreign reserves in F$ and S_{NF} is the private component of the net inflow of financial capital (net foreign saving), also in F$. More specifically, net foreign saving is the annual inflow associated with acquisitions of home bonds by foreigners net of the outflow associated with acquisitions of foreign bonds by home residents. On the current account, *CA*, the net inflow associated with merchandise trade is *NX* and *N* is net factor income (both derived below).

Financial capital is assumed to be less than perfectly mobile internationally, so that interest parity does not hold in general. Financial investors world-wide are assumed to manage a portfolio comprising the national bonds of each country, the base period composition of which accounts for risk factors that are unaltered by the shocks considered here. Other things equal, then, a rise in the after tax home (nominal) bond yield induces a rebalancing of this portfolio that, in turn, causes a corresponding rise in net private in flows on the home capital account. Such a rise might also be caused by an expected exchange rate appreciation. We therefore make these net inflows in F$ depend on a "parity ratio":[13]

[12] The outstanding stock of government bonds and the associated debt service burden, when included, causes little change in short run solutions and so is omitted from the model discussed here for parsimony.

[13] This relationship is made linear to facilitate changes of direction following large shocks. The key parameter read in, however, is the elasticity of net foreign saving to the interest parity ratio, ε_{FS}, from which the coefficient b_{FS} is derived. When this is made arbitrarily large, interest parity is approximated, at least in proportional changes.

$$(19) \qquad S_{NF} = a_{FS} + b_{FS}\left[\frac{\frac{i}{(1+\tau_K)} + \hat{E}^e}{i^*}\right],$$

where $\hat{E}^e$ is the expected annual proportional change (appreciation positive) in the exchange rate. The yield on foreign bonds, i^*, is net of a capital income tax the rate of which is considered to be determined abroad. Interest parity, at least in proportional change terms, can be approximated by making the slope parameter, b_{SF}, or the elasticity from which it stems, ε_{SF}, arbitrarily large.

The investment financed by these domestic and foreign savings is comprised, conventionally, of depreciation replacement, $\delta \bar{K}$, and net investment; the latter motivated by the ratio of the expected future real net return on physical capital to the current real financing cost:[14]

$$(20) \qquad I = I_N + \delta K = K\left[\gamma\left\{\frac{r^e_{KN}}{r}\right\}^{\varepsilon_I} + \delta\right],$$

To obtain the real net return on physical capital we first take an economy-wide average of the gross H$ rental per unit of capital, R_{KG}.

$$(21) \qquad R_{KG} = \sum_{j=1}^{2}\left(\frac{K_j}{\bar{K}}\right)R_{KGj}\ .$$

The corresponding gross *rate of* return on physical capital investment is then the quotient of this with the price of capital goods, P_K (derived subsequently). This raw quotient is the rate of return on investments in physical capital. We then net out the rate of depreciation and, to obtain a *real* net rate of return, we express this rate as a growth rate in purchasing power over consumption goods by also netting out expected inflation:

$$(22) \qquad r^e_{KN} = \frac{1+\frac{R^e_{KG}}{P^e_K}}{(1+\delta)\left(1+\hat{P}^e_C\right)} - 1 \approx \frac{R^e_{KG}}{P^e_K} - \delta - \hat{P}^e_C\ .$$

[14] For long run simulations, the rate of return on installed capital is made endogenous (the expected future value is forced into equality with the endogenous value). In the short run it is exogenous and shocked by the proportion emerging from the long run simulation. Also, in long run solutions, net investment increments the total stock of physical capital in annual increments over the period T_{LR}.

To construct this real net rate of return in the model, expectations are formed via the long run solution over the gross rental rate, R_{KG}, the price of capital goods, P_K and the consumer price level, P_C.[15]

Aggregate investment makes demands on a capital goods industry that uses the two home goods as inputs, via the CES production function:

(23) $I = \left(\sum_{j=1}^{2} \psi_j I_{Sj}^{-\zeta} \right)^{-\frac{1}{1-\zeta}}$. Minimising investment expenditure, $P_K I = \sum_{j=1}^{2} p_{Hj} I_{Sj}$, yields:

(24) $I_{Sj} = s_j^I I \left[\frac{p_{Hj}}{P_K} \right]^{-\sigma_I}$ and the capital goods price: $P_K = \left[\sum_{j=1}^{2} s_j^I P_{H_1}^{1-\sigma_I} \right]^{\frac{1}{1-\sigma_I}}$.

Related to investment is the accumulation of inventories. These are incorporated to capture product price sluggishness and are active only in the short run. They respond simply to changes in producer prices.

(25) $I_{Vj} = I_{Vj}^0 \left(\frac{p_{Hj}}{p_{Hj}^0} \right)^{-\varepsilon_V}$.

Returning to the external sector, the real exchange rate is defined as the value of a home production bundle in terms of corresponding foreign production bundles. It can therefore be measured as the ratio of the home currency price of home output to the (before import tax) home currency price of foreign output:

(26) $e_R = \frac{P_Y}{\left(\frac{P^*}{E} \right)} = E \ \frac{P_Y}{P^*}$ *(E* in *F$/H$)*.

Exports represent the demand for home output by foreigners. In keeping with the "almost small" character of the economy, foreign consumption of each good, *j*, is comparatively large and constant, denoted by Q_j. Foreigners aggregate home exports with their products according to:

(27) $Q_j = \left[\lambda_j X_j^{\rho^*_j} + \lambda^*_j C^*_j{}^{\rho^*_j} \right]^{\frac{1}{\rho^*_j}}$ *where* $\rho^*_j = \frac{\sigma^*_j - 1}{\sigma^*_j}$.

Foreign expenditure on good j is given by: $P_j^F Q_j = (1+\tau_{X_j}) E\, p_{Hj} X_j + p_j^* C_j^*$.

[15] In a steady state such as the one applying at the outset, in which there is no population or productivity growth and therefore no net investment, the quotient in (20) is unity: the net real rate of return on installed physical capital is the same as the real yield on bonds, *r*. Following our trade reform shock, however, the departures from the initial equilibrium are also departures from the steady state, so in general $r_{KN} \neq r$.

where C_j^* denotes foreign supply from all other sources. Optimisation for each good yields:

$$(28) \qquad X_j = \lambda_j^{\sigma_j^*} Q_j \left(\frac{(1+\tau_{Xj}) p_{Hj}}{P_j^F} \right)^{-\sigma_j^*} ,$$

and the composite foreign price of foreign consumption for good j is:

$$(29) \qquad P_j^F = \left[\lambda_j^{\sigma_j^*} E(1+\tau_{Xj}) p_{Hj} + \lambda_j^{*\,\sigma_j^*} p_j^{*(1-\sigma_j^*)} \right]^{\frac{1}{1-\sigma_j^*}} .$$

With exports thus defined, H$ net inflows on the current account of the balance of payments is associated with merchandise trade are:

$$(30) \qquad NX = \sum_{j=1}^{2} \left[\left(1+\tau_{Xj}\right) p_{Hj} X_j - \frac{p_j^*}{E} M_j \right] .$$

The remaining component of the current account, net factor income, depends on base period holdings of domestic debt by foreigners, B_H^* in H$, and of foreign debt by domestic residents, B^*, in F$. These sums are fixed in the short run[16], when current net factor income, measured in H$, takes the form

$$(31) \qquad N = \frac{i^* B^*}{E} - \frac{i B_H^*}{\left(1+\tau_K\right) E} .$$

Finally, the home money market is given a textbook characterisation, with transactions demand for home money driven by GDP while the opportunity cost of holding home money is the nominal yield on home bonds. Real money balances are measured in terms of purchasing power as indexed by the consumer price level:

$$(32) \qquad m_D = a_M Y^{\varepsilon_{MY}} i^{\varepsilon_{Mi}} = m_S = \frac{M_S}{P_C} .$$

Expectations formation

Expectations are formed by consumers over their future nominal disposable income, Y_D^e, and the future consumer price level, P_C^e. Consumers decide on the levels of current consumption, C, and future consumption, C_F, which is considered constant in all future periods. Since values for Y_D^e and P_C^e emerge directly from the long run solution, these form expected future values in the short run. Expectations are also formed by

[16] In the long run B^* and B_H^* are each adjusted to include half of the accumulated private flows (S_{NF}) over the interval T_{LR}. Note that foreign-held debt of home residents is assumed to be denominated in F$. This avoids the non-neutrality of domestic money in the long run.

investors over the average domestic real return on installed capital, r^e_{KN}. This also emerges directly from the long run solution.

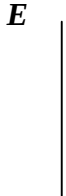
The formation of expectations by domestic and foreign financial investors is less straight-forward. Their net acquisition of domestic bonds, S_{NF}, contributes to the financing of domestic investment and appears as the private component of net inflows on the capital account of the balance of payments. With imperfect international mobility of financial capital these are determined by the "interest parity ratio", $\left[i/(1+\tau_K) + \hat{E}^e \right]/i^*$ where the nominal bond yield is: $i = (1+r)(1+\pi^e) - 1$ and $\pi^e = \hat{P}^e_C$. In forming $\hat{E}^e$ and $\hat{P}^e_C$, a key issue is the information available to financial agents. One assumption is that these agents only know the long run equilibrium. They therefore form their expectations *ex ante*, before any short run behaviour is revealed. An alternative is to assume these expectations are formed *ex post*, once the economy's short run behaviour has been revealed, or that they also account fully for short run behaviour.

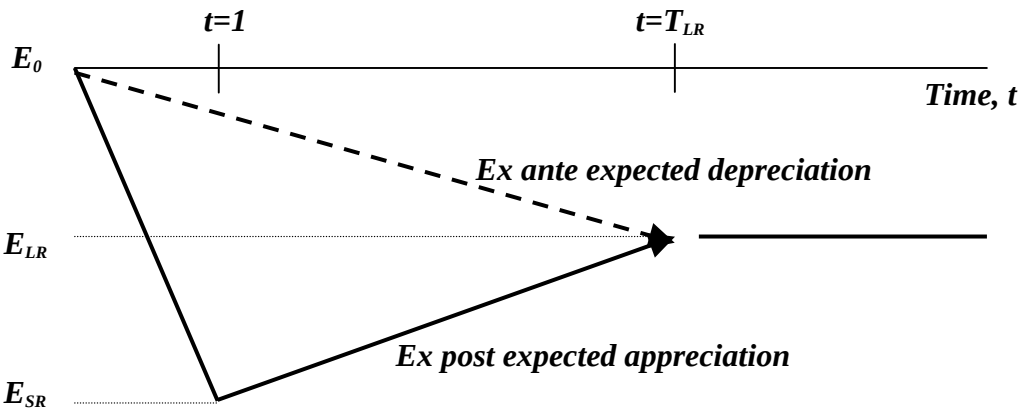
Imagine that a trade reform shock leads to a nominal depreciation and that there is overshooting in the short run. This case is illustrated in Figure 2. *Ex ante*, financial investors expect a future depreciation while *ex post* they expect a future appreciation. Clearly, the net effects of the reform on the economy are sensitive to the extent of financial investors' information about short run behaviour. Because these agents are generally the best informed of decision-makers we assume they also have perfect foresight about short run behaviour and so might be thought of as forming their expectations *ex post*. The expected annual rates of inflation and appreciation are then:

$$(33) \qquad \hat{P}^e_C = \left(\frac{P^e_C}{P_C} \right)^{\frac{1}{T_{LR}}} - 1, \text{ and } \hat{E}^e = \left(\frac{E^e}{E} \right)^{\frac{1}{T_{LR}}} - 1,$$

where T_{LR} is the number of years beyond which the long run equilibrium prevails and both P_C and E are the endogenous short run values of the consumer price level and the exchange rate respectively.

Figure 2: Exchange rate expectations when there is overshooting





Parameterisation

The numerical structure of the model is detailed in Tables 1 though 4. To illustrate short run behaviour following trade liberalisation the economy is made quite open, with imports providing more than half of home consumption in the mainly import-competing sector (2) and exports making up about a fifth of all production in sector 1 (Table 1). The economy has an initial current account deficit which is less than a tenth of nominal GDP (Table 3). Sector 2 is most highly protected (Table 4) and, in fixed exchange rate experiments, it is capital intensive.[17]

Table 1: Initial Equilibrium Volumes[a]

	Good 1	Good 2
Product volume accounts, home goods:		
Aggregate output, *Y*	750	450

[17] For the floating exchange rate experiments in the next section, sector 2 is made labour intensive. Relative factor intensities are allowed to vary in the sensitivity experiments of Section 5.

Consumption at home, C_H	284	125
Use for investment at home, I_S	60	140
Government consumption (home only), G_S	253	108
Exports, X_S	153	77
Starting inventories, I_V	75	45
Volumes including foreign varieties:		
Aggregate home consumption, C_S	346	407
Imports, M	63	287
Aggregate output:	**Economy wide**	
Real GDP at producers' prices (factor cost), Y	1200	
Real GDP (including indirect tax revenue)	1358	
Stocks:		
Physical capital, K	6375	
Home holdings of foreign bonds, B^*	313	
Foreign holdings of home bonds, B^*_H	319	

a Units are immaterial. The numbers are structured to be generally representative of comparatively open trading economies.

Table 2: Initial Prices[a]

	Good 1	**Good 2**
Individual product prices:		
Home (producer), p_H, *H$/unit*	1.0	1.0
Foreign (trading), p^*, *F$/unit*	1.0	1.0
Aggregate consumption[b], p_S, *H$/unit*	1.11	1.31
Imports (after tariffs & exchange), p_M, *H$/unit*	1.05	1.25
	Economy wide	
Aggregate prices:		
GDP price, P_Y, *H$/unit*	1.0	
Capital goods (investment) price, P_I, *H$/unit*	1.0	
Government service price, P_G, *H$/unit*	1.0	
Consumer price, P_C, *H$/unit*	1.22	
Nominal exchange rate, E, *F$/H$*	1.0	
Yields and rates		
Home bond yield, i	0.047	
Foreign bond yield, i^*	0.040	
Gross rental per unit of home physical capital, R_K	0.080	
Net real rate of return on home physical capital, r_{KN}	0.047	
Real home bond yield net of capital income tax, r_N	0.039	
Depreciation rate, δ	0.050	
Rate of time preference, ρ[c]	0.062[c]	

a Units are immaterial. The numbers are structured to be generally representative of comparatively open trading economies.

b Consumer prices are inclusive of consumption tax.

c As indicated in the appendix, the rate of time preference and the time horizon for consumption decisions are interdependent. This rate of time preference coincides with a consumption horizon of 10 years.

Table 3: Accounting Identities: Initial Values:

	H$ value
Capital market identity:[a]	
Investment, $P_I I$	200

Private saving, S	80
Tax revenue, T	361
Government spending, $P_G G$	361
Net foreign saving (private net capital account inflows), S_{NF}	130
Annual increment to official foreign reserves, ΔR	10
Balance of payments:	
Current account net inflows, CA	-120
Capital account net inflows, KA	120
Tax revenue:	
Total, T	361
Income taxes (labour and capital), T_Y	203
Consumption tax, T_C	83
Import tariff, T_M	75
Export tax, T_X	0

a The investment financing identity ($P_I I = S + T - P_G G + S_{NF} - \Delta R$) is not explicit in the model but is implied by the national income disposal and balance of payments identities.

Table 4: Key Parameters

	Good 1	Good 2
Sectoral shares: [a]		
Labour expenditure, η_{11}, η_{12}	0.8	0.2
Inputs to government services	0.7	0.3
Inputs to capital goods production	0.3	0.7
	Economy wide	
Elasticities:		
Money demand to GDP, ε_{MY}	0.5	
Money demand to the nominal interest rate, ε_{Mi}	0.1	
Net foreign saving to the interest parity ratio, ε_{SF}	5.0	
Real net investment to real capital return/ real interest rate ratio, ε_I	1.0	
Inventories to producer prices,[b] ε_V	0	
Utility to aggregate consumption volume, β	0.4	
Elasticities of substitution:		
In consumption, between good 1 and good 2, σ	1.5	
In consumption, between home and imported varieties, σ_S	2.5	
In capital goods production, between good 1 and good 1, σ_I	0.5	
In government consumption, between good 1 and good 2, σ_G	0.5	
In foreign consumption, between home and foreign goods, σ^*	2.5	
Tax rates:		
Labour income, τ_L	0.2	
Capital income, τ_L	0.2	
Consumption, τ_C	0.1	
Imports, τ_M, good 1	0.05	
Imports, τ_M, good 2	0.25	
Exports, τ_x, good 1	0	
Imports, τ_x, good 2	0	

a These shares are as indicated here for the fixed exchange rate case, reflecting the prevalent developing country protection of the capital intensive sector, but are reversed in the floating rate case to represent the tendency of industrial countries to protect their labour intensive industries. The component shares of government services and capital goods are then also reversed to ensure that the former are always labour intensive and the latter capital intensive.

b This elasticity is zero for most experiments and it is allowed to vary between 0 and 45 in the sensitivity analysis conducted in Section 5.

3. Length of Run and Expectations

The central experiment throughout the paper is a reduction in the tariff on imports of good 2 from 25% to 5% (to match that on the imports of good 1). The first step is to

construct a long run equilibrium following the shock. By comparison with the short run version of the model, the distinct features of the long run version are 1) agents expect that simulated changes in prices and rates are permanent, 2) there are no nominal rigidities, 3) there is no inventory adjustment, and 4) physical capital is intersectorally mobile.[18] The net effect of these conditions is that money is neutral in the long run. In the first instance, the shock is introduced for the case in which real government expenditure does not change and there is no tax mix switch, so the government budget moves toward deficit. The nominal exchange rate floats, the monetary target is the consumer price level and the reformed sector is labour intensive. The results from trade reform in this macroeconomic environment are summarised in Table 5.

In this case the anticipated real depreciation is accompanied by a more substantial nominal depreciation. Imports entering final demand are cheaper, causing the consumer price level to fall relative to the GDP price. Since the consumer price is targeted, the GDP price must inflate. The reform's Stolper-Samuelson effect is to raise the real return on capital and reduce the real wage. Government dissaving cheapens home bonds and in the long run this raises the home bond yield by more than the real capital return, crowding out some private investment and causing a long run decline in both the capital stock and GDP. There are partially offsetting rises in home private saving and private inflow on the capital account. As expected, the economy becomes more open, with substantially larger current account net flows compared with GDP and, notwithstanding the real wage fall, the nominal wage inflates. Finally, there is a long run boost to utility, representing the conventional gain from increased trade.

The second column of Table 5 offers corresponding short run results for the case in which all agents are myopic. The key difference is that the producer price inflation, combined with a rigid nominal wage, raises employment substantially. This supply response is what makes the real and nominal depreciations larger. It also helps lift home private savings by more and hence it constrains the rise in the home bond yield. With the increased employment, the net rate of return on physical capital is larger and the decline in investment smaller. In the third column the expectation shocks from the long run solution are introduced to the short run model. The results show a similar overall change in GDP. Consumption expands by less as households anticipate a smaller increase in real disposable income in the long run and larger increases in interest rates.

[18] It is common to assume that larger elasticities drive production and consumption decisions in the long run (Pitchford 1988, Rees and Tyers 2004). We have not done this here to simplify interpretation.

Table 5: Trade Liberalisation under a Floating Rate Regime when there is no Fiscal Correction[a]

% changes in:	Long run	Short run with agents	
		Myopic	Forward looking
Real exch rate, e_R, foreign/local bundle	-5.1	-6.6	-6.8
Nominal exchange rate, E, foreign/local $	-9.7	-10.3	-10.3
Consumer price, P_C	0.0	0.0	0.0
GDP price, P_Y	5.1	4.0	3.9
Capital goods price, P_K	5.3	4.5	4.4
Nominal money supply, M_S	0.3	1.1	0.8
Nominal home bond yield, i	5.1	4.0	1.1
Real home bond yield, r	5.1	4.0	1.1
Net real return on installed capital, r_{KN}	2.2	3.5	3.4
Total employment, L	0.0	3.3	3.1
Nominal wage, W	2.7	0.0	0.0
Real GDP at producer prices, Y	-0.5	1.39	1.3
Real current consumption, C	3.5	4.5	2.9
Real future consumption, C_F	3.5	5.7	4.3
Real investment, I	-3.6	-0.5	1.1
Real government spending, G	0.0	0.0	0.0
Current disposable income, Y_D, $	3.7	5.2	5.0
Future disposable income, Y_{DF}, $	3.7	5.2	3.7
Private savings, S, $	4.7	10.0	22.4
National savings, S_D, $	-49.9	-34.6	-22.9
Net foreign savings, S_{NF}, F$	25.5	20.1	13.6
Current account balance, CA, $	41.2	35.6	28.0
Capital account balance, KA, $	41.2	35.6	28.0
Total tax revenue, T, $	-10.1	-10.3	-10.9
Consumption tax revenue, T_C, $	3.5	4.5	2.9
Import tariff revenue, T_M, $	-70.9	-70.9	-71.4
Direct tax revenue, T_Y, $	6.3	5.8	5.6
Utility	1.0	1.7	1.2
Expectations from long run:			
Disposable income, Y_{DF}, $			3.7
Net real return on installed capital, r_K			2.2
Consumer price level, P_C			0.0
Nominal exchange rate, E			-9.7
After tax real interest rate r_N^F			5.1

a Sector 1 is capital intensive in these simulations, so the sector hurt by trade liberalisation is labour intensive. The case represented has no change in real government spending and no tax mix switch.
Source: Model simulations described in the text.

Private saving therefore rises by more, offsetting the effects of government dissaving to a greater extent. It is noteworthy, however, that the exchange rate does overshoot slightly and that an appreciation is expected *ex post*. The dominant influence on net capital account inflows, however, is the smaller rise in the nominal bond yield.

Results from the same experiment, this time with the central bank targeting the nominal exchange rate and with the liberalised sector capital intensive, are given in Table 6. Here the real depreciation requires considerable producer price deflation. In the long run (full employment) solution (column 1) this leads to a nominal wage decline. Nonetheless, the deflation ensures a net increase in the real consumption wage and even a small rise in the real production wage. This time the Stolper-Samuelson effect of the trade reform is to raise the real wage and reduce the real return on capital. The latter causes a contraction in investment which is exacerbated by the effect of the government's dissaving on the real interest rate. Net investment turns negative and the long run capital stock is smaller, thus reducing long run GDP.

With the fixed exchange rate, however, the short run results are very different from those in Table 5. This is because of the producer price deflation and the more substantial fall in real investment. The rigid nominal wage, combined with the producer price deflation, raises the real production wage, reducing employment and output. This also exacerbates the tightening of the domestic capital market and the real investment decline, particularly where agents are forward-looking. Yet, in the latter case, the contraction in real GDP is more modest. This is because, by comparison with the myopic case, there is a smaller contraction in aggregate demand that has two sources. First, the expected (long run) decline in nominal disposable income is smaller than the expected decline in the consumer price level. Relative to the myopic case, this increases current consumption and reduces private saving, pushing up the real interest rate by more than in the myopic case and inducing greater net financial inflows on the capital account.[19] Second, despite the larger rise in the real interest rate, the contraction in investment is smaller. This is because the decline in expected (long run) capital returns is smaller than the actual short run decline.[20]

Table 6: Trade Liberalisation under a Fixed Exchange Rate Regime with no Fiscal Correction[a]

% changes in:	Long run	Short run with agents	
		Myopic	Forward looking
Real exch rate, e_R, foreign/local bundle	-4.7	-3.1	-2.9

[19] Financial agents see the price level fall in the short run by almost as much as they expect in the long run, though they do expect the small further deflation that creates a wedge between the real and nominal yields.
[20] Were the expectations of financial agents formed *ex ante*, however, the contractionary effect would be substantially larger. This is primarily because the expected deflation would create a more substantial wedge between the real and nominal bond yields. With no change in the exchange rate, the nominal yield is roughly anchored abroad and so the real yield would rise more substantially, enhancing the contraction in investment and home aggregate demand, causing a larger producer price deflation and hence larger reductions in employment and output.

Nominal exchange rate, E, foreign/local $	0.0	0.0	0.0
Consumer price, P_C	-9.6	-8.7	-8.6
GDP price, P_Y	-4.7	-3.1	-2.9
Capital goods price, P_K	-4.8	-4.9	-4.6
Nominal money supply, M_S	-9.6	-9.8	-9.4
Nominal home bond yield, i	4.9	5.4	6.5
Real home bond yield, r	4.9	5.4	8.9
Net real return on installed capital, r_{KN}	-0.2	-4.1	-1.4
Total employment, L	0.0	-5.7	-5.1
Nominal wage, W	-4.6	0.0	0.0
Real GDP at producer prices, Y	-0.92	-3.3	-3.0
Real current consumption, C	3.7	1.6	2.9
Real future consumption, C_F	3.7	2.8	4.1
Real investment, I	-6.9	-9.0	-8.3
Real government spending, G	0.0	0.0	0.0
Current disposable income, Y_D, $	-6.2	-6.4	-5.9
Future disposable income, Y_{DF}, $	-6.2	-6.4	-5.9
Private savings, S, $	-4.7	3.7	-5.5
National savings, S_D, $	-80.6	-87.5	-95.4
Net foreign savings, S_{NF}, F$	24.5	26.9	32.5
Current account balance, CA, $	26.5	29.1	35.3
Capital account balance, KA, $	26.5	29.1	35.3
Total tax revenue, T, $	-18.8	-20.6	-19.9
Consumption tax revenue, T_C, $	-6.3	-7.3	-6.0
Import tariff revenue, T_M, $	-73.5	-73.7	-73.3
Direct tax revenue, T_Y, $	-3.9	-6.5	-6.0
Utility	1.1	0.8	1.2
Expectations from long run:			
Disposable income, Y_{DF}, $			-6.2
Net real return on installed capital, r_K			-0.2
Consumer price level, P_C			-9.6
Nominal exchange rate, E			0.0
After tax real interest rate r_N^F			4.9

a Sector 1 is labour intensive in these simulations, so the sector hurt by trade liberalisation is capital intensive. The case represented has no change in real government spending and no tax mix switch.
Source: Model simulations described in the text.

4. The Interaction of the Exchange Rate and Fiscal Policy Regimes

The experiments of Tables 5 and 6 are here repeated under a variety of fiscal correction assumptions. Consider first the case of the floating exchange rate regime in the country that had previously protected its capital intensive sector. Fiscal policy choices include reduced spending or a switch in the tax mix resulting in a higher rate of

tax on consumption expenditure, labour income or capital income.[21] We also include simulations in which the fiscal policy change is expected but does not occur in the short run. As indicated in Table 7, the real and nominal depreciations are robust throughout. Interestingly, however, most other changes in the economy are not.

A fiscal correction in which the lost revenue is made up via a rise in the consumption tax rate is the policy transition preferred in the public economics literature (Dixit 1985 and Keen and Ligthart 2002). Here, however, we have a key nominal rigidity in the short run and this makes a considerable difference. No gain in utility occurs at any length of run and there is a short run increase in GDP only if the expected tax increase is deferred. No actual or expected consumer price inflation is allowed by the central bank but the increased consumption tax enlarges the wedge between producer and consumer prices, so that the GDP price must fall relative to the targeted consumer price. There is, therefore, a producer price deflation. This causes the nominal wage and the H$ value of expected future disposable income to fall in the long run. If the tax increase is deferred in the short run, the producer price actually inflates, inducing a rise in GDP. This increase is reinforced by expectations of a (long run) fall in real disposable income which induce a substantial increase in precautionary private saving, softening the capital market and greatly increasing investment. In this case the short run nominal exchange rate depreciation overshoots the long run expectation considerably, so that, notwithstanding the interest rate fall, financial investors expect an *ex post* nominal appreciation and so actually increase net inflows on the capital account.[22]

[21] The model includes export tax instruments but they are not used here. It would be unlikely that revenue lost from a tariff reform would be made up through an alternative tax on trade.

[22] Were the expectations of financial investors formed *ex ante*, they would expect a nominal depreciation and so net inflows would contract, moderating the boost to aggregate demand and the short run increase in economic activity.

Table 7: Trade Liberalisation under a Floating Rate Regime with Alternative Fiscal Corrections[a]

% changes in:	Consumption tax rise			Labour income tax rise			Capital income tax rise			Fiscal contraction, ΔG		
	Long run	Short run with expected tax rise		Long run	Short run with expected tax rise		Long run	Short run with expected tax rise		Long run	Short run with expected tax rise	
		No rise	Tax rise		No rise	Tax rise		No rise	Tax rise		No ΔG	ΔG
Real exch rate, e_R	-6.6	-6.0	-4.2	-6.5	-7.4	-7.5	-7.5	-7.6	-8.4	-9.3	-6.9	-8.5
Nominal exchange rate, E	-4.4	-10.0	-1.9	-10.3	-10.6	-10.7	-10.8	-10.7	-11.1	-11.5	-10.4	-11.1
Consumer price, P_C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDP price, P_Y	-2.3	4.4	-2.3	4.3	3.6	3.6	3.6	3.5	3.0	2.5	3.9	2.9
Capital goods price, P_K	-2.1	4.9	-2.4	4.4	4.0	4.0	3.8	3.9	3.4	2.8	4.3	3.4
Home bond yield, i	-0.4	-11.8	7.2	0.0	-1.0	-1.6	7.2	-1.1	4.9	-0.6	6.2	2.4
Real bond yield, r	-0.4	-11.8	7.2	0.0	-1.0	-1.6	7.2	-1.1	4.9	-0.6	6.2	2.4
Real net capital return, r_{KN}	1.6	3.8	-2.3	1.7	3.1	3.1	2.7	3.0	2.6	3.8	3.4	2.4
Total employment, L	0.0	4.0	-6.5	0.0	2.4	2.3	0.0	2.2	1.2	0.0	3.0	-2.6
Nominal wage, W	-4.0	0.0	0.0	2.4	0.0	0.0	0.7	0.0	0.0	-1.5	0.0	0.0
Real GDP at producer prices, Y	0.37	1.68	-2.79	0.30	1.01	0.97	-0.72	0.93	0.53	0.83	1.24	-1.02
Real consumption, C	-1.8	-0.8	-2.5	-1.4	-0.8	-1.6	-3.3	-2.2	-3.1	3.2	4.0	3.6
Real future consumption, C_F	-1.8	-0.9	-2.6	-1.4	-0.8	-1.6	-3.3	-2.7	-3.7	3.2	3.8	3.4
Real investment, I	2.7	15.2	-5.2	2.2	2.7	3.4	-5.4	3.8	-2.1	5.8	-2.2	1.4
Real govt spending, G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.3	0.0	-13.9
Disposable income, Y_D, $	-1.9	6.3	-5.2	-1.5	4.5	-1.0	-3.5	4.3	-2.4	3.4	4.8	1.7
Private savings, S, $	-2.8	62.2	-26.8	-2.3	46.4	3.9	-5.0	55.9	3.7	5.2	11.0	-13.3
National savings, S_D, $	-3.1	17.9	-29.5	-2.5	-0.9	4.3	-5.5	7.9	4.0	5.7	-34.4	-14.6
Net for savings, S_{NF}, F$	-2.0	6.1	8.5	0.0	-0.9	-3.8	-10.3	-5.9	-12.8	-3.0	16.9	6.3
Current acc balance, CA	2.4	18.4	11.4	11.5	10.7	7.3	-0.4	4.8	-3.1	9.4	32.0	20.1
Total tax revenue, T, $	-2.7	-11.4	-1.9	4.0	-12.4	2.1	2.9	-12.9	1.7	-12.0	-10.7	-12.9
Consumption tax revenue, T_C, $	59.3	-0.8	71.9	-1.4	-0.8	-1.6	-3.3	-2.2	-3.1	3.2	4.0	3.6
Import tariff rev, T_M, $	-74.3	-72.3	-74.5	-72.5	-72.5	-72.8	-73.2	-72.9	-73.3	-71.7	-71.1	-71.5
Direct tax revenue, T_Y, $	-1.8	6.5	-5.4	33.6	4.9	30.9	32.8	4.7	31.1	3.4	5.5	1.8
Utility	-0.5	-0.3	-0.8	-0.4	-0.2	-0.5	-1.0	-0.8	-1.1	0.9	1.1	1.0
Expectations (from long run):												
Disposable income, Y_{DF}, $		-1.9	-1.9		-1.5	-1.5		-3.5	-3.5		3.4	3.4
Consumer price level, P_C		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0
Nominal exchange rate, E		-4.4	-4.4		-10.3	-10.3		-10.8	-10.8		-11.5	-11.5
Net real capital return, r_K		1.6	1.6		1.7	1.7		2.7	2.7		3.8	3.8
Real after-tax interest rate, r_N		-0.4	-0.4		0.0	0.0		-2.1	-2.1		-0.6	-0.6

a Sector 1 is capital intensive in these simulations, so the sector hurt by trade liberalisation is labour intensive.
Source: Model simulations described in the text.

When the tax increase is imposed immediately, the tax rise widens the consumer to producer price wedge so that the targeting of the consumer price level leads to producer price deflation. This time, the rigid nominal wage causes real unit labour costs to rise and employment and output to contract. Other things equal, the producer price deflation is sufficient to explain the contraction. Yet it is aided in this instance by the fact that the reduced protection falls on the labour-intensive sector, further contracting labour demand at the fixed nominal wage. Real disposable income therefore falls and so do both private consumption and saving, tightening the home capital market considerably and contracting investment. The higher home bond yield induces a partially offsetting rise in net private inflows on the capital account.[23]

The next fiscal correction considered is a rise in the rate of labour income tax. In this case there is no change in the tax wedge between producer and consumer prices of home goods. Because the liberalisation reduces the consumer price of imports relative to home goods prices, however, and the central bank targets the consumer price level, there is a producer price inflation that turns out to be roughly the same whether the rate of labour income tax is raised in the short run or not. Real unit labour costs fall so that both employment and GDP expand. Savings rise in the short run and the capital market softens, raising investment. Again, if the tax increase is deferred, there is substantial precautionary private saving, almost offsetting the effects of the government's dissaving. If the tax increase is concurrent, most of this private saving rise is absorbed as new government revenue.

When the fiscal correction is a rise in capital income tax, the long run effects are negative because the tax rise discourages foreign capital inflow, forcing up the home real interest rate and discouraging investment. The capital stock therefore shrinks and the long run net real rate of return on physical capital is higher. In the short run the dominant story is the same as before: the producer price inflation raises employment and GDP. When the tax increase is deferred, the expected future reduction in real disposable income and the expected higher real interest rate combine to raise private saving more substantially than in the previous case. Nonetheless, although both income tax corrections yield gains from the trade reforms in the short run, these gains are smaller in the capital income tax case because it discourages foreign inflows.

[23] This expanded net inflow is itself constrained by a long run nominal depreciation that is undershot in the short run, yielding a further expected depreciation.

When the fiscal correction is a contraction in spending the long run outcome is more positive than the other cases in that real GDP expands most. This is because the government's fiscal conservatism promotes domestic saving and there is a slight reduction in the real interest rate, inducing more investment and growth in the capital stock. In the short run, if the spending contraction is deferred but anticipated, this investment is crowded out and the domestic capital market tightens. The absence of the spending contraction sustains aggregate demand, however, and the GDP price still inflates yielding the expected rise in real GDP. It is when the fiscal contraction is immediate that the story changes. In this case there is a short run contraction in real GDP the key to which is the labour intensity of government spending. The fiscal contraction introduces a reduction in labour demand that more than offsets the fall in unit labour costs associated with the producer price inflation. We do not observe this in the long run equilibrium because it is shielded by growth in the capital stock.

Fixed exchange rate regimes are next examined, for an economy in which the sector subjected to the liberalisation is capital intensive. In this case investment is impaired, other things equal, by Stolper-Samuelson effects that reduce the return to physical capital relative to unit labour costs. The results for alternative fiscal corrections are detailed in Table 8. Once again, the nominal exchange rate peg notwithstanding, substantial real depreciations occur in all cases. This time, however, producer price deflations occur throughout with the largest either when the substitute tax is a capital income tax or when the revenue loss is matched by reduced government spending.[24] Consequently, so also are the GDP reductions in these cases largest. In the short run in both cases there are extraordinary collapses in aggregate demand, due in the capital tax case to the increase in the home bond yield necessary to offset the tax and the consequent loss of domestic investment. Most particularly in the latter two cases, the magnitudes of the contractions in domestic economic activity are largest when the spending cut or replacement taxes are implemented immediately. The labour income tax is the least contractionary under these conditions though the consumption tax does better in the short run if its imposition is expected but deferred. Then, the initial consumer price deflation overshoots expectation and so an *ex post* inflation is expected. This suppresses the real bond yield and preserves investment.[25]

[24] Of course, producer price deflations must follow, from equation (26).

[25] Of course, when the consumption tax is imposed immediately, the consumer price deflation is much smaller than its long run expectation, further deflation is therefore expected and the real bond yield is higher.

Table 8: Trade Liberalisation under a Fixed Exchange Rate Regime with Alternative Fiscal Corrections

% changes in:	Consumption tax rise			Labour income tax rise			Capital income tax rise			Fiscal contraction, ΔG		
		Short run with expected tax rise			Short run with expected tax rise			Short run with expected tax rise			Short run with expected tax rise	
	Long run	No rise	Tax rise	Long run	No rise	Tax rise	Long run	No rise	Tax rise	Long run	No ΔG	ΔG
Real exch rate, e_R	-6.4	-2.1	-3.6	-6.3	-3.3	-3.4	-7.9	-3.5	-4.9	-9.3	-3.2	-5.2
Nominal exchange rate, E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Consumer price, P_C	-4.0	-8.3	-0.9	-10.3	-8.8	-8.8	-11.0	-8.8	-9.4	-11.6	-8.7	-9.6
GDP price, P_Y	-6.4	-2.1	-3.6	-6.3	-3.3	-3.4	-7.9	-3.5	-4.9	-9.3	-3.2	-5.2
Capital goods price, P_K	-6.7	-3.0	-5.6	-6.5	-5.1	-5.1	-7.6	-5.2	-7.6	-9.4	-5.2	-7.6
Home bond yield, i	-1.0	4.5	2.0	-0.5	3.4	2.6	12.9	1.6	21.4	-1.6	6.6	3.6
Real bond yield, r	-1.0	-5.8	8.9	-0.5	7.1	6.3	12.9	7.1	25.5	-1.6	13.8	8.8
Real net capital return, r_{KN}	-0.7	-13.3	1.9	-0.7	-0.8	-1.0	0.9	0.6	-2.7	-0.6	3.1	-2.7
Total employment, L	0.0	-4.8	-7.3	0.0	-6.5	-6.8	0.0	-7.2	-9.5	0.0	-5.5	-11.9
Nominal wage, W	-6.0	0.0	0.0	-5.9	0.0	0.0	-8.5	0.0	0.0	-8.9	0.0	0.0
Real GDP at producer prices, Y	0.05	-2.8	-4.3	-0.03	-3.81	-3.98	-1.98	-4.23	-5.62	0.20	-3.23	-7.10
Real consumption, C	-2.3	-1.5	-3.1	-1.8	-1.5	-2.6	-5.2	-4.1	-5.6	2.8	3.5	2.8
Real future consumption, C_F	-2.3	-1.8	-3.4	-1.8	-1.6	-2.7	-5.2	-5.1	-6.6	2.8	3.1	2.4
Real investment, I	0.4	5.4	-8.9	-0.3	-7.2	-6.5	-14.8	-5.7	-19.6	1.5	-12.7	-8.6
Real govt spending, G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-15.0	0.0	-20.3
Disposable income, Y_D, \$	-6.3	-4.7	-7.8	-12.0	-7.0	-14.2	-15.9	-7.6	-18.1	-9.0	-6.5	-11.9
Private savings, S, \$	-7.7	52.9	-51.0	-13.0	28.1	-49.4	-18.4	49.5	-58.7	-7.0	-18.0	-67.8
National savings, S_D, \$	-8.8	-35.1	-58.2	-14.9	-65.0	-56.4	-21.0	-45.2	-67.0	-8.1	-109.1	-77.4
Net for savings, S_{NF}, F\$	-5.0	22.5	10.1	-2.5	16.9	13.2	-21.3	8.1	-3.2	-8.1	32.9	18.1
Current acc balance, CA	-5.4	24.4	11.0	-2.7	18.4	14.3	-23.1	8.8	-3.5	-8.7	35.6	19.6
Total tax revenue, T, \$	-6.4	-20.5	-3.2	-6.2	-21.9	-3.0	-7.9	-22.9	-4.3	-22.8	-20.1	-24.1
Consumption tax revenue, T_C, \$	55.9	-9.7	73.1	-11.9	-10.1	-11.1	-15.7	-12.6	-14.5	-9.1	-5.5	-7.0
Import tariff rev, T_M, \$	-75.5	-74.2	-75.0	-75.4	-74.5	-74.8	-76.6	-75.2	-76.0	-75.0	-73.2	-74.0
Direct tax revenue, T_Y, \$	-6.5	-5.1	-8.1	21.3	-7.3	26.9	20.3	-7.9	26.3	-9.3	-6.5	-12.6
Utility	-0.7	-0.5	-1.0	-0.6	-0.5	-0.8	-1.6	-1.5	-2.0	0.8	0.9	0.7
Expectations (from long run):												
Disposable income, Y_{DF}, \$		-6.3	-6.3		-12.0	-12.0		-15.9	-15.9		-9.0	-9.0
Consumer price level, P_C		-4.0	-4.0		-10.3	-10.3		-11.0	-11.0		-11.6	-11.6
Nominal exchange rate, E		0.0	0.0		0.0	0.0		0.0	0.0		0.0	0.0
Net real capital return, r_K		-0.7	-0.7		-0.7	-0.7		0.9	0.9		-0.6	-0.6
Real after-tax interest rate, r_N		-1.0	-1.0		-0.5	-0.5		-4.3	-4.3		-1.6	-1.6

a Sector 1 is labour intensive in these simulations, so the sector hurt by trade liberalisation is capital intensive.

Source: Model simulations described in the text.

A summary of the effects of each alternative fiscal policy on aggregate economic activity (real GDP, *Y*) is offered in Table 9. By this criterion, a fixed exchange rate regime is robustly undesirable when trade reform is implemented. The short run effects of the real depreciations that result are dominated by producer price deflation and rising unit labour costs. Were an exchange rate peg required for other reasons, these results suggest that the least undesirable fiscal correction is a rise in the labour income tax. Floating exchange rate regimes perform better because the real depreciations are absorbed in nominal exchange rate changes. If the target of monetary policy is the consumer price level, however, floating rate regimes are not without blemish. The combination of the consumer price target and a rise in the consumption tax rate causes producer price deflation and a contraction in output. A fiscal contraction also reduces output where government spending is a substantial component of economic activity and where it is biased in favour of labour intensive services. In floating rate regimes also, the labour income tax appears to be the best fiscal correction alternative.

Table 9: Effects of Trade Liberalisation on Overall Economic Activity with and without a Fiscal Correction[a]

Per cent change	**Floating exchange rate[b]**		**Fixed exchange rate[c]**	
Fiscal correction	**Long run**	**Short run with forward looking agents**	**Long run**	**Short run with forward looking agents**
No fiscal correction	-.5	1.3	-0.9	-3.0
Consumption tax	0.4	-2.8	0.06	-4.3
Labour income tax	0.3	1.0	-0.03	-4.0
Capital income tax	-0.7	0.5	-2.0	-5.6
Spending contraction[d]	0.8	-1.0	0.2	-7.1

a The measure of economic activity used here is GDP at producers' prices or factor cost, deflated by the GDP price or producer price index.
b The floating exchange rate regime applies where the liberalised sector is labour intensive.
c The fixed exchange rate regime applies where the liberalised sector is capital intensive.
d Government services are labour intensive.
Source: Numerical results from the model described in the text.

Gains from trade are traditionally measured in terms of aggregate utility. In the neoclassical theory, the revenue from tariffs is returned to the collective private household in lump sum, thereby contributing to private consumption and utility. Here we model a separate government with its own pattern of expenditure. Yet the services it provides do not enter the utility function. For this reason, in this model, government activity merely crowds out utility-bearing private consumption. Trade reform with no rise in government consumption, as in Tables 5 and 6, therefore yields utility gains. Correspondingly, trade reform with a fiscal contraction also crowds out less private consumption and bears increased utility. When taxes are increased, however, private utility is being sacrificed and the outcome is always negative. Nonetheless, from Table 10 it is possible to compare the three taxing fiscal correction cases. These suggest that, with either a floating or fixed exchange rate regime, raising the labour income tax is the superior fiscal correction, followed by a consumption tax rise.

Table 10: Effects of Trade Liberalisation on Utility with and without a Fiscal Correction[a]

Per cent change	Floating exchange rate[b]		Fixed exchange rate[c]	
Fiscal correction	**Long run**	**Short run with forward looking agents**	**Long run**	**Short run with forward looking agents**
No fiscal correction	1.0	1.2	1.1	1.20
Consumption tax	-0.5	-0.8	-0.7	-1.0
Labour income tax	-0.4	-0.5	-0.6	-0.8
Capital income tax	-1.0	-1.1	-1.6	-2.0
Spending contraction[d]	0.9	1.0	0.8	0.7

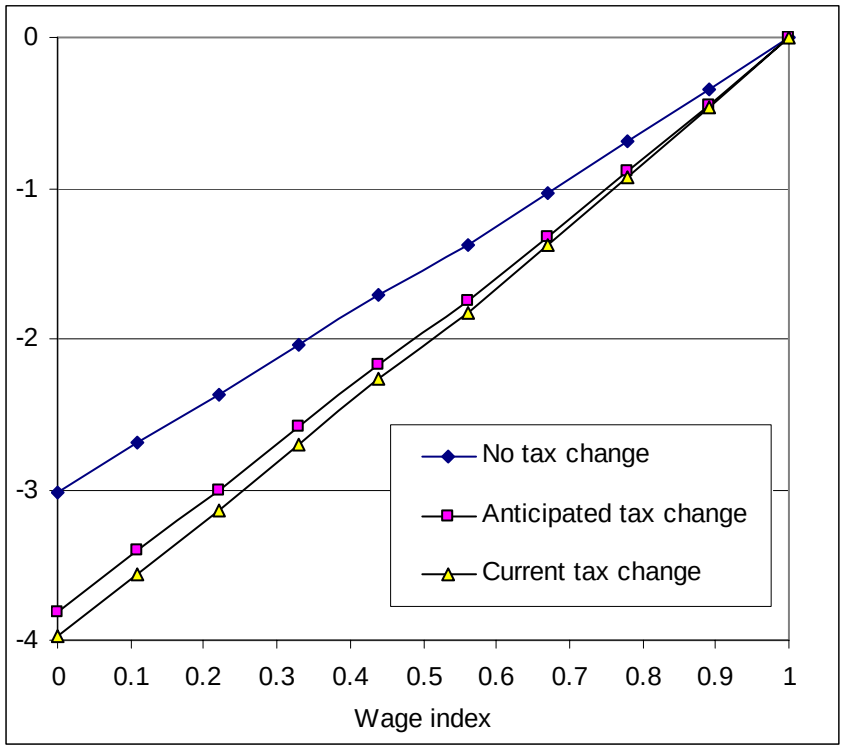
a Utility ignores any contribution from government services.
b The floating exchange rate regime applies where the liberalised sector is labour intensive.
c The fixed exchange rate regime applies where the liberalised sector is capital intensive.
d Government services are labour intensive.
Source: Numerical results from the model described in the text.

5. Other Sensitivities

Wage rigidity

Nominal wage stickiness is the central determinant of the real effects observed. When nominal wages are flexible in the short run, no combination of reasonable parameter settings or of trade reform with fiscal policy yields a significant contraction of real GDP. We illustrate the effects of varying wage flexibility by shocking the nominal wage in a range of magnitudes between "full" employment at one extreme and the full wage rigidity. When the nominal exchange rate is pegged and the lost tariff revenue, where it is recouped, comes from a labour income tax increase, a flexible labour market would deliver nominal wage declines of between four and six per cent. By dividing these wage changes into intervals and repeating the solutions, each time shocking the exogenous nominal wage, we obtain the results shown in Figure 3. Because the nominal wage changes introduced are in linear succession, the real GDP changes are also approximately linear. The point is that no intermediate level of wage indexation would reverse the GDP contractions obtained and the more rigid are wages the greater those contractions become.

Figure 3: Wage rigidity and real GDP in the short run

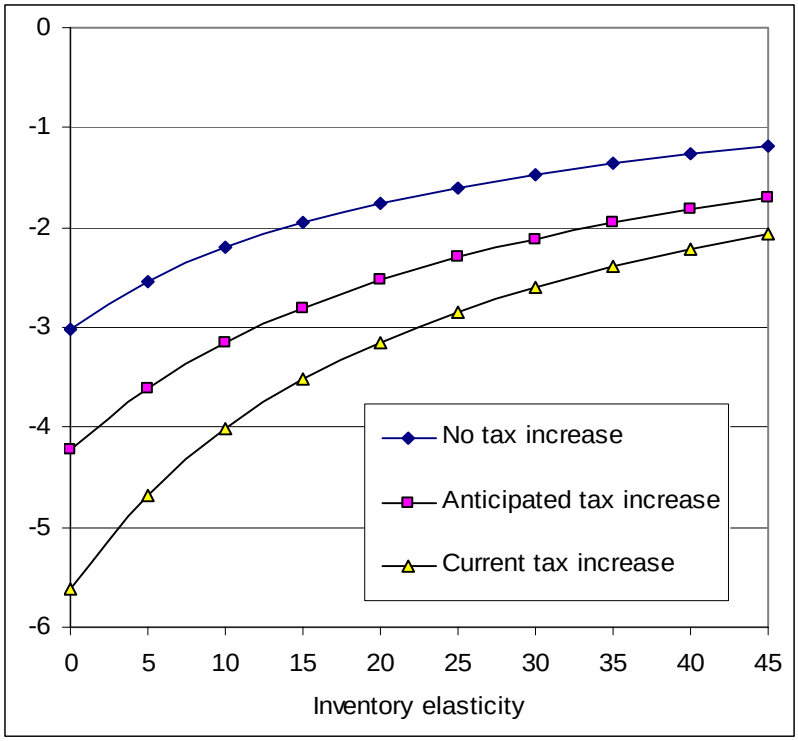


Sector 2 is capital intensive and the nominal exchange rate is fixed.
Fiscal balance is here restored via a labour income tax increase.

Product price rigidity

Product price rigidity is introduced through endogenous inventories. The elasticity of inventories to price changes was set to zero for all but one set of experiments. In the case where the nominal exchange rate is pegged, the liberalised sector is capital intensive and the lost revenues are recouped from capital income tax, solutions were constructed for a range of inventory elasticities, ε_V (equation 25). The results are illustrated in Figure 4. As is clear from the figure, endogenous inventories damp the effects on product prices and this reduces the sizes of the producer price deflations. Inventories alone, however, do not reverse the contraction no matter how elastic they are to product price changes.[26]

Figure 4: Product price rigidity and Real GDP in the Short Run



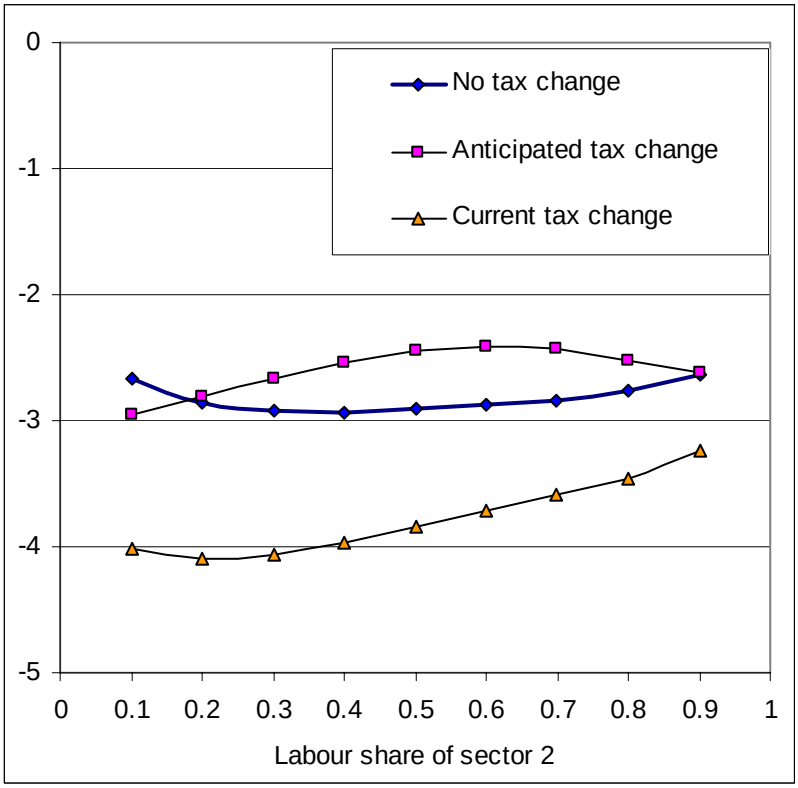
Sector 2 is capital intensive and the nominal exchange rate is fixed. Fiscal balance is here restored via a capital income tax increase.

[26] Moreover, the model does not include the physical costs of withdrawing significant proportions of output from the market. With such costs included it is likely that the larger inventory elasticities would reduce the contractions by less than shown in Figure 4.

Sectoral technologies

A key determinant of the results is the capital intensity of the sector subject to trade liberalisation. If that sector is comparatively capital intensive, the reform reduces the expected return on installed capital and investment falls, or rises by less. A bias is therefore suggested in favour of the liberalisation when Sector 2 is labour intensive. In fact, however, there is an opposite bias associated with the rigidity of the nominal wage. When the capital intensive sector is subject to trade reform there is a boost to the demand for labour relative to capital. This tends to offset the effects of any producer price deflation on real unit labour costs. Given these opposing biases the net effects prove non-linear and idiosyncratic. They are illustrated in Figure 5.

Figure 5: Sectoral Technology and Real GDP_{FC} in the Short Run

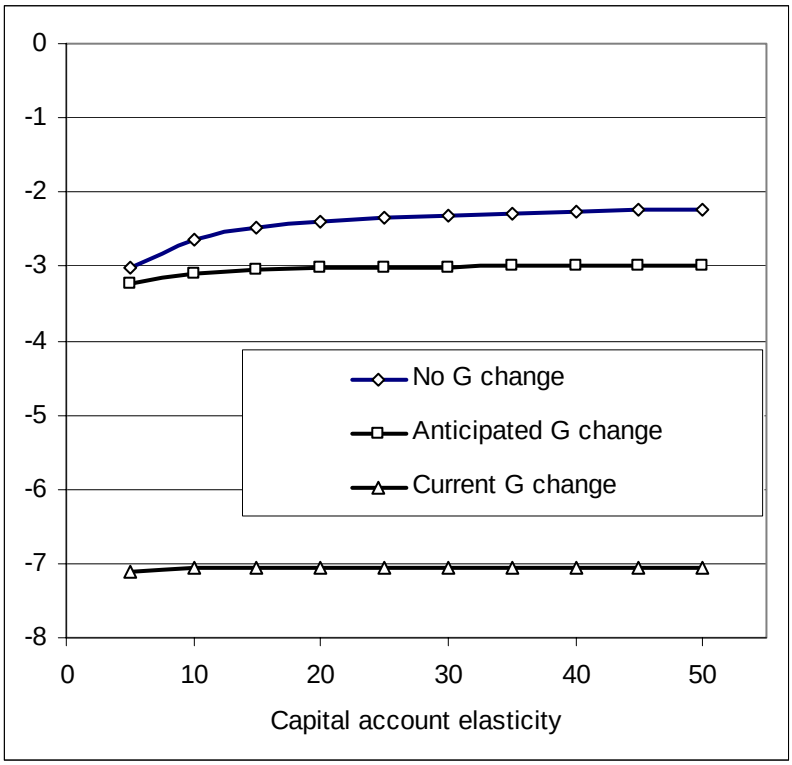


Sector 1 has complementary capital intensity and the nominal exchange rate is fixed.
Fiscal balance is here restored via a consumption tax increase.

International mobility of financial capital

When shocks cause changes in the "interest parity ratio", private flows on the capital account change according to the value of the elasticity of foreign savings, ε_{SF}. This elasticity can be made arbitrarily large, so that perfect capital mobility is closely approximated, as is interest parity (at least in terms of proportional changes). The value of this elasticity does make a substantial difference to the results when agents are myopic. When agents are forward-looking, however, its impacts on the results seem slight. The case of a fixed exchange rate regime with a spending reduction as the fiscal correction is illustrated in Figure 6. More mobile financial capital moderates the short run real interest rate rises when no spending change occurs or when one is anticipated but deferred. When it is implemented immediately the changes in the real interest rate rise are balanced, approximately, by expected inflation and so there is little change in net inflows on the capital account. Financial capital mobility therefore has little impact on the results.

Figure 6: Financial capital mobility and Real GDP in the Short Run



Sector 2 is capital intensive and the nominal exchange rate is fixed.
Fiscal balance is here restored via a contraction in government spending.

6. Conclusion

A comparative static two-sector, two-factor "almost small" open economy model is here extended to include forward-looking agents via different lengths of run. The model is applied to the implications for this economy of a variety of combinations of trade liberalisation and associated fiscal policy changes. Conditions for expansion in the short run are thereby explored numerically.

Even in this otherwise structurally neoclassical economy, a combination of GDP price deflation and nominal wage stickiness is shown to cause trade liberalisation to be contractionary. The outcome depends on the choice of exchange rate and tax regimes. Because trade liberalisation, taken alone, reduces the home prices of foreign goods, there is a substitution away from home produced goods and a real depreciation. With the fixed nominal exchange rate regime adopted by many developing countries this necessitates a contractionary GDP price deflation. In a floating exchange rate regime with monetary policy targeting the consumer price level, the regime preferred by the larger industrialised economies, short run gains are more likely but the results are not without blemish. In one case, if lost tariff revenue is made up via a consumption tax increase, this causes a wedge between consumer and producer prices and a contractionary GDP price deflation must occur. In another, if the fiscal correction is a cut in spending and government services are labour intensive, the reduction in labour demand associated with the spending cut can be sufficient to contract the whole economy. In each case the key is the nominal wage stickiness.

Thus, the results prove quite sensitive to the choice of fiscal correction and it is notable that it is the particular tax mix switch preferred in the public economics literature (the switch from tariff to consumption tax revenue) that yields a contraction in economic activity in both the pegged and floating rate cases. These results support the relaxation of target zone boundaries when inflation-targeting central banks are confronted with increases in rates of consumption tax. If the exchange rate is fixed and the consumer price level targeted, trade liberalisation makes producer price deflation unavoidable and it is therefore contractionary in the short run. The fiscal response is again important, however, with the alternatives of a spending contraction or revenue replacement via a capital income tax substantially deepening the short run contraction. In both floating and fixed exchange rate regimes, a fiscal correction in the form of a labour income tax performs best.

Finally, the results are sensitive to the formation of expectations by financial investors. If those investors only have information about the long run equilibrium, expected depreciations or deflations tend to enlarge the simulated contractionary effects. If our standard assumption is adopted, that these agents have full information about both the short and long run behaviour of the economy, changes in net inflows on the capital account tend to moderate the contractionary effects of trade reform in the short run.

References

Chang, J. and R. Tyers (2003), "Trade reform, macroeconomic policy and sectoral labour movement in China", Chapter 14 in Garnaut, R. and L. Song (eds.) *China 2003: New Engine for Growth*, Asia Pacific Press, September: 231-275.

Corden, W.M. (1997), *Trade Policy and Economic Welfare*, Oxford: Clarendon Press.

Davies, R., J. Rattso and R. Torvik (1998), "Short run consequences of trade liberalisation: a computable general equilibrium model of Zimbabwe", *Journal of Policy Modeling* 20(3): 305-333.

Dixit, A.K. (1985), "Tax policy in open economies", in A.J. Auerbach and M. Feldstein (eds), *Handbook of Public Economics*, Vol 1, Amsterdam: North Holland.

Ethier, W.J. (1984), "Higher dimensional issues in trade theory", Chapter 3 in R.W. Jones and P.B. Kenen (eds), *Handbook of International Economics*, Volume I, Amsterdam: North Holland.

Feltenstein, A. (1992), "Tax policy and trade liberalisation", International Monetary Fund Working Paper 92/108, Washington DC, December.

Harris, R. (1984), "Applied general equilibrium analysis of small open economies with scale economies and imperfect competition", *American Economic Review* 74: 1016-1032.

Ianchovichina, E. and W. Martin (2002), "Economic impacts of China's accession to the WTO", World Bank, Washington DC, June.

Jones, R.W. (1971), "A three-factor model in theory, trade and history", in J.N. Bhagwati et al. (eds), *Trade, Balance of Payments and Growth: Essays in Honour of C.P. Kindleberger*, Amsterdam: North Holland.

Keen, M. and J.E. Ligthart (2002), "Coordinating tariff reduction and domestic tax reform", *Journal of International Economics* 56: 489-507.

Krueger, A.O. (1977), "Growth, distortions and patterns of trade among many countries", Princeton Studies in International Finance No.40.

Krugman, P.R. (1995), "Increasing returns, imperfect competition and the positive theory of international trade", Chapter 24 in G.M. Grossman and K. Rogoff (eds), *Handbook of International Economics*, Amsterdam: North Holland.

Mabugu, R. (2001), "Short run effects of tariff reform in Zimbabwe: applied general equilibrium analysis", *Journal of African Economies*, 10(2): 174-190.

McKibbin, W.J. (1999), "Trade liberalisation in a dynamic setting", presented at the Second Annual Conference on Global Economic Analysis, Denmark, June 19-21.

McKibbin, W.J. and P.J. Wilcoxen (2002), "The role of economics in climate change policy", *Journal of Economic Perspectives*, 16(2): 107-129.

Marston, R.C. (1984), "Real wages and the terms of trade: alternative indexation rules for an open economy", *Journal of Money, Credit and Banking*, 16(3): 285-301.

Mayer, W. (1974), "Short run and long run equilibrium for a small open economy", *Journal of Political Economy* 82(5): 955-967.

Meller, P. and A. Solimano (1987), "A simple macro model for a small open economy facing a binding external constraint (Chile)", *Journal of Development Economics* 26(1): 25-35.

Mussa, M. (1974), "Tariffs and the distribution of income: the importance of factor specificity, substitutability and intensity in the short and long run", *Journal of Political Economy* 82: 1191-1204.

Obstfeld, M. (1984), "Capital flows, the current account and the real exchange rate: consequences of liberalisation and stabilisation", NBER Working Paper No. 1526, Cambridge Massachusetts, December.

Pitchford, J.D. (1988), "Short and long run effects of macroeconomic policies in an open economy: a survey", Working Papers in Economics and Econometrics No. 156, Australian National University, March.

Rees, L. and R. Tyers (2004), "Trade reform in the short run: China's WTO accession", *Journal of Asian Economics* 15(1): 1-31, January-February.

Walmsley, T., T. Hertel and E. Ianchovichina, 2001. "Assessing the impact of China's WTO accession on foreign ownership", GTAP Resource #649, presented at the Fourth Annual Conference on Global Economic Analysis, Purdue University, June 27-29.

Appendix: Optimal Current and Future Consumption

Consumers have rate of time preference ρ. They choose consumption in the current year, C, and a consumption level that is constant in all future years, C_F, to maximise over horizon T:

$$\text{(A1)} \quad U = C^{\beta} + \sum_{t=2}^{T} \frac{C_t^{\beta}}{(1+\rho)^t} = C^{\beta} + C_F^{\beta} R_1 \quad \text{where } R_1 = \frac{1-\left(\frac{1}{1+\rho}\right)^{T-1}}{\rho} \ .$$

Their carry-in real wealth in the current year is W_1 and their current nominal saving is $S = Y_D - P_C C$. Dividing through by P_C, their corresponding real saving is $s = y_D - C$. The real bond rate net of tax is $r_N = r/(1+\tau_K)$. So their carry-in real wealth in period 2 is $W_2 = W(1+r_N) + s$. Their real saving in all subsequent years is $s_F = y_D^F - C_F$, so that their carry-in real wealth in period 3 is $W_3 = \left[W(1+r_N)+s\right](1+r_N) + s_F$. Correspondingly, their carry-in real wealth in period T is:

$$\begin{aligned} W_T &= \left[W(1+r_N)+s\right]\left(1+r_N^F\right)^{T-2} + s_F\left[1+\left(1+r_N^F\right)+\left(1+r_N^F\right)^2+\ldots+\left(1+r_N^F\right)^{T-3}\right] \\ &= \left[W(1+r_N)+s\right]\left(1+r_N^F\right)^{T-2} + \frac{s_F}{r_N^F}\left[\left(1+r_N^F\right)^{T-2}-1\right]. \end{aligned} \quad \text{(A2)}$$

The difference between the present value of the terminal wealth and current carry-in wealth is then:

$$\text{(A3)} \quad \Delta W = \frac{W_T}{(1+r_N)\left(1+r_N^F\right)^{T-2}} - W = \frac{s}{(1+r_N)} + \frac{s_F}{(1+r_N)} R_2 \ , \ \text{where } R_2 = \frac{1-\left(\frac{1}{1+r_N^F}\right)^{T-2}}{r_N^F} \ .$$

The household considers ΔW to be an exogenous wealth accumulation target. It therefore chooses C and C_F to maximise (A1) subject to (A3). After substituting for the savings levels in terms of consumption, the first order conditions yield:

$$\text{(A4)} \quad C = C_F \left(\frac{R_2}{R_1}\right)^{\frac{1}{1-\beta}} \ .$$

From (A3) and (A4), future consumption is:

$$\text{(A5)} \quad C_F = \frac{y_D + R_2 y_D^F - \Delta W(1+r_N)}{\left(\frac{R_2}{R_1}\right)^{\frac{1}{1-\beta}} + R_2}$$

In terms of the nominal disposable incomes actually modelled, we have:

$$\text{(A6)} \qquad C = \frac{\dfrac{Y_D}{P_C} + \dfrac{Y_D^F}{P_C^F\, r_N^F} - \Delta W\left(1+r_N\right)}{1+R_2\left(\dfrac{R_2}{R_1}\right)^{\frac{1}{1-\beta}}} \;,\; C_F = \frac{\dfrac{Y_D}{P_C} + \dfrac{Y_D^F}{P_C^F\, r_N^F} - \Delta W\left(1+r_N\right)}{\left(\dfrac{R_2}{R_1}\right)^{\frac{1}{1-\beta}} + R_2} \,.$$

In the initial steady state, $C = C_F$, implying that $R_1(T) = R_2(T)$ from which T can be derived numerically. ΔW is then obtained from initial conditions via (A3) as:

$$\text{(A7)} \qquad \Delta W = \frac{\left(\dfrac{Y_D^0}{P_C^0} - C^0\right)\left(1+R_2^0\right)}{1+r_N^0} \;.$$

With the parameter values adopted in the text the elasticities of current real consumption to its key determinants are:

Elasticity of C to:	
r_N	-0.42
r_N^F	-0.62
P_C	-0.13
P_C^F	-0.89
Y_D	0.15
Y_D^F	0.99