Trade Liberalization, Macroeconomic Adjustment, and Welfare: How Costly Are Nominal Rigidities?

by

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Abstract

It has long been argued that the presence of nominal rigidities could cause adverse macroeconomic adjustment to trade liberalization and thus reduce the benefits of freer trade. We explore the welfare cost of macroeconomic adjustment within the framework of new open economy macroeconomic models. The welfare effect of trade liberalization is decomposed into a steady-state efficiency gain and a transitional loss associated with wage-price stickiness and is estimated for a wide range of parameter values. We find that while the transitional loss can be a substantial proportion of steady-state gains under fixed exchange rates, it is relatively small under a flexible exchange rate regime supported by a simple Taylor-type rule.

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I. Introduction

Economic effects of trade liberalization have been investigated extensively. This literature is generally concerned with the long-run effects and employs models that assume flexible prices and wages. Macroeconomic analysis of open economies, however, has emphasized the role of nominal rigidities in determining the short-run effects of trade policy on macroeconomic variables such as output, employment, and the current account. In this analysis, monetary policy has an important influence on how macroeconomic variables respond to trade liberalization. For example, under fixed exchange rates, tariff cuts lower the relative price of foreign goods and (in the presence of sticky prices) typically cause a temporary contraction of output and employment as well as a deficit in the current account.[2] These effects can be altered by home currency depreciation under flexible exchange rates.[3] Adverse macroeconomic adjustment to trade liberalization arising from nominal rigidities could potentially involve substantial costs. There is little work, however, which has assessed these costs and compared them to long-run benefits of freer trade.

Welfare implications of macroeconomic adjustment to trade policy were difficult to examine within the early macroeconomic models that did not have strong microeconomic foundations. The optimizing framework of the new open economy macroeconomic models, however, makes it possible to evaluate the effect of macroeconomic adjustment on welfare. The present paper uses this framework to examine the dynamic effects of a permanent trade policy shock (a reduction in tariffs), and determine the cost of macroeconomic adjustment

[2] For an early discussion of the macroeconomic effects of a tariff under fixed exchange rates, see Chacholiades (1978) and Dornbusch (1980).

[3] The analysis of the macroeconomic effects of a tariff under flexible exchange rates goes back to Mundell (1961), and has been extended by Boyer (1977) and Krugman (1982).

due to nominal rigidities.[4] Another goal of the paper is to explore how monetary policy influences the macroeconomic adjustment costs.

To explore the adjustment to trade liberalization, we use a simple version of the new open economy macroeconomic models with two traded goods, industry-specific capital, and monopolistic competition in both goods and labor markets. The macroeconomic adjustment in our model is based on nominal rigidities arising from wage-price adjustment costs as in Rotemberg's (1982) model. We choose the Rotemberg setup because it has straightforward aggregation properties for examining household welfare (as all households behave the same in equilibrium) and accounts for direct costs of adjusting nominal wages and prices. We believe that our analysis based on this model provides a reasonable approximation to the aggregate welfare implications of macroeconomic adjustment to trade policy. Our welfare analysis, however, excludes inefficiency costs due to wage-price dispersion.[5]

Our model with two traded goods sectors allows for trade liberalization gains from both interindustry and intraindustry trade. However, our analysis uses the standard assumption of macroeconomic models that each sector has a fixed number of symmetric firms, and thus does not incorporate potential gains from trade resulting from firm

[4] Faruqee et al. (2006) examine the effect of tariffs in a dynamic general equilibrium model of world economy with four regional blocs. They are concerned, however, with macroeconomic implications of trade policy and do not address the issue of how nominal rigidities influence welfare effects of trade policy. Canzoneri et al. (2006) estimate welfare costs of nominal rigidities within a new neoclassical synthesis model, but their focus in on costs arising from business cycle rather than trade policy shocks.

[5] An alternative explanation of wage-price inertia uses Calvo's (1983) model, in which only a fraction of firms change prices in each period. Although both approaches lead to similar wage-price dynamics at the aggregate level, they have different welfare implications. For example, there is an explicit resource cost of changing prices in the Rotemberg but not with the Calvo mechanism. Moreover, while wage-price changes are synchronized in the Rotemberg model, they are staggered in the Calvo model. Thus there is an additional distortion in the Calvo model arising from the dispersion of wages and prices across household and firms.

heterogeneity or entry of new firms.[6] We also use the typical assumption that households supply their services to firms in both sectors. This assumption ignores possibly significant costs of inter-sector labor mobility. Our analysis is further simplified by the assumption that there is no capital accumulation or capital mobility between sectors. Although these assumption abstract from some important features of the adjustment process, they serve to isolate the role of nominal rigidities in the adjustment process and help identify costs of these rigidities.

Sticky wages and prices introduce transitional dynamics in the model. The welfare effect of reducing trade restrictions in the model is decomposed into a steady-state and a transitional effect. The steady-state welfare effect captures efficiency gains associated with long-run resource allocation (within a given set of varieties). The transitional effect picks up the influence of nominal rigidities and includes losses resulting from not only costs of changing nominal wages and prices, but also inefficiency costs arising from slow adjustment in allocation of resources due to nominal rigidities. The loss associated with the transitional effect is viewed as the cost of macroeconomic adjustment to a reduction in trade barriers.

One issue that has not been adequately examined is how large are macroeconomic adjustment costs in relation to long-run benefits of trade liberalization? To explore this question, a quantitative version of the model is used to estimate transitional and steady-state welfare effects of a tariff reduction for a small country that is financially integrated with the rest of the world. We do not calibrate our model to an actual economy or a particular type of

[6] See Melitz (2003) for a discussion of how reallocation across firms with heterogeneous productivity within industries is a source of gains from trade. Broda and Weinstein (2006) provide evidence that there are significant gains from importing a larger number of varieties. Trade models with heterogeneous firms or endogenous varieties, however, do not incorporate nominal rigidities and are not integrated with open economy macro models.

economy, but instead explore results for a variety of settings that would include conditions suitable for developing as well as advanced economies. Our analysis focuses on the effects of trade liberalization in the form of unilateral tariff reduction, but we also briefly examine the effects of bilateral tariff cuts in our sensitivity analysis.

The paper also explores how adjustment to trade liberalization and the cost of this adjustment is affected by monetary policy. We highlight the comparison between fixed and flexible exchange rates. Flexible exchange rates require a nominal anchor, and such anchor is assumed to be provided by price-level targeting via a simple Taylor-type interest rate rule. The macroeconomic impact of trade liberalization is found to be very different for the two monetary policy regimes. Lower import tariffs initially decrease output, employment and the current account balance under fixed exchange rates, but exert the opposite effect on these variables under the interest rate rule.

The welfare cost of macroeconomic adjustment under fixed exchange rates varies across different parameterizations of the model and is found to be in the range of 15 to 30 percent of steady-state gains. The paper also finds that the interest rate rule entails a lower macroeconomic adjustment cost than fixed exchange rates under nearly all plausible parameterizations, and this cost tends to be below 10 percent of steady-state gains. The superior performance of the interest rate rule results from exchange rate flexibility, which enables the rule to generally keep the paths of real variables closer to long-run values and requires smaller changes in nominal wages and prices.

The basic model is developed in Section II. Section III parameterizes the model and uses it to estimate macroeconomic and welfare effects of trade liberalization. Section IV concludes the paper.

II. Theoretical Framework

A. Basic Setup

There are two countries, a small home country and a large foreign country. Two goods, M and X, are produced in the two countries. The production of each good requires labor and capital specific to each sector. Capital endowments are fixed but labor supply is variable.

To introduce nominal rigidities in the model, it is assumed that both goods and labor markets are characterized by monopolistic competition, and changes in wages and prices are subject to convex adjustment costs. There is interindustry as well as intraindustry trade. The home country is a net importer of good M and a net exporter of good X. Trade restrictions take the form of import tariffs.

Households trade a short-term foreign bond denominated in foreign currency to borrow or lend internationally. International borrowing or lending is unrestricted but subject to a transaction cost that increases in foreign debt. There are no stochastic shocks in the model and the inflation rate equals zero in steady state.

B. Consumption and Production

We focus on the relations for the home economy. The foreign economy has similar relations (an asterisk is used to denote foreign variables and parameters). The household's consumption basket is given by

$$C_t = \left[\chi_M^{1/\eta} C_{M,t}^{(\eta-1)/\eta} + \chi_X^{1/\eta} C_{X,t}^{(\eta-1)/\eta} \right]^{\eta/(\eta-1)}, \tag{1}$$

where $C_{M,t}$ and $C_{X,t}$ are consumption indexes for goods M and X, η is the elasticity of substitution between the two goods, and $\chi_M + \chi_X = 1$. The consumption index for each sector is defined as

$$C_{T,t} = \left[\chi_{TH}^{1/\theta_T} C_{TH,t}^{(\theta_T -1)/\theta_T} + \chi_{TF}^{1/\theta_T} C_{TF,t}^{(\theta_T -1)/\theta_T} \right]^{\theta_T/(\theta_T -1)}, T = M, X \,, \tag{2}$$

where, for sector *T (= M, X),* $C_{TH,t}$ and $C_{TF,t}$ are consumption bundles of home and foreign varieties, respectively, θ_T represents the elasticity of substitution between the home and foreign bundles, and $\chi_{TH} + \chi_{TF} = 1$. For each good, there is a continuum of home and foreign varieties in the unit interval. Consumption aggregates of home and foreign varieties, indexed by $h,\ f \in [0,1]$, for the two goods are

$$C_{TH,t} = \left[\int_0^1 C_{TH,t}(h)^{(\varepsilon_T -1)/\varepsilon_T} dh \right]^{\varepsilon_T/(\varepsilon_T -1)}, C_{TF,t} = \left[\int_0^1 C_{TF,t}(f)^{(\varepsilon_T -1)/\varepsilon_T} df \right]^{\varepsilon_T/(\varepsilon_T -1)}, T = M, X, \tag{3}$$

where, for simplicity, the elasticity of substitution among varieties, ε_T, is assumed to be the same for home and foreign bundles of each good.

Optimal allocation of consumption expenditures between the two goods, between the home and foreign bundles of each good, and among different varieties of each bundle leads to the following demand functions:

$$C_{M,t} = \chi_M C_t (P_{M,t} / P_t)^{-\eta}, \quad C_{X,t} = \chi_X C_t (P_{X,t} / P_t)^{-\eta}, \tag{4}$$

$$C_{TH,t} = \chi_{TH} C_{T,t} (P_{TH,t} / P_{T,t})^{-\theta_T}, C_{TF,t} = \chi_{TF} C_{T,t} (P_{TF,t} / P_{T,t})^{-\theta_T}, T = M, X \,, \tag{5}$$

$$C_{TH,t}(h) = C_{TH,t} (P_{TH,t}(h) / P_{TH,t})^{-\varepsilon_T}, C_{TF,t}(f) = C_{TF,t} (P_{TF,t}(f) / P_{TF,t})^{-\varepsilon_T}, T = M, X \,, \tag{6}$$

where $P_{TH,t}(h)$ and $P_{TF,t}(f)$ are the prices of varieties of home and foreign goods; $P_{TH,t}$ and $P_{TF,t}$ are price indexes that minimize the unit cost of home and foreign bundles defined in (3), and P_t and $P_{T,t}$ are the cost-minimizing price indexes for the aggregate basket (1) and the consumption index (2). These price indexes are given by

$$P_t = \left[\chi_M P_{M.t}^{1-\eta} + \chi_X P_{X,t}^{1-\eta} \right]^{1/(1-\eta)}, \tag{7}$$

$$P_{T,t}=\left[\chi_{TH}P_{TH,t}^{1-\theta_T}+\chi_{TF}P_{TF,t}^{1-\theta_T}\right]^{1/(1-\theta_T)},T=M,X\ , \tag{8}$$

$$P_{TH,t}=\left[\int_0^1 P_{TH,t}(h)^{1-\varepsilon_T}\,dh\right]^{1/(1-\varepsilon_T)},\ P_{TF,t}=\left[\int_0^1 P_{TF,t}(f)^{1-\varepsilon_T}\,df\right]^{1/(1-\varepsilon_T)},T=M,X\ . \tag{9}$$

Optimal allocation of consumption expenditures abroad yields similar expressions for foreign demand functions and price indexes. The foreign demand for home bundles and varieties can be expressed as:

$$C_{TH,t}^{*}=\chi_{TH}^{*}C_{T,t}^{*}(P_{TH,t}^{*}/P_{T,t}^{*})^{-\theta_T^{*}},\quad C_{TH,t}^{*}(h)=C_{TH,t}^{*}(P_{TH,t}^{*}(h)/P_{TH,t}^{*})^{-\varepsilon_T},T=M,X\ , \tag{10}$$

where the substitution elasticity between the home and foreign bundles abroad is allowed to be different than that at home.

For each good, the production technology for a firm is given by the following CES production function:

$$Y_{T,t}=\left[\alpha_T^{1/\sigma}L_{T,t}^{(\sigma-1)/\sigma}+(1-\alpha_T)^{1/\sigma}K_{T,t}^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)},T=M,X\ , \tag{11}$$

where $Y_{M,t}$, $L_{M,t}$ and $K_{M,t}$ represent, respectively, output, a bundle of labor inputs, and a specific capital input for good M ; $Y_{X,t}$, $L_{X,t}$ and $K_{X,t}$ are the corresponding variables for good X ; and σ is the elasticity of substitution between labor and capital for both goods. The optimal choice of inputs implies the following demand functions for labor and capital:

$$L_{T,t}=\alpha_T Y_{T,t}(W_t/MC_{T,t})^{-\sigma},K_{T,t}=(1-\alpha_T)Y_{T,t}(RR_{T,t}/MC_{T,t})^{-\sigma},T=M,X\ , \tag{12}$$

where W_t is the wage index (defined below); $RR_{M,t}$ and $RR_{X,t}$ are the rental rates for capital inputs specific to goods M and X ; and $MC_{M,t}$ and $MC_{X.t}$ denote the marginal costs of producing both goods. For each good, the marginal cost equals the minimum unit cost and can be derived from (11) as

$$MC_{T,t} = \left[\alpha_T W_t^{1-\sigma} + (1-\alpha_T) RR_{T,t}^{1-\sigma} \right]^{1/(1-\sigma)}, T = M, X \ . \tag{13}$$

The labor input bundles are aggregates of differentiated services supplied by a continuum of households in the unit interval. The aggregate bundle of labor services, indexed by $l \in [0,1]$, used in the production of each good is defined as

$$L_{M,t} = \left[\int_0^1 L_{M,t}(l)^{(\varepsilon_L - 1)/\varepsilon_L} dl \right]^{\varepsilon_L/(\varepsilon_L - 1)}, \quad L_{X,t} = \left[\int_0^1 L_{X,t}(l)^{(\varepsilon_L - 1)/\varepsilon_L} dl \right]^{\varepsilon_L/(\varepsilon_L - 1)}, \tag{14}$$

where ε_L is the substitution elasticity for labor services. The optimal allocation of the aggregate labor input among different services in the two sectors gives the total demand for each household's service as

$$L_t(l) = L_{M,t}(W_t(l)/W_t)^{-\varepsilon_L} + L_{X,t}(W_t(l)/W_t)^{-\varepsilon_L}, \tag{15}$$

where $W_t(l)$ represents the household's wage rate and W_t is the following wage index (which minimizes the cost of the labor input bundle):

$$W_t = \left[\int_0^1 W_t(l)^{1-\varepsilon_L} dl \right]^{1/(1-\varepsilon_L)}. \tag{16}$$

C. Households

The utility of an infinitely-lived household is given by

$$U_t(l) = \sum_{s=t}^{\infty} \beta^{s-t} u[C_s(l), L_s(l)], \tag{17}$$

where $C_s(l)$ is the household's aggregate consumption. The single-period utility is assumed to be

$$u(.) = \left(\frac{C_s^{1-\rho}(l)}{1-\rho} - \frac{\psi L_s^{1+\mu}(l)}{1+\mu} \right). \tag{18}$$

Households hold one-period domestic and foreign bonds. Domestic bonds are denominated in home currency while foreign bonds are denominated in foreign currency. Only foreign bonds are used for international borrowing or lending and their holding is subject to a transaction cost. Wage changes involve adjustment costs.

The household budget constraint is given by

$$\begin{aligned} &B_{t+1}(l) + S_t B^*_{t+1}(l) = (1+R_{t-1})B_t(l) + S_t(1+R^*_{t-1})(1-TC_{t-1})B^*_t(l) \\ &+ W_t(l)L_t(l)(1-AC_{W,t}(l)) + PF_t(l) + RE_t(l) + TR_t(l) - P_tC_t(l), \end{aligned} \tag{19}$$

where $B_t(l)$ and $B^*_t(l)$ are home and foreign bonds held by households at the beginning of period *t*; S_t is the exchange rate; R_{t-1} and R^*_{t-1} are the home and foreign interest rates for a loan in period $t-1$ (paid at the beginning of period t); TC_{t-1} is the transaction cost for foreign borrowing or lending in period $t-1$; $PF_t(l)$ and $RE_t(l)$ are the household's shares of total profits and rents; $TR_t(l)$ are government transfers (discussed below); and $AC_{W,t}(l)$ is the household's cost of adjusting wages. Wage adjustment costs (as a proportion of wage income) are assumed to be given by the following quadratic function:

$$AC_{W,t}(l) = \frac{\omega_W}{2}\left(\frac{W_t(l)}{W_{t-1}(l)} - 1\right)^2. \tag{20}$$

Each household chooses consumption and sets the wage rate to maximize lifetime utility (17) subject to the budget constraint (19) and labor demand (15). The household optimization yields the following first-order conditions:

$$\frac{\beta C_t(l)^{\rho} P_t}{C_{t+1}(l)^{\rho} P_{t+1}} = \frac{1}{1+R_t}, \tag{21}$$

$$\frac{S_t}{S_{t+1}} = \frac{(1+R^*_t)(1-TC_t)}{1+R_t}, \tag{22}$$

$$(\varepsilon_L - 1)(1 - AC_{w,t}(l))W_t(l) = \varepsilon_L \psi L_t^{\mu} P_t / C_t^{-\rho} - W_t(l)^2 \partial AC_{W,t}(l) / \partial W_t(l)$$
$$-[(W_t(l)W_{t+1}(l)L_{t+1})/((1+R_t)L_t)]\partial AC_{W,t+1}(l)/\partial W_t(l). \quad (23)$$

In steady state with $W_t(l) = W_{t-1}(l)$, (23) simplifies to $W_t(l)/P_t = (\varepsilon_L/(\varepsilon_L - 1))\psi L_t^{\mu}/C_t^{-\rho}$.

D. Firms

Each firm takes demand for its variety as given and sets prices to maximize the present discounted value of profits. Price changes are subject to adjustment costs. Price adjustment costs (as a proportion of profits) for the two goods are of the same form as wage adjustment costs, and are given by the following quadratic functions:

$$AC_{T,t}(h) = \frac{\omega_P}{2}\left(\frac{P_{TH,t}(h)}{P_{TH,t-1}(h)} - 1\right)^2, \; T = M, X \; , \quad (24)$$

where the adjustment cost parameter, ω_P, is assumed to be the same for both sectors.

Firms in both sectors are able to price discriminate between the home and foreign markets. For simplicity, we assume that prices in both markets are set in terms of the home currency. Let $P'_{TH,t}(h)$ denote the home-currency price of a home variety of good T set for the foreign market. This price is related to the foreign-currency price of the variety abroad as

$$P'_{TH,t}(h) = S_t P^*_{TH,t}(h)/(1+\tau^*_T), \quad T = M, X \; , \quad (25)$$

where τ^*_T represents the foreign import tariff rate. Define $P'_{TH,t} = \left[\int_0^1 P'_{TH,t}(h)^{1-\varepsilon_T} dh\right]^{1/(1-\varepsilon_T)}$,

$P^*_{TH,t} = \left[\int_0^1 P^*_{TH,t}(h)^{1-\varepsilon_T} dh\right]^{1/(1-\varepsilon_T)}$, and use (25) to obtain $P'_{TH,t}(h)/P'_{TH,t} = P^*_{TH,t}(h)/P^*_{TH,t}$. Using this condition, (6) and (10), we can express profits of a home firm in each sector as

$$PF_{T,t}(h) = (P_{TH,t}(h) - MC_{T,t})C_{TH,t}(P_{TH,t}(h)/P_{TH,t})^{-\varepsilon_T}(1 - AC_{T,t}(h))$$
$$+ (P'_{TH,t}(h) - MC_{TH,t})C^*_{TH,t}(P'_{TH,t}(h)/P'_{TH,t})^{-\varepsilon_T}(1 - AC'_{T,t}(h)), T = M, X, \quad (26)$$

where $AC'_{T,t}(h)$ is the adjustment cost for the foreign-market price analogous to (24). The firm chooses $P_{TH,t}(h)$ and $P'_{TH,t}(h)$ to maximize $\sum_{s=t}^{\infty} D_{t,s} PF_{T,s}(h)$, where $D_{t,s}$ denotes the rate used to discount s-period values at period t. The optimal choice for $P_{TH,t}(h)$ satisfies the following first-order condition, for $T = X, M$:

$$\begin{aligned}&(1 - AC_{T,t}(h))(\varepsilon_T - 1)P_{T,t}(h) = (1 - AC_{T,t}(h))\varepsilon_T MC_{T,t} \\ &-P_{TH,t}(h)(P_{TH,t}(h) - MC_{T,t})\partial AC_{T,t}(h)/\partial P_{TH,t}(h) \\ &-[P_{TH,t}(h)(P_{TH,t+1}(h) - MC_{T,t+1})C_{TH,t+1})/((1+R_t)C_{TH,t})]\partial AC_{TH,t+1}(h)/\partial P_{TH,t}(h).\end{aligned} \tag{27}$$

In steady state, (27) reduces to $P_{T,t}(h) = (\varepsilon_T / (\varepsilon_T - 1))MC_{T,t}$. The first-order conditions for $P'_{TH,t}$ has the same form as (27) and implies that $P'_{TH,t}(h) = P_{TH,t}(h)$. It follows that

$$P_{TH,t} = S_t P^*_{TH,t} / (1 + \tau^*_T), \quad T = M, X\ . \tag{28}$$

Assuming similar price setting by foreign firms, we also have

$$P_{TF,t} = (1 + \tau_T) S_t P^*_{TF,t}, \quad T = M, X\ , \tag{29}$$

where τ_T is the home import tariff rate.

E. Equilibrium

In equilibrium, all households make the same choice. Thus, aggregating over all households, $C_t = C_t(l), L_t = L_t(l), W_t = W_t(l)$. Also, since all households receive the same share of rents, profits, and transfers, $RE_t = RE_t(l), PF_t = PF_t(l), TR_t = TR_t(l)$. Output of each sector equals demand at home and abroad, so that

$$Y_{T,t} = C_{TH,t} + C^*_{TH,t}, \quad T = M, X\ . \tag{30}$$

Foreign demand, $C^*_{TH,t}$, is determined by (10). Total labor supply equals the sum of labor demand in the two sectors:

$$L_t = L_{M,t} + L_{X,t} \,. \tag{31}$$

For each sector, there is a fixed supply of capital specific to the sector. Letting a bar over the variable denote fixed supply, we have

$$K_{T,t} = \overline{K}_{T,t}, \quad T = M, X \,. \tag{32}$$

Tariff revenue is redistributed to households in the form of lump-sum transfers. Thus total household transfers are

$$TR_t = \tau_M S_t P^*_{MF,t} C_{MF,t} + \tau_X S_t P^*_{XF,t} C_{XF,t} \,. \tag{33}$$

National income at home prices equals

$$NI_t = W_t L_t (1 - AC_{W,t}) + RE_t + PF_t + TR_t \,. \tag{34}$$

Aggregating household budget constraints, noting that home bonds are not held abroad ($\int_0^1 B_t(l)dl = 0$), and using (34), we can express the national budget constraint as

$$S_t B^*_{t+1} = S_t (1 + R^*_{t-1})(1 - TC_{t-1}) B^*_t + NI_t - P_t C_t \,. \tag{35}$$

Following Laxton and Pesenti (2003), we assume that transaction costs are the following function of the real value of net foreign assets

$$TC_t = \phi_1 \frac{\exp(\phi_2 S_t B^*_{t+1} / P_t) - 1}{\exp(\phi_2 S_t B^*_{t+1} / P_t + 1}, \quad \phi_1 > 0, \phi_2 > 0 \,. \tag{36}$$

According to this function, $TC_t = 0$ when $B^*_{t+1} = 0$. The current account is determined as

$$CA_t = S_t (B^*_{t+1} - B^*_t) \,. \tag{37}$$

We consider two monetary policy regimes. Under the first regime, the exchange rate is fixed as

$$S_t = \overline{S} \,, \tag{38}$$

The second regime maintains flexible exchange rates and uses the interest rate as an instrument to targets the price level. This policy regime is described by the following interest rate rule:

$$R_t = \bar{R} + \delta \log(P_t / \bar{P}), \quad \delta > 0, \tag{39}$$

where $\bar{R}$ denotes the steady-state value of the interest rate and $\bar{P}$ is the price-level target. This policy can be viewed as a simple version of a Taylor rule that targets the price level instead of inflation and does not include output gap.[7]

Under the assumption that the home price level is stationary, (21) implies that $\bar{R} = (1-\beta)/\beta$. Assuming that the home and foreign discount factors are the same ($\beta = \beta^*$) and the foreign price level is also stationary, the value of net foreign assets equals zero in the steady state according to the foreign counterpart of (21), (22), and (36). Our model, however, allows the home country to accumulate net foreign wealth or debt in the transition process.

III. Quantitative Analysis

A. Calibration

We calibrate the model for a hypothetical economy that is small in relation to the foreign economy. In the baseline model, both M and X sectors are assumed to have similar characteristics. Exports of a developing country could be less differentiated, but more labor intensive and competitive than its imports. Differences between export and imports along these dimensions could be reversed for an advanced country. We consider variations of the

[7] The difference between price-level and inflation targeting is not important in the present model without stochastic shocks.

baseline model, which allow for such differences between the M and X sectors. Parameterization of the baseline model and its variations is summarized in Table 1.

We choose the following values for various shares in the initial steady state before trade liberalization (a bar over a variable denotes its initial steady-state value). Both goods are assumed to have equal share in aggregate consumption, so that $\bar{P}_X \bar{C}_X = \bar{P}_M \bar{C}_M = .5\bar{P}\bar{C}$. We also assume that imports (equal to exports in steady state) account for a quarter of aggregate expenditures, i.e., $\bar{P}_{MF}\bar{C}_{MF} + \bar{P}_{XF}\bar{C}_{XF} = \bar{S}(\bar{P}^*_{MH}\bar{C}^*_{MH} + \bar{P}^*_{XH}\bar{C}^*_{XH}) = .25\bar{P}\bar{C}$. This value accords with average long-run shares of imports in GDP for emerging as well as advanced countries.[8] Imports of *M* are assumed to be 80 percent of total imports while exports of *X* are assumed to be a similar percentage of total exports. This assumption allows for interindustry as well as intraindustry trade and makes the home country a net importer (exporter) of good *M (X)*.[9] The labor share, $\bar{W}\bar{L} / \bar{P}\bar{C}$, is set equal to 0.6.

We use quarterly frequency and let the discount factor equal 0.99, which implies a steady-state value of the annualized real rate of interest equal to 4 percent. Estimates for other parameters of the utility function vary over a fairly wide range. For the baseline version, we choose a value of 0.5 for the intertemporal elasticity of substitution ($1/\rho$), and 0.25 for the elasticity of labor supply ($1/\mu$). Alternative values of these parameters are explored in our sensitivity analysis. We normalize the initial steady-state values of consumption, the wage rate and all price indexes to equal one. These normalization and our

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[8] The average share of imports in GDP over the 1990-2008 period is 27 percent for emerging and 23 percent for advanced countries (source: WEO database).

[9] These assumptions also imply that intraindustry trade accounts for about 40 percent of total trade for each good.

assumed shares are used to determine the values of weights in the consumption indexes ($\chi_M, \chi_X, \chi_{MF}, \chi_{MX}, \chi_{XF}, \chi_{XH}$) as well as the weight for the labor-effort index in the utility function (ψ).

Elasticities of substitution between varieties of the two products ($\varepsilon_M, \varepsilon_X$) are assumed to equal 8.0. This value implies a mark-up of a little less than 15 percent and is within the range of various estimates for markups.[10] There is considerable disagreement about the elasticity of substitution between home and foreign bundles of each good (θ_M, θ_X). A low value for this elasticity between 0.5 and 1.5 is typically used in macroeconomic models with an aggregated traded goods sector.[11] Studies of traded goods at a more diaggregated or multi-sectoral level produce much higher estimates of the elasticity. Estimates by Hertel et al. (2004), for example, indicate that the elasticity varies across sectors and its average value is close to 6.0. We chose this value of the elasticity for both goods in our baseline case, but explore the sensitivity of results to a wide range of values. Also, we allow the elasticity to differ between M and X in the variations of the baseline model. The elasticity of substitution between the two traded goods (η) is assumed to be lower than the substitution elasticity for home and foreign bundles, and is set equal to 3.0.

The substitution elasticity for varieties of labor services (ε_L) is assumed to also equal 8.0, which makes the markup in the labor market the same as that in the goods market. Different values of ε_L are considered in the sensitivity analysis. The elasticity of substitution

[10] Martins, Scarpetta, and Pilat (1996), for example, estimate the average markup for manufacturing sectors in OECD countries at around 20 percent. Chari, Kehoe, and McGrattan (2002) use a markup estimate of 11 percent based on studies of the United States.

[11] Estimation of such models generally yields an estimate of the elasticity close to the lower half of this range (e.g., see Bergin, 2004, Lubik and Schorfheide, 2005).

between labor and capital (σ) is generally considered to be close to one, and we assume that this value equals 0.9.[12] Labor intensity is assumed to be the same for both goods ($\alpha_M = \alpha_X$) in the baseline model, but allowed to differ in the variations of the model.

We let the baseline value of δ in the interest rate rule (39) equal 0.5, which is the value suggested by Taylor (1993) for the rule in its more general form. Implications of different values of this parameter for macroeconomic adjustment costs are also explored in our analysis. Parameters of the adjustment cost functions (ω_P and ω_W) determine the degree of wage–price inertia. We use a value of 400 for each parameter in the baseline case, which accords with recent estimates and is roughly equivalent to a four-quarter average contract length in a Calvo-type model.[13] A wide range of values for these parameters are also considered in our sensitivity analysis to explore how the degree of nominal rigidities determines the adjustment to trade liberalization. Both parameters of the transaction cost function (ϕ_1 and ϕ_2) are assumed to equal 0.01. The transactions costs based on these parameters ensure convergence to a steady state with zero net foreign assets, but are small enough to make little difference to dynamics of the model.

The home economy is assumed to have higher tariffs initially than the foreign economy. Our basic experiments examine the effects of a unilateral trade liberalization, which lowers the home tariffs to the foreign levels. We focus on the case, in which initial home tariffs equal 20 percent in both sectors while foreign tariffs equal 10 percent (i.e.,

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[12] For the use of a similar value, see Jomini et al. (1991), for example.

[13] Similar estimates have been used by Globel Economy Model (GEM) and Global Integrated Monetary and Fiscal model (GIMF). See, for example, Faruqee et al. (2005).

$\tau_M = \tau_X = .2, \tau_M^* = \tau_X^* = .1$).[14] We also consider an alternative case where tariffs on M imports are higher than X imports (we let $\tau_M = .25$ and $\tau_X = .15$).[15] The size of the foreign economy is assumed to be very large relative to the home economy, and thus home tariff cuts have a negligible effect on the foreign price indexes of the two goods ($P_{M,t}^*$ and $P_{X,t}^*$) and the foreign interest rate (R_t^*). These variables are treated as exogenous and assumed to be constant.[16] Although the home country is small, it still has monopoly power (because of producing differentiated goods) that depends on the elasticities of substitution between the home and foreign bundles in the foreign market (θ_M^*, θ_X^*). Arguably, the degree of substitution between home and foreign goods is likely to be greater in the large foreign than in the small home market. We assume that the foreign substitution elasticities are larger than the domestic elasticities, and choose a baseline value of 12.0 for both θ_M^* and θ_X^*. These value leads to Nash optimal tariff rates of less than 10 percent. In our experiments, the home tariffs are cut to 10% and thus stay above the optimal rate even after trade liberalization.

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[14] The tariff rates vary across countries, but tend to be higher for developing countries than for high-income countries. According to recent estimates by Anderson and Martin (2006), the average (import-weighted) tariff rates for developing and high-income countries were 10 percent and 3 percent, respectively. We use higher than average tariff rates to allow for additional restrictions arising from non-tariff barriers.

[15] Sectors with relatively higher imports are likely to have more tariff and non-tariff protection. In high-income countries, for example, agriculture and textiles have been subject to higher restrictions than other goods.

[16] In view of the foreign counterpart of (8), this assumption implies that the values of χ_{MH}^* and χ_{XH}^* are very small. Note that for our normalizations and assumptions regarding $\overline{C}_{MH}^*$ and $\overline{C}_{MH}^*$, the values of $\chi_{MH}^*\overline{C}_M^*$ and $\chi_{XH}^*\overline{C}_X^*$ are determined by (10), (28), and (29). However, values of χ_{MH}^* and χ_{XH}^* can still be made arbitrarily close to zero by choosing sufficiently large values of $\overline{C}_M^*$ and $\overline{C}_X^*$.

B. Macroeconomic Adjustment

We first discuss how macroeconomic adjustment to trade liberalization differs under fixed exchange rate and the Taylor rule.[17] These differences are illustrated in Figure 1, which shows the dynamic response of output, employment, consumption, and the current account over 20 quarters to a decrease in home tariff rates from 20 to 10 percentage points in the baseline model.[18] To highlight the influence of wage-price rigidities, the figure also displays time paths of the variables for the case where these rigidities are absent and wages and prices are fully flexible (these time paths are derived by setting $\omega_P = \omega_W = 0$ in the baseline model). In this case, there is no transitional dynamics and the tariff cut causes all variables to adjust to their new steady-state values in the same period. As the figure shows, the response of variables is very different under both regimes in the presence of wage-price inertia.

In the case of fixed exchange rates, the tariff cut lowers the price of foreign varieties relative to home varieties and shifts demand from domestic to imported goods in both sectors. This shift leads to an initial decline in both output and employment. The output and employment response in this case is opposite to that under flexible wages and prices. Also, consumption decreases less than output because of consumption smoothing considerations, and thus, the tariff reduction causes a temporary deterioration in the current account.

In contrast, home-currency depreciation under the Taylor rule brings about an initial increase in output and employment by stimulating foreign demand for domestic goods and dampening the shift in home demand from domestic to imported goods. In fact, (as discussed

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[17] The DYNARE program is used to obtain a deterministic steady-state solution to the nonlinear model before and after trade liberalization and to derive the dynamic response of model variables in the transition process.

[18] Output is defined as $(P_{MH,t}Y_{M,t} + P_{XH,t}Y_{X,t})/P_t$. Quarter zero represents the initial steady state and quarter one the first quarter after tariff reduction.

below) the exchange rate overshoots its new equilibrium value and the initial expansion in output and employment is greater than that in the absence of sticky wages and prices. As consumption increases less than output, flexible exchange rates lead to a current account surplus.

Figure 2 illustrates how the response of key nominal variables to lower tariffs differs between the two regimes. Under fixed exchange rates, the interest rate does not change and the price level falls gradually to accommodate the relative price changes induced by tariff cuts. In the case of the Taylor rule, on the other hand, the reduction in the interest rate (in response to a fall in the price level) causes the exchange rate to jump above its long-run value.[19]

C. Welfare Effects

We next examine welfare effects of trade liberalization under different monetary policies. Welfare gains are measured by an equivalent-variation index, γ, which is defined as the constant amount (expressed as a fraction of steady-state consumption before trade liberalization) that needs to be given to households to make them indifferent between the initial steady state and the new state (including the transition period) after trade liberalization. This index is given by the following relation:

$$\sum_{s=t_0}^{\infty} \beta^{s-t_0} u[(1+\gamma)\bar{C}, \bar{L}] = \sum_{s=t_0}^{\infty} \beta^{s-t_0} u(C_s, L_s), \tag{40}$$

[19] The reason for the overshooting behavior of the exchange rate in response to tariff reduction is similar to that for the well-known Dornbusch (1976) result that under sticky prices, a permanent increase in the money supply causes the exchange rate to overshoot its equilibrium value.

where $\{C_s, L_s\}_{s=t_0}^{\infty}$ is the sequence of consumption and labor supply after trade liberalization at time t_0, and $u(.)$ is defined in (18). The index γ measures the total welfare effect of tariff reduction and can be decomposed as

$$\gamma = \gamma_{TR} + \gamma_{SS}, \tag{41}$$

where γ_{TR} and γ_{SS} measure the transitional and steady-state welfare effects of trade liberalization. Letting a tilde denote a variable's steady-state value after trade liberalization, we calculate the steady-state index as

$$u[(1+\gamma_{SS})\bar{C}, \bar{L}] = u(\tilde{C}, \tilde{L}), \tag{42}$$

and use (41) to determine the transitional index residually. Note that if wages and prices were fully flexible, the transitional effect would disappear (consumption and employment would change from $\bar{C}$ and $\bar{L}$ to $\tilde{C}$ and $\tilde{L}$ at t_0) and γ would equal γ_{SS}.

Table 2 displays the welfare effects of trade liberalization for the baseline model as well as several variations of this model. In the table, the welfare indexes (γ, γ_{TR} and γ_{SS}) are multiplied by 100 to express welfare effects in percentage terms. For each case, the results are shown for two trade liberalization experiments: (1) tariff reductions from 20% to 10% for both M and X, and (2) a tariff reduction from 25% to 10% for M, and a reduction from 15% to 10% for X. For the baseline model, the table shows that lower tariffs lead to a steady-state welfare gain of 0.370 percent of initial steady-state consumption in the case of uniform tariffs and a gain of 0.612 percent in the case of higher initial tariff for M. The transitional effects involve losses that, as a percentage of steady-state gains, are between 15 and 20 percent for fixed exchange rates and below 10 percent for the Taylor rule. Thus our baseline results suggest that the welfare effect after accounting for macroeconomic adjustment is only moderately lower than the steady-state effect and this difference is smaller under the Taylor rule.

The table also explores the sensitivity of the results to variations that allow M and X to differ along several dimensions. Variation 1 assumes that X is less differentiated and more labor intensive than M, which conditions may be appropriate for a developing country. Variation 2 makes the opposite assumptions suitable for an advanced country. Variations 3 and 4 explore differences in the degree of competition between the two sectors. Estimates of transitional and steady-state effects vary across variations. Transitional losses for the Taylor rule are substantially lower and less variable across variations than the losses for fixed exchange rates. Transitional losses for the Taylor rule, for example, remain below 10 percent of steady state gains in all cases while those for fixed exchange rates vary between 15 and 30 percent.[20]

Superior performance of the Taylor rule can be explained in terms of additional flexibility provided by exchange rate adjustment. Benefits of trade liberalization arise from more efficient resource allocation resulting from adjustment of relative prices of home to foreign varieties (in each sector) towards their optimal values.[21] If the exchange rate is fixed and wages and prices are sticky, tariff cuts lower the relative prices of foreign varieties, but little further adjustment takes place in the short run. Exchange rate adjustment under the Taylor rule (induced by the interest rate response to prices), however, allows the relative prices to move closer to the optimal values in the short run. Thus the rule improves resource

[20] The transitional losses associated with fixed exchange rates are especially high relative to steady-state gains for variations 2 and 3.

[21] Optimal values differ from the steady-state values because of distortions resulting from the presence of monopoly power in the goods and labor markets.

allocation faster and leads to lower wage-price adjustment costs (by requiring smaller changes in nominal prices and wages) than the fixed exchange rate policy. Our results for the Taylor rule are not very sensitive to the value of the price level coefficient in the rule, δ. Varying the value of δ from 0.25 to 2.0, we find that the transitional loss for the tariff cuts in the baseline model (with uniform tariffs) increases slightly in δ. But, even at the high value of $\delta = 2.0$, the transitional loss equals 0.030 , which is still less than half of the loss under fixed exchange rates (shown in Table 2).

D. Sensitivity Analysis

We performed extensive sensitivity analysis to examine the robustness of our results to alternative values of the key parameters. We first explored the effects of different values for the parameters ρ, μ, and ε_L, which could potentially influence both the short- and long-run effects of tariff cuts. We let ρ and μ vary from 2 to 5 and ε_L from 5 to 11. These variations exert little effect on the steady-state welfare measure. The transitional loss also does not change much for most variations, and remains smaller under the Taylor rule than fixed exchange rates.

We next examine the influence of changes in the values θ_M and θ_M on our results. As estimates of the substitution elasticity between home and foreign goods vary considerably across studies, we considered variations in the values of θ_M and θ_M over a wide range from 2 to 10. Higher values of these parameters would be expected to lead to larger steady-state gains, but it is not clear how this change would affect the transitional losses for the two regimes. The effects for the baseline case with uniform tariffs are illustrated in Figure 3. Letting $\theta_M = \theta_X = \theta$, the figure shows the steady-state welfare effect as well as the total welfare effects for the two regimes for different values of θ. As shown in the figure, an increase in θ from 2 to 10 results in more than 100% increase in the steady-state gain. The transitional loss (the difference between the steady state and the total effect) also increases in θ for fixed exchange rates, but changes little in the case of the Taylor rule.

Finally, we also explored how the degree of wage-price stickiness affects the results. We let the adjustment cost parameters for prices and wages, ω_P and ω_W vary from 200 to 1000. An increase in the values of these parameters would be expected to increase the cost of macroeconomic adjustment, but interestingly, we find that the increase in this cost is greater under fixed exchange rates than the Taylor rule. This result is illustrated in Figure 4 (also for the baseline case with uniform tariffs). Letting $\omega_P = \omega_W = \omega$, the figure shows that the ratio of the transitional loss to the steady state gain increases under fixed exchange rates from 0.11 at $\omega = 200$ to 0.31 at $\omega = 1000$. This ratio for the Taylor rule increases over this range by a smaller amount: from 0.03 to 0.11. We also experimented with variations that allow prices to be more or less sticky than wages. These variations did not make much difference to the results.

Our analysis assumes that trade liberalization takes the form of an unanticipated unilateral tariff cut. We now briefly discuss how our basic results are changed under alternative tariff shocks. First, we examine the possibility that the tariff reduction may be anticipated sometime before it actually takes place. To explore this effect, we considered an experiment in which a 10% tariff cut in quarter $t_0 + n$ is announced in quarter t_0. In this case, macroeconomic adjustment starts in quarter t_0 in anticipation of the future tariff cut, but we find that major changes still occur at the time of the actual cut (i.e., in quarter $t_0 + n$). In the presence of nominal rigidities, the anticipation of the tariff cut does not significantly reduce the macroeconomic adjustment cost. In fact, for the case of $n = 4$, the transitional loss falls marginally under fixed exchange rates, but rises somewhat under the Taylor rule.[22]

Next, we briefly explore the effects of a bilateral tariff reduction. We examined the effect of a 5 percentage point decrease in home as well as foreign tariffs in the baseline model with uniform tariffs. Both the macroeconomic and welfare effects change in this experiment. The impact effect of the bilateral tariff reductions on output, employment, consumption and the current account is now positive in both regimes. Bilateral 5% tariff cuts are found to cause greater welfare gains for the home country than the 10% unilateral cut. As bilateral trade liberalization requires smaller adjustment in the relative prices of home to foreign goods in the two sectors, the transitional losses are smaller.[23]

IV. CONCLUSIONS

Macroeconomic literature has long emphasized the role of nominal rigidities in causing costly macroeconomic adjustment to trade liberalization. Although there is an extensive literature on measuring the long-term gains from trade liberalization, there is little or no work on estimating the macroeconomic adjustment costs of this policy due to nominal rigidities. This paper provides estimates of these costs based on a dynamic general equilibrium framework that focuses on nominal rigidities as the key source of short-run adjustment. The estimates are derived for a small economy that is well integrated into global

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[22] The transitional losses (in percent of initial steady state consumption) are -0.046 and -0.033 under fixed exchange rates and the Taylor rule, respectively.

[23] The total and transitional welfare effects for fixed exchange rates are 1.683 and -0.035, respectively. The corresponding values for the Taylor rule are 1.690 and -0.027. Note that the results are sensitive to our assumption (motivated by the size difference between the home and foreign countries) that the price elasticity of export demand is larger than that of import demand. If this asymmetry is removed (i.e. we let $\theta_M = \theta_X = \theta_M^* = \theta_X^* = 6$), the welfare gain decreases in both regimes.

financial markets and initially has higher trade restrictions in the form of tariffs than the rest of the world.

The macroeconomic and welfare effects for such an economy depend on monetary policy. We contrast a policy that fixes the exchange rate with a simple Taylor-type rule that targets the price level and allow the exchange rate to be flexible. An unanticipated unilateral tariff cut has a negative impact on output, employment and the current account under fixed exchange rates, but a positive impact on these variables under the Taylor rule. The welfare cost of macroeconomic adjustment, moreover can be substantial under fixed exchange rates, but is relatively small in the case of the Taylor rule. Our analysis shows, for example, that over a wide range of parameter values, the transitional loss varies from 15 to 30 percent of steady-state gains under fixed exchange rates. The percentage loss for the Taylor rule, however, tends to be below 10 percent.

To isolate the role of nominal rigidities in the adjustment process, the paper has abstracted from other possible sources of short-run adjustment costs. Factor mobility between sectors, for example, could entail significant costs. Incorporating such costs would be an important extension of the paper's analysis. The paper's model, moreover, treats the number of firms and capital stock in each sector as exogenously determined variables. Allowing these variables to be determined endogenously would also represent a significant extension of the model. Exploring how adjustment cost of trade liberalization would be affected by such extensions would be interesting topics for future research.

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Table 1. Parameter Values and Normalizations

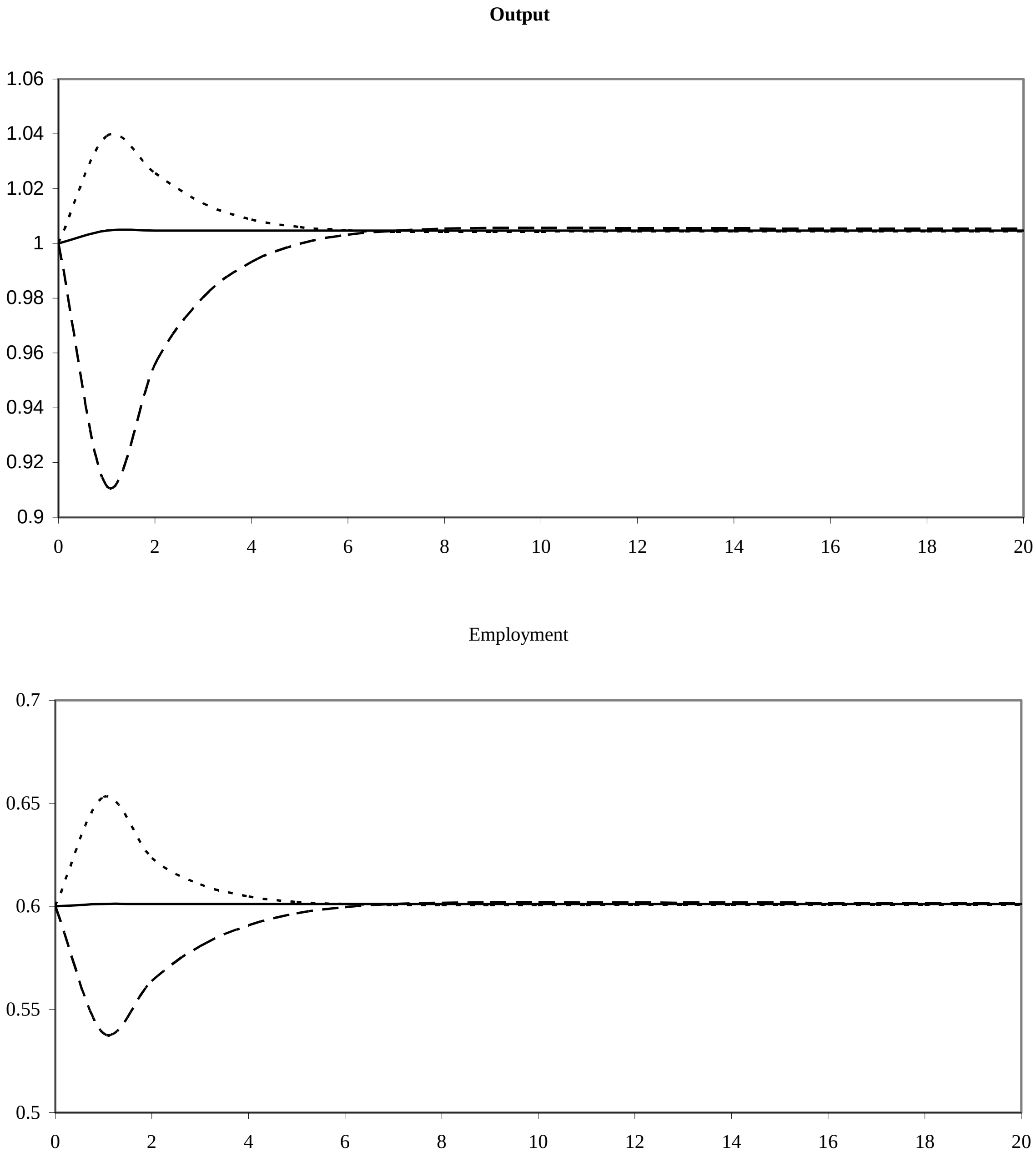
Baseline Model	
Shares	$\chi_M = \chi_X = 0.5, \chi_{MF} = 0.4, \chi_{MH} = 0.6,$ $\chi_{XF} = 0.1, \chi_{XH} = 0.9$
Utility Parameters	$\rho = 2.0, \mu = 4.0, \psi = 6.75\,,\ \beta = 1.0/1.01$
Elasticities of Substitution	$\eta = 3.0, \theta_M = \theta_X = 6.0, \varepsilon_M = \varepsilon_X = \varepsilon_L = 8.0$ $\theta_M^* = \theta_X^* = 12.0$
Technology Parameters	$\sigma = .9, \alpha_M = \alpha_X = .7$
Adjustment and Transaction Costs	$\omega_P = \omega_W = 400, \phi_1 = \phi_2 = 0.01$
Initial Steady-State Values	$\tau_M = \tau_X = .2$ (or $\tau_M = .25, \tau_X = .15$), $\tau_M^* = \tau_X^* = .1$ $\bar{C} = 1,\ \bar{L} = .6\,, \bar{S} = .833,$ $\bar{W} = \bar{P} = \bar{P}_M = \bar{P}_X = \bar{P}_{MH} = \bar{P}_{MF} = \bar{P}_{XH} = \bar{P}_{XF} = 1,$ $\bar{P}_M^* = \bar{P}_X^* = \bar{P}_{MF}^* = \bar{P}_{XF}^* = 1\,.$
Variations	
Variation 1	$\theta_M = 3, \theta_X = 9\,,\ \alpha_M = (2/3)\alpha_X$
Variation 2	$\theta_M = 9, \theta_X = 3\,,\ \alpha_M = (3/2)\alpha_X$
Variation 3	$\varepsilon_M = 5, \varepsilon_X = 11$
Variation 4	$\varepsilon_M = 11, \varepsilon_X = 5$

Table 2. Welfare Effects of Trade Liberalization
(in percent of initial steady-state consumption)

	Total Effect (%) Fixed ER	Total Effect (%) Taylor Rule	Transitional Effect (%) Fixed ER	Transitional Effect (%) Taylor Rule	Steady-State Effect (%)
Baseline Model					
Uniform tariffs	0.305	0.349	-0.066	-0.021	0.370
Higher M tariffs	0.515	0.565	-0.098	-0.047	0.612
Variation 1: X less differentiated and more labor intensive					
Uniform tariffs	0.291	0.316	-0.050	-0.025	0.341
Higher M tariffs	0.346	0.390	-0.084	-0.043	0.432
Variation2: M less differentiated and more labor intensive					
Uniform tariffs	0.261	0.356	-0.104	-0.009	0.365
Higher M tariffs	0.521	0.686	-0.185	-0.020	0.706
Variation 3: X more competitive					
Uniform tariffs	0.215	0.275	-0.076	-0.015	0.291
Higher M tariffs	0.371	0.448	-0.114	-0.036	0.484
Variation 4: M more competitive					
Uniform tariffs	0.386	0.437	-0.081	-0.030	0.467
Higher M tariffs	0.650	0.688	-0.115	-0.076	0.765

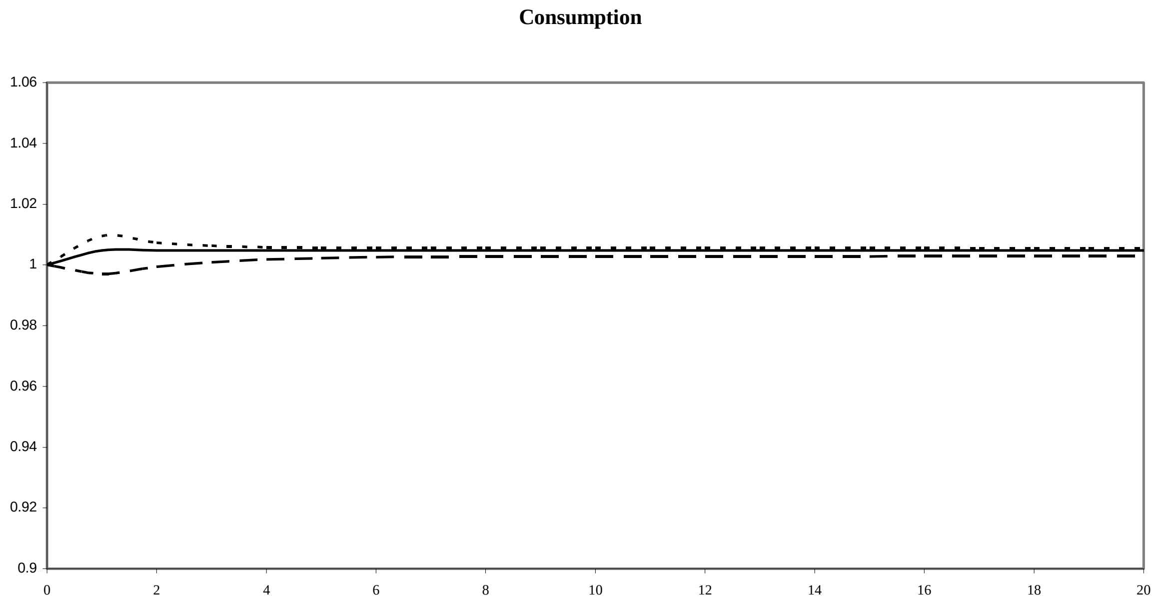
Note: Total, transitional and steady-state effects equal 100γ, $100\gamma_{TR}$ and $100\ \gamma_{SS}$, respectively. Both τ_M and τ_X are reduced from 0.2 to 0.1 in the case of uniform tariffs while τ_M is reduced from 0.25 to 0.1, and τ_X from 0.15 to 0.1 in the case of higher M tariffs. Parameter values for the baseline model and its variations are shown in Table 1.

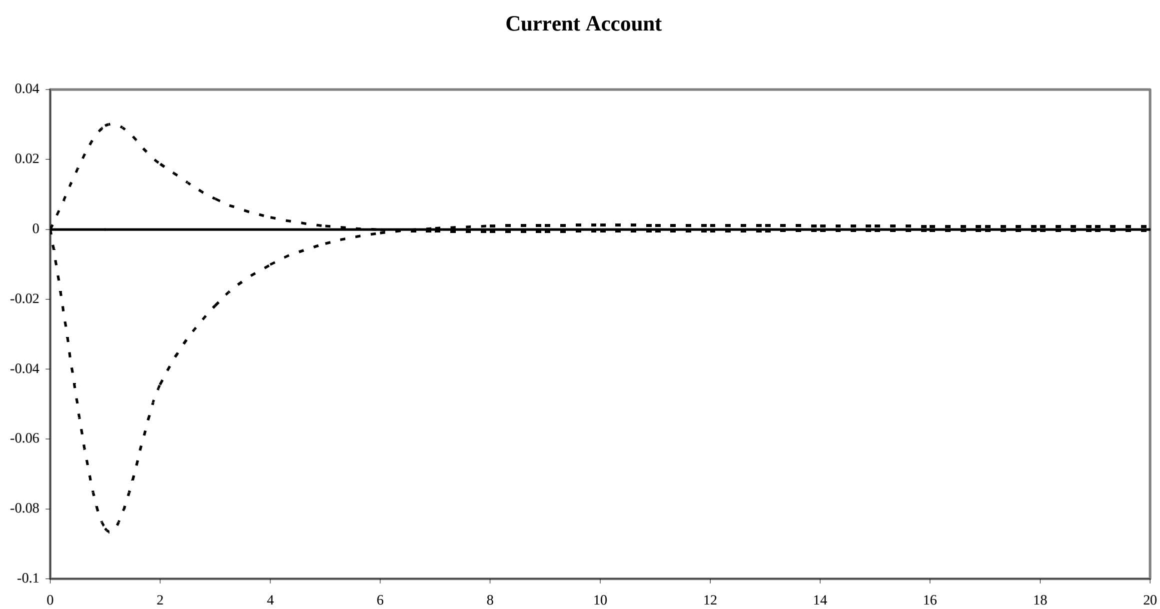
Figure 1. Dynamic Response of Real Variables to Trade Liberalization



_ _ _ _ Fixed Exchange Rates, ... Taylor Rule, ____ Flexible Wages and Prices

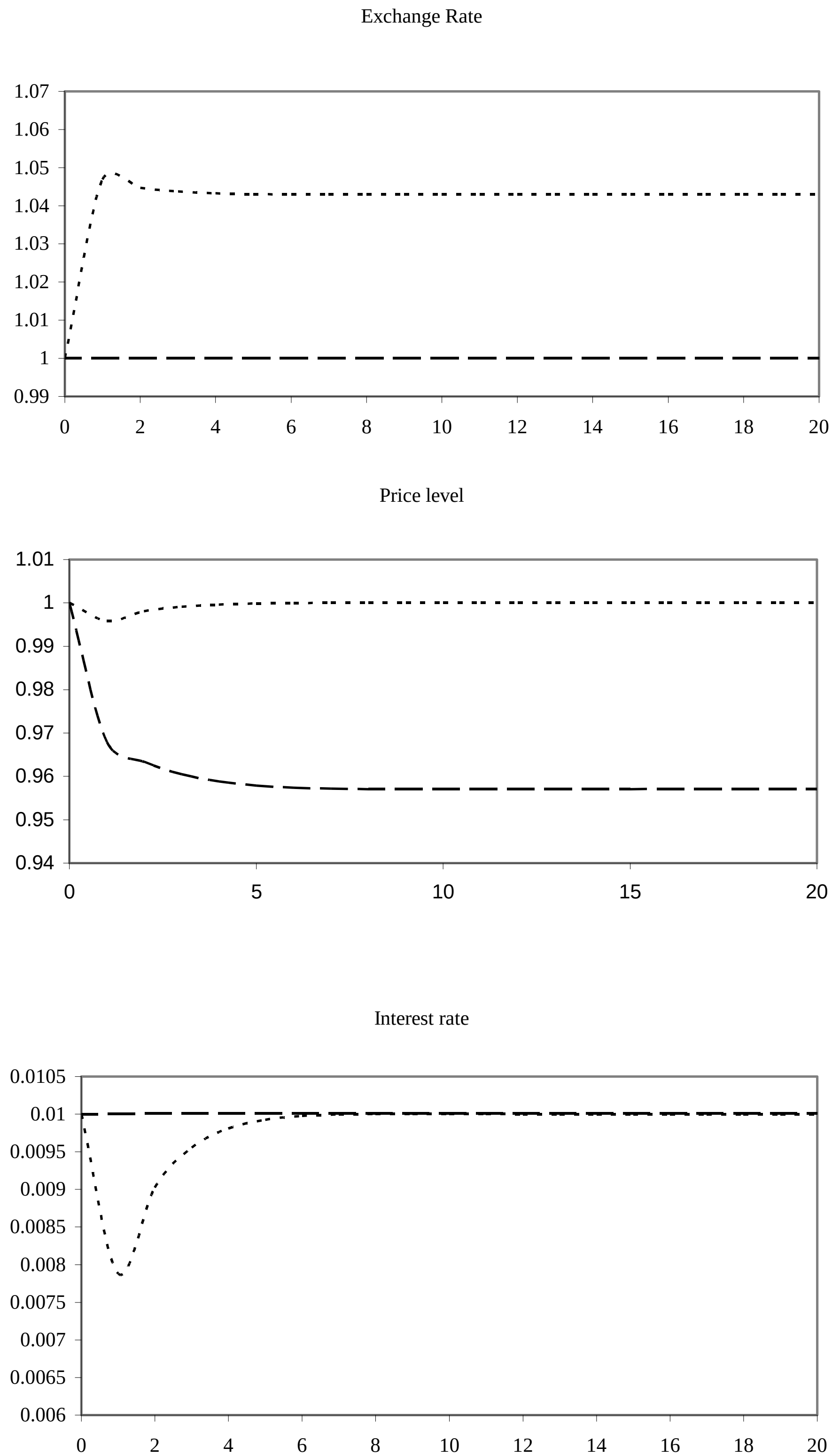
Figure 1 (Continued). Dynamic Response of Real Variables to Trade Liberalization





_ _ _ _ Fixed Exchange Rates, ... Taylor Rule, ____ Flexible Wages and Prices

Figure 2. Dynamic Response of Nominal Variables to Trade Liberalization



_ _ _ _ Fixed Exchange Rates, ... Taylor Rule

Figure 3. Welfare Effects under Different Values of Theta

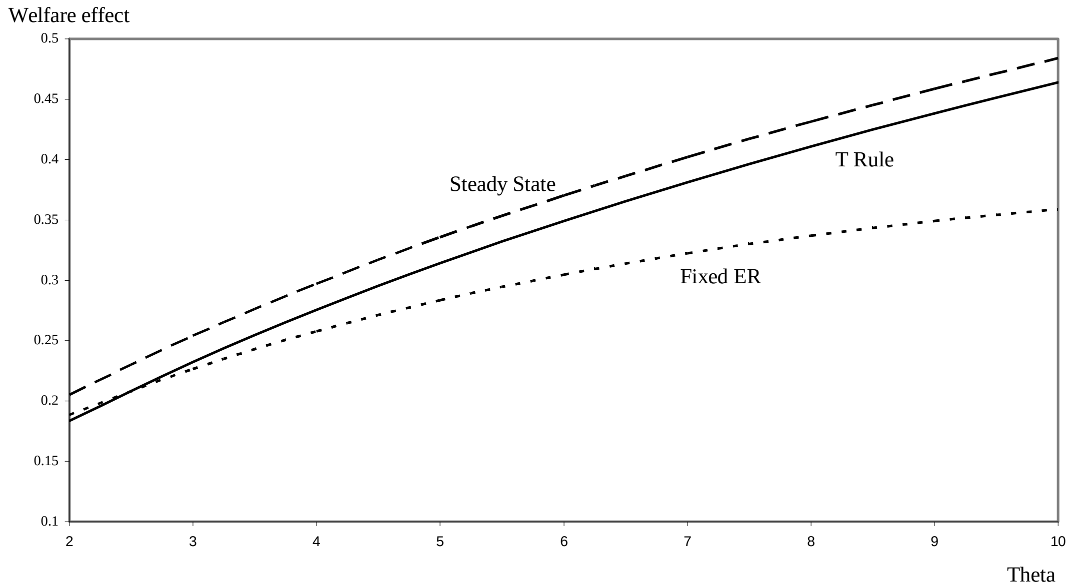


Figure 4. Transitional Loss-Steady State Gains Ratio under Different Values of Omega