MACROECONOMIC AND WELFARE EFFECTS OF AN FDI SURGE:

A DYNAMIC GENERAL EQUILIBRIUM ANALYSIS

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Abstract

This paper uses a dynamic general equilibrium model to explore the macroeconomic as well as welfare effects of a large increase in FDI, such as that experienced recently by a number of emerging economies. The basic quantitative analysis of the model shows that for an economy with free access to the international financial market, a large FDI capital inflow leads to a surplus in the current account, but does not have large effects on other macroeconomic variables. The macroeconomic effects are more pronounced, however, for an economy not well integrated with the global financial market. The analysis also measures the net welfare effect of FDI to examine whether benefits of technology transfer outweigh the loss due to repatriation of monopoly profits. FDI is, in fact, found to lead to a net welfare loss in the absence of technology spillovers. The choice of the exchange rate regime or the degree of nominal rigidities has little effect on this result. The net welfare loss is higher, moreover, if foreign firms are more productive.

JEL Classification: F21, F41, O11

Key Words: Foreign direct Investment, Capital Inflows, Emerging Economies,
New Open economy Macroeconomic Models

1. Introduction

The bulk of foreign direct investment (FDI) takes place between advanced countries. There has been a significant recent increase, however, in FDI flows into developing countries; especially Latin America and East Asia (see Figure 1). FDI tends to involve new entry (greenfield investment) as well as mergers and acquisitions. Recent trends also show that nontraded goods sectors are attracting sizable FDI (see Figure 2). A number of emerging countries have experienced large increases in FDI over short periods. Figure 3 illustrates this behavior for selected large emerging economies.

A surge in FDI raises concerns about its macroeconomic and welfare effects in the host country. Although there is an extensive and growing literature on various aspects of FDI, the macroeconomic and welfare effects of an FDI surge have not been adequately explored in a consistent dynamic general equilibrium framework. To fill this gap in the literature, the present paper explores these effects within the framework of new open economy macroeconomic models. FDI is generally viewed as a vehicle for the transfer of productive knowledge (e.g., technological expertise, marketing and managerial skills) as well as capital to host countries.[1] FDI flows are also regarded as a source of long-term transfers of capital.[2] To capture these features, the FDI surge is modeled as an exogenous permanent increase in the varieties produced by more productive foreign firms. To account for the facts discussed above, FDI is assumed to occur in both traded and

[1] The view of FDI as a source of productive knowledge is related to explanations of multinational operations (Dunning, 1981, 1993) based on three advantages enjoyed by a multinational firm: an ownership advantage (possessing an intangible asset), a location advantage (selling via a foreign subsidiary more profitable than exporting), and an internalization advantage (control of the use of the asset more advantageous than selling or leasing the asset).

[2] For example, see Sarno and Taylor (1999) for evidence that FDI flows are a more stable source of financing domestic expenditures than portfolio capital flows.

nontraded goods and represent a mixture of additional varieties (new entry) and replacement of existing home varieties by foreign varieties (acquisitions).

The paper simplifies the analysis by assuming that there is no capital accumulation or intermediate goods. Although these assumptions do not allow us to address certain issues discussed in the literature, they are useful in focusing the analysis on basic macroeconomic and welfare effects of FDI within a dynamic framework.[3] As we are concerned with the effects at the aggregate level, we also abstract from heterogeneity across foreign (or home) firms.[4]

Nominal rigidities are introduced in the model by assuming adjustment costs for both wages and prices. One interesting issue examined in the paper is how macroeconomic variables respond to FDI over time under different monetary policy (exchange rate) regimes in the presence of nominal rigidities. The dynamic general equilibrium models of open economies typically assume free access to the international capital market. Under this assumption, the macroeconomic effects of a capital inflow arising from FDI are limited as they would largely induce an offsetting capital outflow rather than higher expenditures. Thus the paper also examines the macroeconomic implications of restricted access to the global capital market.

Another interesting issue is whether FDI improves or worsens the host country's welfare. In the paper's model, FDI confers benefits because foreign firms can produce

[3] Our model, for example, does not examine the issue of how FDI affects domestic investment (see Bosworth and Collins, 1999 for empirical evidence on this affect). Our model also does not account for vertical FDI. As well, the model does not incorporate a possible link between FDI and economic growth, which could arise from new varieties of capital goods as in models of endogenous technical change by Romer (1990), and Grossman and Helpman (1991). See Borenzstein et al. (1998) and Gao (2005) for discussion of this link.

[4] Models of heterogeneous firms have been used to understand organizational choices by individual firms and explore some recent developments in the pattern of FDI and international trade. See Helpman (2006) for a review of this line of analysis.

new varieties and employ more efficient production techniques. However, foreign firms also receive monopoly profits and the repatriation of these profits causes losses from FDI. Additional gains can arise from FDI if multinational's productive knowledge spills over to domestic firms. Recent empirical evidence suggests, however, that while foreign firms tend to be more productive than domestic firms, there is no strong evidence that they enhance the productivity of home firms through knowledge spillovers.[5] In the absence of strong spillovers, it is not obvious that FDI leads to a net increase in the host country's welfare.[6] The paper also examines whether nominal rigidities cause the short-run welfare effects of FDI to differ significantly from the long-run effects.

A quantitative version of the model is used to estimate the dynamic response of key macroeconomic variables to an FDI surge and assess the sign and the size of its effect on welfare. The baseline model is calibrated for a small emerging economy. The response of major macroeconomic variables in the model differs between fixed and flexible exchange rates, but is small when the economy has free access to the international financial market. An interesting result of the quantitative analysis is that FDI causes a welfare loss in the baseline model that assumes no technology spillovers. This result holds under both fixed and flexible exchange rates and in the presence as well as the absence of nominal rigidities. The paper examines the sensitivity of the results to a number of variations that include different assumptions about the FDI mix (of new entry and acquisitions in the traded and nontraded goods), access to the international financial

[5] For reviews of the evidence, see Hanson (2001), and Gorg and Greenaway (2004).
[6] The welfare effect of FDI for the host country can also be ambiguous in models different than ours. For example, Balcoa Ries (2001) shows that FDI may decrease home welfare in an endogenous growth model (where FDI increases the growth rate) because of the transfer of profits from home to foreign firms. Also, see Cheng et al (2005) who use a continuum Ricardian trade model with perfect competition to show that the effect of FDI by North can improve or worsen South's welfare.

market and relative productivity of foreign firms. This analysis yields a number of interesting results. FDI in the export good leads to a greater welfare loss than that in the nontraded good. Higher transaction costs in international borrowing or lending strengthen the macroeconomic impact of FDI. More productive foreign firms (with greater potential for technology transfer) cause a larger welfare loss.

The theoretical framework is presented in section 2. The basic quantitative analysis is discussed in section 3. Section 4 undertakes the sensitivity analysis and Section 5 concludes.

2. Theoretical Framework

2.1 Basic Setup

To explore the macroeconomic and welfare consequences of a surge in FDI, this section develops a simple dynamic general equilibrium model for a small emerging economy without capital accumulation and intermediate goods. Monetary policy is assumed to use the short term interest rate as its instrument, and for simplicity, money is not introduced explicitly in the model.[7] As the paper does not address fiscal policy issues, government expenditures and taxes are also not explicitly modeled.

There are two countries, a small home country (representing an emerging economy) and a large foreign country. An asterisk is used to denote foreign variables. One variable input, labor, is used in each country to produce a traded and a nontraded good. There are many households and firms in both economies. Each household supplies a differentiated labor service and each firm a differentiated product variety under monopolistic competition. To introduce nominal rigidities in both labor and goods

[7] The model can, however, be easily extended to allow money stock to be an instrument of monetary policy.

markets, it is assumed that both wages and prices are subject to quadratic adjustment costs. FDI is introduced in each sector by letting foreign firms (with higher labor productivity) produce a number of varieties in the home economy. FDI surge is modeled as an exogenous permanent increase in foreign firms due to new entry or acquisitions. We focus on the simple case where foreign households have 100% ownership of foreign firms and domestic households wholly own home firms.

Households trade a short-term foreign bond denominated in foreign currency to borrow or lend internationally. Initially, international borrowing or lending is assumed to be unrestricted but subject to a very small transaction cost that increases in foreign debt.[8]

2.2 Consumption and Production

The household's aggregate consumption basket is given by

$$C_t = \left[\chi_N^{1/\gamma} C_{N,t}^{(\gamma-1)/\gamma} + \chi_T^{1/\gamma} C_{T,t}^{(\gamma-1)/\gamma} \right]^{\gamma/(\gamma-1)}, \tag{1}$$

where $C_{N,t}$ and $C_{T,t}$ are consumption indexes for the differentiated nontraded and traded goods, $\chi_N + \chi_T = 1$, and γ is the elasticity of substitution between the traded and nontraded goods. The consumption index for the differentiated traded good is

$$C_{T,t} = \left[\chi_X^{1/\eta} C_{X,t}^{(\eta-1)/\eta} + \chi_M^{1/\eta} C_{M,t}^{(\eta-1)/\eta} \right]^{\eta/(\eta-1)}, \tag{2}$$

where $C_{X,t}$ is the consumption bundle of domestically-produced varieties of the traded good (which are also exported); $C_{M,t}$ is the corresponding consumption bundle of (imported) foreign varieties; η represents the elasticity of substitution between the two bundles; and $\chi_X + \chi_M = 1$.

[8] Such a cost ensures that the model converges to a deterministic steady state with zero net foreign assets.

In the presence of FDI in the home economy, foreign as well as home firms produce the nontraded and export goods. Letting n and n' denote the ranges of the nontraded-good varieties produced by home and foreign firms, the consumption bundle for the nontraded good is defined as

$$C_{N,t} = \left[\int_0^n C_{N,t}(i)^{(\sigma-1/\sigma} di + \int_n^{n+n'} C_{N,t}(i')^{(\sigma-1/\sigma} di \right]^{\sigma/(\sigma-1)}, \tag{3}$$

where $i \in [0, n]$ and $i' \in [n, n+n']$ index home and foreign firms, and σ is the elasticity of substitution between any pair of varieties. Similarly, indexing home and foreign firms producing the export good by $j \in [0, \nu]$ and $j' \in [\nu, \nu+\nu']$, we define the consumption bundle for the export good as

$$C_{X,t} = \left[\int_0^{\nu} C_{X,t}(j)^{(\sigma-1/\sigma} dj + \int_{\nu}^{\nu+\nu'} C_{X,t}(j')^{(\sigma-1/\sigma} dj' \right]^{\sigma/(\sigma-1)}. \tag{4}$$

Finally, the consumption aggregate for the import good is

$$C_{M,t} = \left[\int_0^{\nu^*} C_{M,t}(j^*)^{(\sigma-1/\sigma} dj^* \right]^{\sigma/(\sigma-1)}, \tag{5}$$

where $j^* \in [0, \nu^*]$ indexes varieties of the imported good (produced abroad).

Optimal allocation of the consumption expenditure between the nontraded and traded goods, between the home and foreign bundles of traded goods, and among different varieties of each product category leads to the following demand functions:

$$C_{N,t} = \chi_N C_t (P_{N,t} / P_t)^{-\gamma}, \quad C_{T,t} = \chi_T C_t (P_{T,t} / P_t)^{-\gamma}, \tag{6}$$

$$C_{X,t} = \chi_X C_{T,t} (P_{X,t} / P_{T,t})^{-\eta}, \quad C_{M,t} = \chi_M C_{T,t} (P_{M,t} / P_{T,t})^{-\eta}, \tag{7}$$

$$C_{N,t}(i) = C_{N,t}(P_{N,t}(i) / P_{N,t})^{-\sigma}, \quad C_{N,t}(i') = C_{N,t}(P_{N,t}(i') / P_{N,t})^{-\sigma} \tag{8}$$

$$C_{X,t}(j) = C_{X,t}(P_{X,t}(j) / P_{X,t})^{-\sigma}, \quad C_{X,t}(j') = C_{X,t}(P_{X,t}(j') / P_{X,t})^{-\sigma}, \tag{9}$$

$$C_{M,t}(j^{*}) = C_{M,t}(P_{M,t}(j^{*}) / P_{M,t})^{-\sigma} \tag{10}$$

where $P_{N,t}(i)$ and $P_{N,t}(i')$ are the prices of the varieties of the nontraded good produced by home and foreign firms; $P_{X,t}(j)$ and $P_{X,t}(j')$ are the prices of the export-good varieties produced by home and foreign firms; $P_{M,t}(j^{*})$ are the prices of a variety of the import good; P_t and $P_{T,t}$ are the cost-minimizing price indexes for the aggregate basket (1) and the traded goods consumption bundle (2) ; and $P_{N,t}$, $P_{X,t}$ and $P_{M,t}$ are the cost-minimizing price indexes for nontraded, export and import goods defined in (3), (4) and (5). Similarly, foreign optimal allocation between different categories of consumption goods yields the following foreign demand function for the export good and its varieties:

$$C^{*}_{X,t} = \chi^{*}_{X} C^{*}_{T,t} (P^{*}_{X,t} / P^{*}_{T,t})^{-\eta} . \tag{11}$$

$$C^{*}_{X,t}(i) = C^{*}_{X,t}(P^{*}_{X,t}(i) / P^{*}_{X,t})^{-\sigma}, \quad C^{*}_{X,t}(i') = C^{*}_{X,t}(P^{*}_{X,t}(i') / P^{*}_{X,t})^{-\sigma} \tag{12}$$

The cost-minimizing price indexes are defined as

$$P_t = \left[\chi_N P_{N.t}^{1-\gamma} + \chi_T P_{T,t}^{1-\gamma} \right]^{1/(1-\gamma)}, \quad P_{T,t} = \left[\chi_X P_{X,t}^{1-\eta} + \chi_M P_{M,t}^{1-\eta} \right]^{1/(1-\eta)}, \tag{13}$$

$$P_{N,t} = \left[\int_0^n P_{N,t}(i)^{1-\sigma} di + \int_n^{n+n'} P_{N,t}(i')^{1-\sigma} di' \right]^{1/(1-\sigma)}, \tag{14}$$

$$P_{X,t} = \left[\int_0^{\nu} P_{X,t}(j)^{1-\sigma} dj + \int_{\nu}^{\nu+\nu'} P_{X,t}(j')^{1-\sigma} dj' \right]^{1/(1-\sigma)} . \tag{15}$$

$$P_{M,t} = \left[\int_0^{\nu^{*}} P_{M,t}(j^{*})^{1-\sigma} dj^{*} \right]^{1/(1-\sigma)} \tag{16}$$

The technology for home firms is given by the following production functions:

$$Y_{N,t}(i) = A_N L_{N,t}(i), \quad Y_{X,t}(j) = A_X L_{X,t}(j), \tag{17}$$

where $Y_{N,t}(i)$, $L_{N,t}(i)$ and A_N represent output, a bundle of labor inputs and an index of labor productivity for a home firm producing the nontraded good, and $Y_{X,t}(j)$, $L_{X,t}(j)$ and A_X are the corresponding variables for a home firm producing the export good. The production functions for the foreign firms operating at home are

$$Y_{N,t}(i') = A'_N L_{N,t}(i'), \quad Y_{X,t}(j') = A'_X L_{X,t}(j') \tag{18}$$

which allow foreign firms to have different labor productivity than home firms. Output of each firm equals the sum of home and foreign demand in the export sector, but only home demand in the nontraded sector. Thus

$$Y_{X,t}(j) = C_{X,t}(j) + C^*_{X,t}(j), \quad Y_{X,t}(j') = C_{X,t}(j') + C^*_{X,t}(j'), \tag{19}$$

$$Y_{N,t}(i) = C_{N,t}(i), \quad Y_{N,t}(i') = C_{N,t}(i'). \tag{20}$$

The labor input bundle is an aggregate of differentiated services supplied by a continuum of households in the unit interval. The aggregate index of labor services, indexed by $l \in [0,1]$, in each sector is defined as

$$L_{N,t} = \left[\int_0^1 L_{N,t}(l)^{(\varepsilon-1)/\varepsilon}\, dl\right]^{\varepsilon/(\varepsilon-1)}, \quad L_{X,t} = \left[\int_0^1 L_{X,t}(l)^{(\varepsilon-1)/\varepsilon}\, dl\right]^{\varepsilon/(\varepsilon-1)}, \tag{21}$$

where ε 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, $L_t(l) = L_{N,t}(l) + L_{X,t}(l)$, as

$$L_t(l) = L_t(W_t(l)/W_t)^{-\varepsilon}, \tag{22}$$

where $L_t = L_{N,t} + L_{X,t}$, and W_t represents a wage index defined as

$$W_t = \left[\int_0^1 W_t(l)^{1-\varepsilon}\, dl\right]^{1/(1-\varepsilon)}. \tag{23}$$

The marginal costs of home and foreign firms in the two sectors are given by

$$MC_{N,t}(i) = W_t / A_N\,, \quad MC_{X,t}(i) = W_t / A_X\,. \tag{24}$$

$$MC_{N,t}(i') = W_t / A'_N\,, \quad MC_{T,t}(j') = W_t / A'_X \tag{25}$$

2.3 Households

The utility of an infinitely-lived household is given by

$$U_t(l) = \sum\nolimits_{s=t}^{\infty} \beta^{s-t} u[C_s(l), L_s(l)]\,, \tag{26}$$

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

$$u(.) = \left(\frac{C_\tau^{1-\theta}(l)}{1-\theta} - \frac{\psi L_\tau^{1+\mu}(l)}{1+\mu} \right). \tag{27}$$

Households hold domestic and foreign bonds. Domestic bonds are denominated in home currency while foreign bonds are denominated in foreign currency. Only foreign bonds are use for international borrowing or lending and their holding is subject to a transaction cost. There is also an adjustment cost associated with wage changes. Household budget constraint is given by

$$\begin{aligned} &B_{t+1}(l) + S_t B^*_{t+1}(l) = (1+R_{t-1})B_t(l) + S_t(1+R^*_{t-1})(1-TC_{t-1})B^*_t(l) \\ &+ W_t(l)L_t(l)(1-AC_{L,t}(l)) + PR_{H,t}(l) - P_t C_t(l), \end{aligned} \tag{28}$$

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 $t-1$; $PR_{H,t}(l)$ is the household's share of profits; and $AC_{L,t}(l)$ is the household's cost of adjusting wages. The wage adjustment

costs (as a proportion of wage income) are assumed to be given by the following quadratic function:

$$AC_{L,t}(l) = \frac{\omega_W}{2}\left(\frac{W_t(l)}{W_{t-1}(l)} - 1\right)^2. \tag{29}$$

Each household chooses consumption and sets the wage rate to maximize lifetime utility (24) subject to the budget constraint (25) and labor demand (20). The household optimization yields the following first order conditions:

$$\frac{\beta C_t(l)^{\theta} P_t}{C_{t+1}(l)^{\theta} P_{t+1}} = \frac{1}{1+R_t}, \tag{30}$$

$$\frac{S_t}{S_{t+1}} = \frac{(1+R_t^*)(1-TC_t)}{1+R_t}, \tag{31}$$

$$\begin{aligned}(\varepsilon - 1)(1 - AC_{L,t}(l))W_t(l) = \varepsilon\psi L_t^{\mu} P_t / C_t^{-\theta} - W_t^2(l)\partial AC_{L,t}(l)/\partial W_t(l) \\ -[(W_t(l)W_{t+1}(l)L_{t+1})/((1+R_t)L_t)]\partial AC_{L,t+1}(l)/\partial W_t(l).\end{aligned} \tag{32}$$

2.4 Firms

Each firm takes the 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 nontraded and traded goods are of the same form as wage adjustment costs and are given by the following quadratic functions:

$$AC_{N,t}(i) = \frac{\omega_P}{2}\left(\frac{P_{N,t}(i)}{P_{N,t-1}(i)} - 1\right)^2, \quad AC_{N,t}(i') = \frac{\omega_P}{2}\left(\frac{P_{N,t}(i')}{P_{N,t-1}(i')} - 1\right)^2, \tag{33}$$

$$AC_{X,t}(j) = \frac{\omega_P}{2}\left(\frac{P_{X,t}(j)}{P_{X,t-1}(j)} - 1\right)^2, \quad AC_{X,t}(j') = \frac{\omega_P}{2}\left(\frac{P_{X,t}(j')}{P_{X,t-1}(j')} - 1\right)^2, \tag{34}$$

where the adjustment cost parameter, ω_P, is assumed to be same for both home and foreign firms as well as both sectors.

For a home firm producing the nontraded good and facing the demand function given in (8), profits in each period equal

$$PR_{N,t}(i) = (P_{N,t}(i) - MC_{N,t}(i))C_{N,t}(P_{N,t}(i)/P_{N,t})^{-\varepsilon}(1 - AC_{N,t}(i)). \tag{35}$$

Profits of a foreign firm in the nontraded-good sector, $PR_{N,t}(i')$, are defined analogously. Let $D_{t,\tau}$ denote the rate used to discount τ-period values at period t. The firm i chooses $P_{N,\tau}(i)$ to maximize $\sum_{\tau=t}^{\infty} D_{t,\tau} PR_{N,\tau}(i)$. The optimal price at t satisfies the following first-order condition:

$$\begin{aligned}
&(1 - AC_{N,t}(i))[(\sigma - 1)P_{N,t}(i) - \sigma MC_{N,t}(i)] = \\
&-P_{N,t}(i)(P_{N,t}(i) - MC_{N,t}(i))\partial AC_{N,t}(i)/\partial P_{N,t}(i) \\
&-[P_{N,t}(i)(P_{N,t+1}(i) - MC_{N,t+1}(i))C_{N,t+1})/((1+R_t)C_{N,t})]\partial AC_{N,t+1}(i)/\partial P_{N,t}(i).
\end{aligned} \tag{36}$$

Firms producing the export good 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 $\tilde{P}_{X,t}(j) = S_t P^*_{X,t}(j)$ denote the price of a home variety set for the foreign market. Profits of a home firm in the export sector are then given by

$$\begin{aligned}
PR_{X,t}(j) &= (P_{X,t}(j) - MC_{X,t}(j))C_{X,t}(P_{X,t}(j)/P_{X,t})^{-\varepsilon}(1 - AC_{X,t}(j)) \\
&+ (\tilde{P}_{X,t}(j) - MC_{X,t}(j))C^*_{X,t}(\tilde{P}_{X,t}(j)/\tilde{P}_{X,t})^{-\varepsilon}(1 - AC_{X,t}(j)),
\end{aligned} \tag{37}$$

where $\tilde{P}_{X,t}$ is the price index for the bundle of home varieties sold abroad. Profits of a foreign firm, $PR_{X,t}(j')$, are similarly defined. The first-order conditions for the optimal

prices of export-good varieties are similar to (33) and imply that $\tilde{P}_{X,t}(j) = P_{X,t}(j)$ and $\tilde{P}_{X,t}(j') = P_{X,t}(j')$.

2.5 Equilibrium

In equilibrium, all households in the home economy 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 profits, $PR_{H,t}(l) = PR_{H,t}$. As well, equilibrium prices, firm profits and outputs are the same for all i, j, i' and j'. Let $P_{N,t} = P_{N,t}(i)$, $P_{X,t} = P_{X,t}(j)$, $P'_{N,t} = P_{N,t}(i')$, and $P'_{X,t} = P_{X,t}(j')$. In each sector, aggregate profits for home and foreign firms equal $PR_{N,t} = nPR_{N,t}(i)$, $PR_{X,t} = \nu PR_{X,t}(j)$, $PR'_{N,t} = n'PR_{N,t}(i')$, and $PR'_{X,t} = \nu' PR_{X,t}(j')$. Similarly, aggregate home and foreign sectoral outputs equal $Y_{N,t} = nY_{N,t}(i)$, $Y_{X,t} = \nu Y_{X,t}(j)$, $Y'_{N,t} = n'Y_{N,t}(i')$, and $Y'_{X,t} = \nu' Y_{X,t}(j')$.

Since households profits equal total profits of domestic firms,

$$PR_{H,t} = PR_{N,t} + PR_{X,t}, \tag{38}$$

where $PR_N(i)$ and $PR_X(j)$ are the same for all i and j in equilibrium. Letting $PR_{F,t}$ denote total profits of all foreign firms operating at home, we also have

$$PR_{F,t} = PR'_{N,t} + PR'_{X,t}. \tag{39}$$

As the profits of foreign firms are repatriated to foreign households, national product equals

$$NP_t = DP_t - PR_{F,t} = W_t L_t (1 - AC_{W,t}) + PR_{H,t} \tag{40}$$

where $DP_t \equiv P_{N,t}Y_{N,t} + P'_{N,t}Y'_{N,t} + P_{X,t}Y_{X,t} + P'_{X,t}Y'_{X,t}$ denotes domestic product.

Aggregating household budget constraints, noting that home bonds are not held abroad ($\int_0^1 B_t(l)dl = 0$), and using (39), we can express the national budget constraint as

$$S_t B_{t+1}^* = S_t(1+R_{t-1}^*)(1-TC_{t-1})B_t^* + NP_t - P_t C_t . \quad (41)$$

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

$$TC_t = \phi_1 \frac{\exp(\phi_2 S_t B_{t+1}^* / P_t) - 1}{\exp(\phi_2 S_t B_{t+1}^* / P_t + 1}, \quad \phi_1 > 0, \phi_2 > 0 . \quad (42)$$

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

$$CA_t = S_t(B_{t+1}^* - B_t^*) = NI_t - P_t C_t , \quad (43)$$

where $NI_t = S_t(1+R_{t-1}^*)(1-TC_{t-1})B_t^* - S_t B_t^* + NP_t$ represents national income.

2.6 Monetary policy, FDI Surge

We consider a range of monetary policies. We focus on the special cases of pure fixed and flexible exchange rates, which have received considerable attention in the literature. These special regimes can be represented by the following assumptions

$$S_t = \bar{S} , \quad (44)$$

$$P_t = \bar{P} , \quad (45)$$

where the pure flexible exchange rate case is identified with a policy of fixing the price level (or maintaining a zero rate of inflation).[9]

An FDI surge is modeled as a permanent increase in the number of foreign firms. New foreign firms are assumed to consist of two types: (1) firms that can introduce new

[9] The model could be easily extended to allow for a deterministic inflation rate. In this case, nominal variables can be redefined as deviations from a deterministic trend. We also explored a monetary policy regime described by the following interest rate rule: $R_t = \bar{R} + \delta \log(P_t / \bar{P}), \quad \delta > 0$, where $\bar{R}$ denotes the steady-state value of the interest rate and $\bar{P}$ is the price level target.

varieties in the home economy, and (2) firms that can produce existing home varieties more efficiently (at a lower cost) than home firms. New entry involves more firms of the first type while acquisitions lead to an increase in the number of the second type of firms.[10] To acquire a home firm, the foreign firm pays a price equal to the discounted value of the home firm's stream of profits. In our simple setup, new entry does not involve purchase of any domestic assets and thus simply results in an outflow of the profits of new firms in the balance of payments account.[11] Acquisitions, on the other hand, lead to an FDI inflow (arising from the purchase of home firms) followed by an outflow of profits of acquired firms. Letting n_A and ν_A denote the number of firms acquired in period t in the two sectors, the FDI inflow in the period equals

$$F_t = \sum_{\tau=t}^{\infty} (n_A PR_{N,\tau} + \nu_A PR_{X,\tau}) / (1+R_\tau)^{\tau-t}. \qquad (46)$$

3. Basic Quantitative Analysis

3.1 Calibration

The model is calibrated for a small emerging economy. Parameterization of the baseline model is summarized in Table 1. The initial steady-state values of consumption ($\bar{C}$), labor supply ($\bar{L}$), various home prices ($\bar{P}$, $\bar{P}_N$, $\bar{P}_T$, $\bar{P}_X$ and $\bar{P}_M$), and the exchange rate ($\bar{S}$) are all normalized to equal 1.0. Under this normalization, χ_N and χ_T represent the steady-state shares of nontraded and traded goods in aggregate consumption while χ_{TH} and χ_{TF} are the steady-state shares of home and foreign goods in traded goods. We

[10] We assume implicitly that that a new or existing domestic variety produced by a multinational is not the same as its foreign variety (produced abroad). We use this assumption to stay close to the standard framework of macroeconomic models of open economies. Note, however, that this view of FDI is somewhat different than the typical formulation where a multinational can produce the same variety at different locations and chooses whether to produce it in one or multiple locations.

[11] An extension of our model to add land or capital as another factor in the production function would allow new entry to also generate capital inflows.

assume that $\chi_N = 0.6$, $\chi_T = 0.4$, and $\chi_{TH} = \chi_{TF} = 0.5$.[12] Since aggregate expenditures equal GDP in steady state, these assumptions imply that in the long run, traded goods would account for 40% of GDP while imports (or exports) would equal 20% of GDP.[13] These values are representative of a number of emerging economies.

The elasticity of substitution between traded and nontraded goods (γ) is generally considered to be close to one, and we assume that this value equals 1.1. The substitution elasticity between home and foreign traded goods (η) is set equal to 2.0, which represents the higher end of the range of estimates for this parameter for macroeconomic models, but below the values suggested by studies at a more disaggregated or multi-sectoral level (e.g., Hertel et al, 2004). We choose a value of 8.0 for the substitution elasticity for varieties of each product category (σ).This value implies a mark up of a little less than 15 percent and is within the range of various estimates for markups.[14] Substitution elasticity for labor services (ε) is also assumed to equal 8.0.

Letting a quarter represent a unit of time in the model, the discount rate is assumed to be 0.99, which implies an estimate of the annualized real rate of interest equal to 4%. There is a wide range of estimates for other parameters of the utility function. For the baseline version, we choose a value of 0.5 for the intertemporal elasticity of substitution ($1/\theta$), and 0.25 for the elasticity of labor supply ($1/\mu$). Alternative values of these parameters are explored in our sensitivity analysis. Given our normalization and

[12] As there is balanced trade in steady state, the steady state value of $\chi^*_{TH} C^*_{T,t}$ equals 0.2.

[13] The real GDP in the model can be expressed as $G_t = (P_{N,t} Y_{N,t} + P_{TH,t} Y_{T,t}) / P_t$. In steady state, net foreign assets equal zero and $G_t = C_t$.

[14] 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.

the choice of ε, the steady-state version of (31) is used to calculate the value of ψ (the weight for the labor effort index in the utility function).

Parameters of the adjustment cost functions (ω_P and ω_W) are set equal to 1400 each. These values generate plausible inertia in the behavior of wages and prices.[15] In the transaction cost function, values of both parameters (ϕ_1 and ϕ_2) are assumed to equal 0.01. These values lead to a slow convergence to a steady state with zero net foreign assets.

Empirical studies generally find foreign firms to have higher productivity than home firms, but estimates of the productivity gap vary across studies. For the baseline case, we assume that a foreign firm's labor productivity is 10% larger than that of a home firm (we let $A_N = A_X = 1$, and $A'_N = A'_X = 1.1$). Later, we explore the effect of a higher or a lower productivity gap.

In the initial steady state, we assume (for simplicity) that foreign firms are absent and normalize the number of home firms to equal unity (i.e., we let $n = \nu = 1$, and $n' = \nu' = 0$). The FDI surge is represented by a mix of increases in the number of foreign firms (due to new entry and acquisitions) and decreases in the number of home firms (because of acquisitions) in the two sectors. To determine this mix, we assume that the FDI surge represents an inflow in the balance of payments close to 7.5% of initial national income.[16] As suggested by the recent trends in the sectoral composition of FDI, we also assume that acquisitions generate similar FDI inflows in each sector. The ratio of new entrants to acquired firms is difficult to pin down. We later explore the effect of

[15] Laxton and Pesenti (2003) assume similar values for adjustment cost functions of this type.
[16] This number is within the range of increases in FDI inflows (as a percentage of GDP) experienced by several emerging economies over short periods.

varying this ratio, but we simply assume that this ratio equal to one in the baseline model.[17] Using the above assumptions, the FDI mix is defined as follows: $n' = 0.01$, $\nu' = 0.015$, $n_A = 0.005$ and $\nu_A = 0.0075$.[18]

3.2 Macroeconomic Adjustment

To explore the consequences of an FDI surge, the baseline model examines the effects of an unanticipated permanent increase in the FDI represented by the mix defined above. This mix generates initial sales of foreign firms equal to about 2.3% (and an FDI inflow close to 7.5%) of initial national income.[19] For illustrative purposes, all of the FDI increase is assumed to occur in one period.[20] This section discusses the macroeconomic adjustment to this increase. Figure 4 illustrates the dynamic response of key macroeconomic variables over 20 quarters to the FDI increase in quarter 1 (quarter 0 represents the initial steady state). To explore the role of the exchange rate, the response of each variable is shown for both the fixed and flexible exchange rate cases.

The first four graphs in Figure 4 illustrate the behavior of the exchange rate, the price level, the rate of interest and the current account under the two exchange rate regimes. Under fixed exchange rates, the interest rate is linked to the constant foreign interest rate via interest rate parity. The price level falls as foreign firms introduce more varieties and lower prices of both new acquired varieties (because they have lower costs).

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[17] The UNCTAD data on Mergers and Acquisitions (M & A) suggests that acquisitions (which account for the bulk of M & A) are an important source of FDI. As the data on M & A is not comparable with that on FDI, it is difficult to determine the relative importance of new entry and acquisitions.

[18] These values are derived as follows. To generate the same FDI inflow in each sector, we let $\nu_A = 1.5 n_A$, since the nontraded sector is 1.5 times the export sector. We also let $n' - n_A = n_A$ and $\nu' - \nu_A = \nu_A$, to have the ratio of new entry to acquisition equal one. Using these constraints, n', ν' and ν_A can be made functions of n_A. The value of n_A is chosen to generate the desired FDI inflow.

[19] The DYNARE program is used to obtain a deterministic steady-state solution to the nonlinear model before and after FDI, and to derive the dynamic response of model variables to this change.

[20] The results are not affected much by relaxing this assumption.

The price level falls gradually because of wage-price stickiness. The behavior of these variables is different under flexible exchange rates. To prevent the price level from falling under this regime, the interest rate is lowered to stimulate demand. The decrease in the home interest rate below the foreign interest rate leads to an offsetting exchange rate depreciation over time (to maintain the interest rate parity). To bring about this depreciation, the exchange rate rises initially and overshoots its new equilibrium value.

Under both regimes, the inflow of FDI funds causes a sharp increase in the current account. This effect occurs because the inflow arises from the sale of domestic firm's equity (i.e., claims to future profits), and this sale does not, by itself, represent an increase in long-term income. The income generated by the sale is thus used largely to purchase foreign assets rather than increase expenditures and thus, the inflow results in an almost equivalent surplus in the current account. It is interesting to note that under flexible rates, the value of the home currency falls initially (the exchange rate rises) and thus the large current account surplus in the initial period is accompanied by depreciation.

The last four graphs in Figure 4 exhibit the dynamic response of consumption, employment, real domestic product and the balance of trade. As the figure shows, the flexible exchange rate paths for all four variables lie above the fixed exchange rate paths over the first ten quarters. This difference can be explained by the different behavior of the interest and exchange rates between the two regimes. The lower interest rates under the flexible exchange rates induce greater consumption, which increases domestic demand for both home and foreign goods. The higher exchange rate under this policy makes home goods relatively cheaper and switches both domestic and foreign demand from foreign to home goods. Both of these effects stimulate domestic output and

employment while the exchange-rate effect dominates in producing a larger balance-of-trade surplus under flexible rates.

Although the macroeconomic dynamics differs between the fixed and flexible exchange rate cases, the macroeconomic impact of FDI is not large in both cases. In the first quarter, for example, consumption increases by 0.26% under flexible exchange rates, and decreases by 0.08% under fixed exchange rates. The main reason for this result is that in the presence of free access to the international financial market, the FDI inflow is used essentially to acquire foreign assets, and thus it does not significantly boost demand for goods. Section 4.2 explores how the macroeconomic effects of FDI might change if international borrowing and lending involves substantial transactions costs.

3.3 Welfare Effects

This section examines the welfare effects of FDI under different exchange rate policies. There are two opposing effects of FDI on welfare: a positive effect arising from the introduction of new varieties and the use of more efficient production techniques, and a negative effect caused by the outflow of monopoly profits. The sign and the magnitude of the net welfare effect of FDI is an interesting empirical issue to be explored. We use an equivalent-variation index, α, to measure the net welfare effect of FDI. This index is defined as the constant amount (expressed as a fraction of steady-state consumption before FDI) that needs to be given to or taken away from households to make them indifferent between the initial steady state and the new state (including the transition period) after FDI. This index is given by the following relation:

$$\sum_{s=t_0}^{\infty} \beta^s u[(1+\alpha)\bar{C}, \bar{L}] = \sum_{s=t_0}^{\infty} \beta^{s-t_0} u(C_s, L_s) \qquad (47)$$

where $\{C_s, L_s\}_{s=t_0}^{\infty}$ is the sequence of consumption and labor supply after the FDI injection at time t_0, and $u(.)$ is defined in (27). The net effect is positive or negative as α is greater or less than zero.

Table 2 displays the welfare measures for both fixed and flexible exchange rates in the baseline model as well as a number of variations discussed below. The macroeconomic adjustment for both cases is based on transitional dynamics due to wage-price adjustment costs. To see whether transitional dynamics plays an important role in determining the welfare effect, the table also shows the welfare index for the baseline model in the absence of wage-price adjustment costs (i.e., with $\omega_w = \omega_p = 0$ in the baseline model). In this case, wages and prices are fully flexible and the economy moves form the initial to the new steady state without any transitional dynamics (and the adjustment is essentially the same for both fixed and flexible exchange rates).

For the baseline model, the results in the table show that despite the differences in the response of macroeconomic variables, the welfare effect is similar for both exchange rate regimes. In both cases, FDI causes a welfare loss equal to about seven tenths of one percent of initial consumption (or national income). The macroeconomic adjustment, in fact, does not make any appreciable difference as the loss is about the same even in the absence of wage-price adjustment costs. Nominal rigidities can potentially lead to significant welfare effects by slowing down the adjustment of relative prices. The FDI package in the baseline model, however, requires very little adjustment in relative prices and hence there is little or no scope for macroeconomic adjustment to influence welfare.

4. Further Analysis

4.1 Alternative FDI Mixes

One interesting issue is whether FDI in the export sector has different effects than that in the nontraded sector. To explore this question, we consider two special cases, in which all FDI takes place either in the export sector or in the nontraded sector. For each case, we pick the values for new entry and acquisitions, which lead to roughly the same foreign sales and FDI as the baseline mix.[21] Export-oriented FDI is generally thought to exert a more favorable effect on the balance of trade than FDI directed towards nontraded goods. Our analysis (see Figure 5) shows that while the export-sector FDI does indeed initially produce a larger balance of trade surplus than the nontraded-sector FDI under fixed exchange rates, this result is reversed under flexible exchange rates. To understand this reversal, note that FDI in the nontraded- sector leads to a larger appreciation of the exchange rate (because it lowers the relative price of the nontraded good), and a greater improvement in the balance of trade through this channel. This indirect effect of the nontraded-sector FDI on the balance of trade is stronger in our model than the direct effect of the export-good FDI (via more varieties and lower prices of the export good).

The welfare effect also differs considerably between the two cases. As Table 2 (rows 3 and 4) shows, FDI concentration in the export sector leads to a much higher welfare loss than that in the nontraded sector. The key reason for this result is that positive benefits of FDI in the form of lower prices of foreign varieties are realized by home residents in the case where FDI takes place in the nontraded sector. In the case of

[21] These values are: $\nu_A = .015$, $\nu' = .03$, and $n_A = n' = 0$ for the export- sector FDI; and $n_A = .01$, $n' = .02$ and $\nu_A = \nu' = 0$ for the nontraded-sector FDI.

the export-sector FDI, however, some of these FDI benefits are transferred to foreign residents (via changes in the terms of trade).

We also examine the implications of changing the ratio of new entrants to acquisitions. To facilitate comparison with the baseline mix, we kept the number of foreign firms (and thus the level of foreign sales) in each sector the same, but allowed the new entry-acquisition ratio to vary between a higher value of 2.0 and a lower value of 0.5. In this experiment, the main effect of varying the ratio turns out to be a change in the FDI capital inflow. This change does not make an appreciable difference to the response of other macroeconomic variables. Also, the difference in the welfare effect between the high- and the low-ratio cases is not large (see rows 5 and 6 of table 2).

4.2 High Transactions Costs in the International Financial Market

We next consider the case of an economy that is not well integrated with the global financial market because national financial institutions are not well developed or there are other impediments to international borrowing or lending. In our setup, we can capture this possibility by assuming a high value of TC, which represents transactions costs in the purchase or sale of foreign assets. To highlight the difference from the baseline model (where TC is close to zero), we consider a case where the value of TC equals about 15% of the world interest rate for foreign assets held in quarter 1.[22]

Figures 6 and 7 compare the macroeconomic effects of the basic FDI mix between the high-transaction-costs and baseline cases under both fixed and flexible exchange rates. Costly intermediation in the international financial market induces households to use more of the FDI inflow to increase current spending. As the figures

[22] Using (42), we set $\phi_1 = \phi_2 = 0.2$ to obtain this value.

show, the macroeconomic impact of FDI on consumption, employment and real domestic product is magnified under both exchange rate regimes. In the first quarter, for example, consumption in the presence of high transaction costs is 1% higher than that in the baseline case under fixed as well as flexible exchange rates. High-transaction costs also lead to a smaller balance of trade as less foreign assets are acquired in this case.

Surprisingly, the welfare loss is somewhat lower under high transaction costs. One reason for this result is that in the presence of monopolistic competition, equilibrium output and employment are below the socially optimal levels. Short-run expansion of these variable induced by the FDI inflow in the case of high transaction costs is thus welfare improving.

4.3 The Relative Productivity of Foreign Firms

There is strong evidence that multinationals tend to be more productive than local firms, but the estimates of the productivity differential differ across studies[23]. One intriguing issue is whether a greater productivity differential would improve or worsen host country's welfare. On the one hand, more productive foreign firms would confer benefits of transferring more superior technology. More efficient foreign firms, on the other hand, would capture a greater share of the market and extract larger monopoly profits.

To determine the influence of higher productivity on the net welfare effect of the basic FDI mix, we considered a range of productivity differentials of foreign over domestic firms from 5% to 20%.[24] The results of this experiment are illustrated in Figure 8. For the baseline value of the elasticity of substitution between varieties (σ) equal to 8,

[23] For example, see Haddad and Harrison (1993), Aitken and Harrison (1999) and Takii (2004) for evidence on productivity differences between home and foreign firms in certain developing countries.
[24] We increase $A_N'(=A_X')$ from 1.05 to 1.2 while keeping $A_N = A_X = 1$.

the figure shows that the welfare loss increases substantially as foreign firms become more productive. The productivity advantage in the baseline model is 10%. Doubling this advantage almost doubles the loss under fixed as well as flexible exchange rates. The figure also shows the effect of lowering the substitution elasticity to 5. The lower elasticity implies a higher mark up and thus larger monopoly profits per unit of output. It also implies a lower price elasticity of demand, which would decrease the loss of market share by less productive domestic firms. The price-elasticity effect dominates the mark-up effect and the welfare loss is smaller for the case of the lower substitution elasticity over the entire range of the productivity differential. However, even for the lower substitution elasticity, the welfare loss increases as the productivity differential becomes larger.

5. Conclusions

The paper examines the macroeconomic and welfare effects of an increase in FDI within the framework of a dynamic general equilibrium model. A number of emerging countries have recently experienced large increases in FDI inflows over a short period. This paper does not attempt to explain why such an FDI surge takes place, but its model does provide new results about both the macroeconomic and welfare effects of the surge.

The macroeconomic impact of an FDI capital inflow depends on whether there are significant transaction costs (or other frictions) in international borrowing or lending. In the standard model with very small transaction costs, FDI inflows essentially lead to purchase of foreign assets (i.e., a current account surplus) and have little effect on current spending or macroeconomic activity. In the presence of large transaction costs, however, the macroeconomic impact of FDI is strong.

The net welfare effect of multinational penetration is ambiguous on theoretical grounds, especially if (as discussed in the introduction) strong technology spillovers of FDI are absent. The quantitative version of our model implies that the FDI surge causes a welfare loss for the host country under a plausible set of parameter values. Our analysis also identifies factors that influence the sign and the magnitude of the welfare effect. One interesting result is that more productive foreign firms worsen home country's welfare.

To focus on basic effects of an FDI increase, the paper uses a simple model where one factor, labor, is used to produce final goods. One limitation of this framework is that it does not incorporate certain features of FDI such as that multinational penetration generally involves purchase of non-labor factors (e.g. land) and often leads to investment in capital. Our model also does not allow for the possibility that foreign firms may introduce new varieties of intermediate goods in the host country, which would be beneficial for home firms producing final goods. Extension of our framework to include additional factors of production or intermediate goods would address further issues about the effects of FDI and represent an interesting topic for future research.

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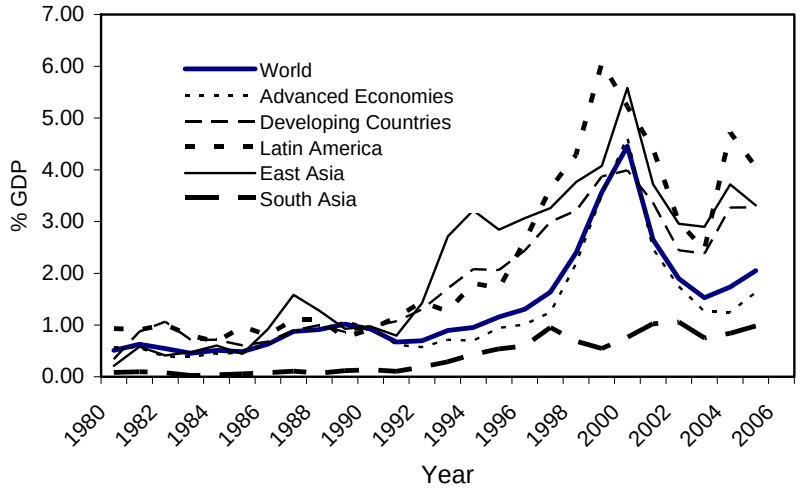
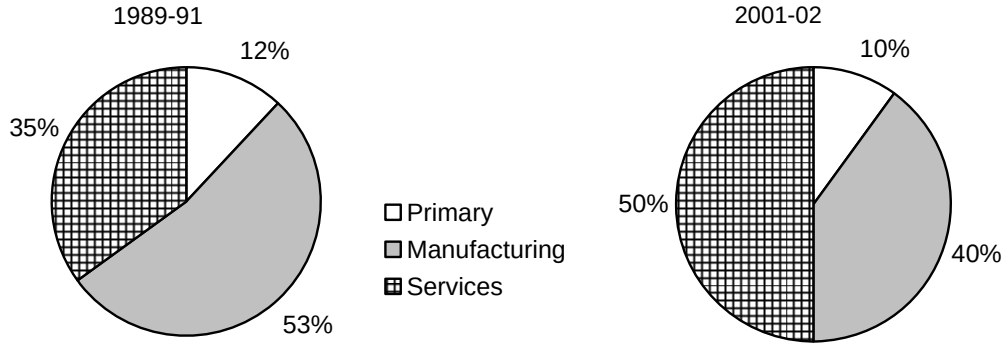
Figure 1: FDI Inflows (in % of GDP)



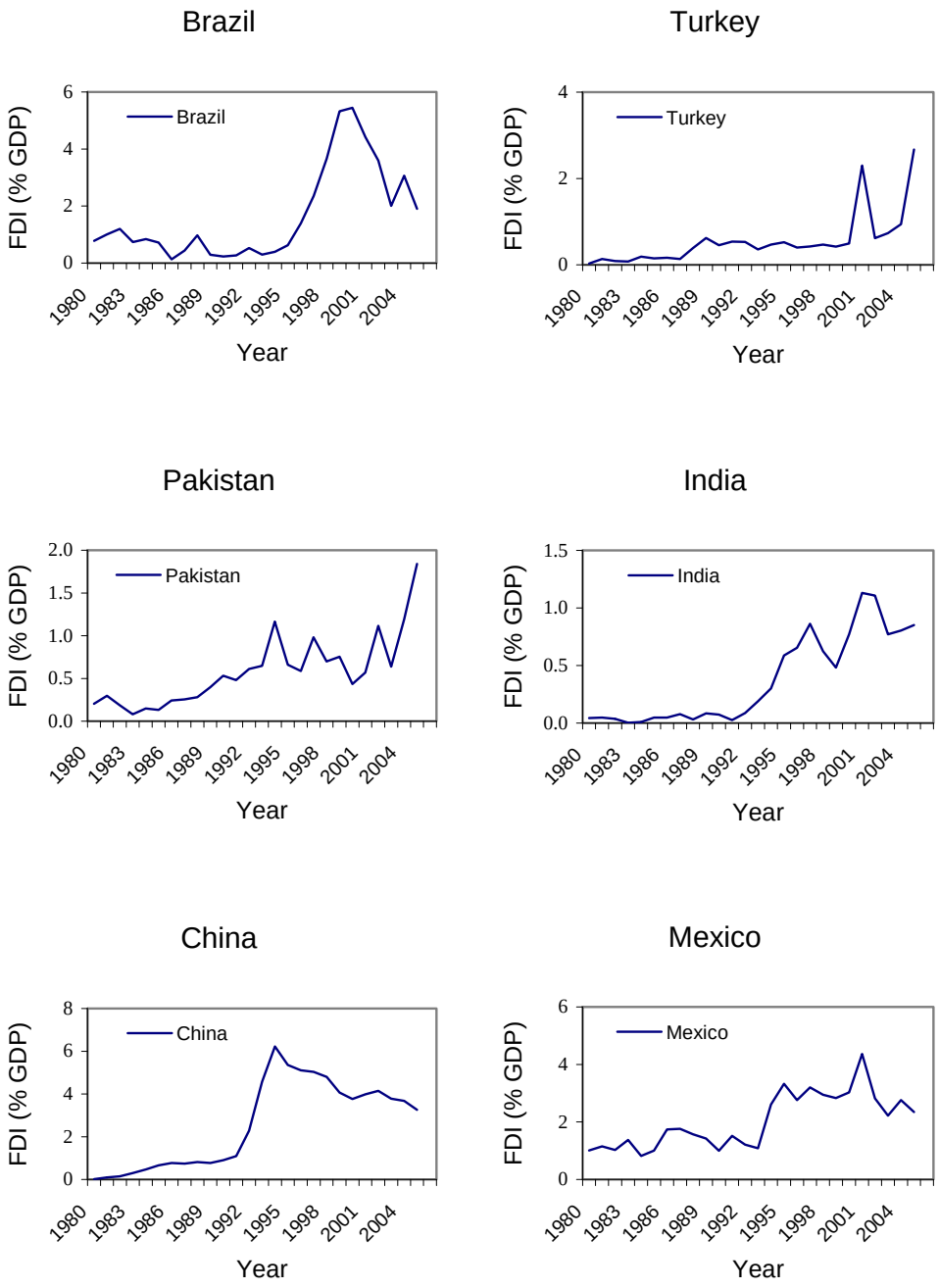
Source: World Investment Report, UNCTAD 2006

Figure 2: Distribution of FDI by Sectors in Developing Countries, 1989-91 and 2001-02



Source: World Investment Report, 2004, UNCTAD.

Figure 3: FDI (in percent of GDP) for Selected Countries



Source: World Investment Report, UNCTAD, www.unctad.org

Figure 4: Macroeconomic Effects of FDI under Fixed and Flexible Exchange Rates

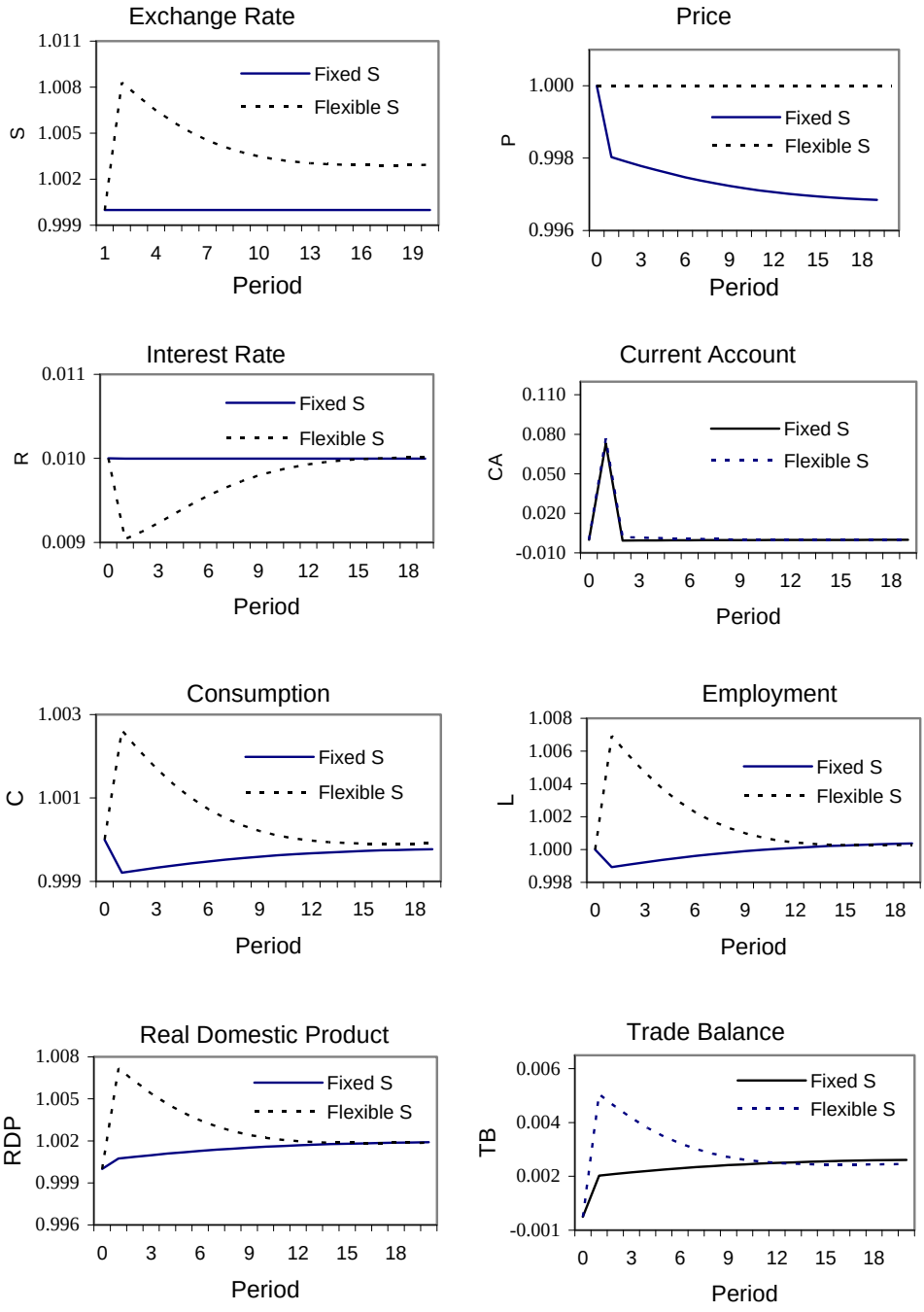


Figure 5: Trade Balance Dynamics Under Different FDI Packages

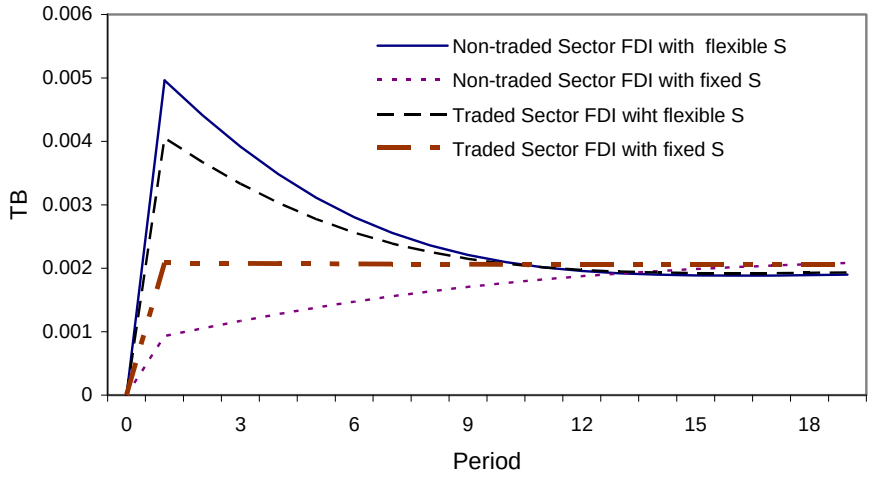


Figure 6: Macroeconomic Effects of FDI under Fixed Exchange Rates with Different Transaction Costs

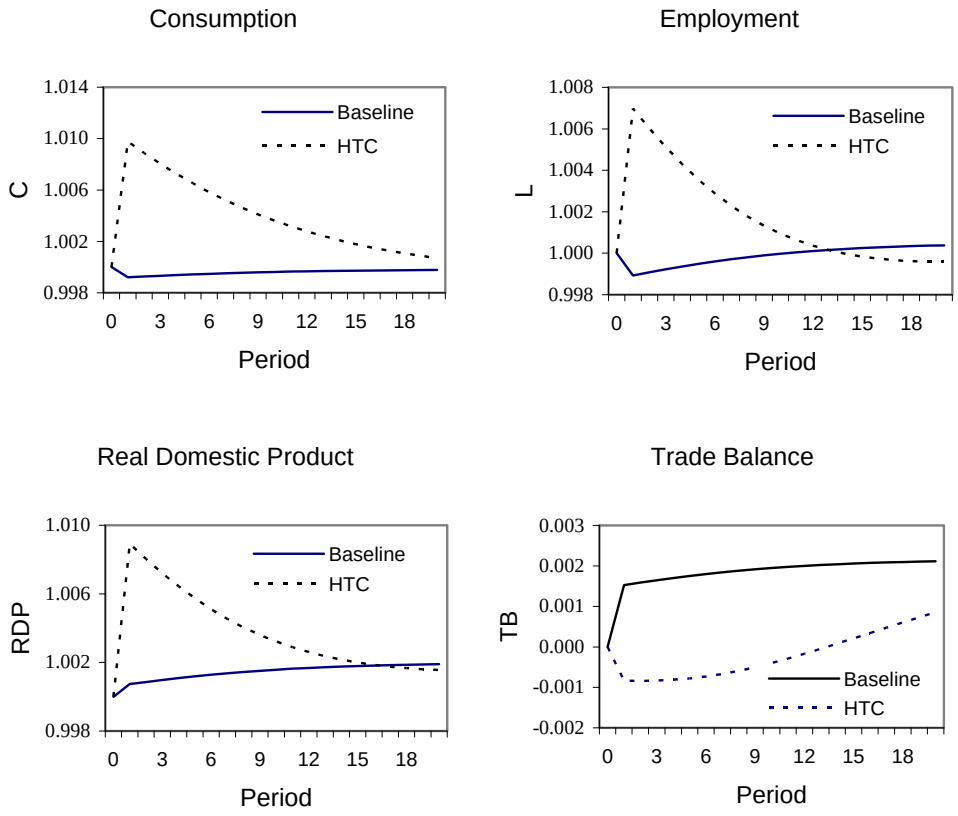


Figure 7: Macroeconomic Effects of FDI under Flexible Exchange Rates with Different Transaction Costs

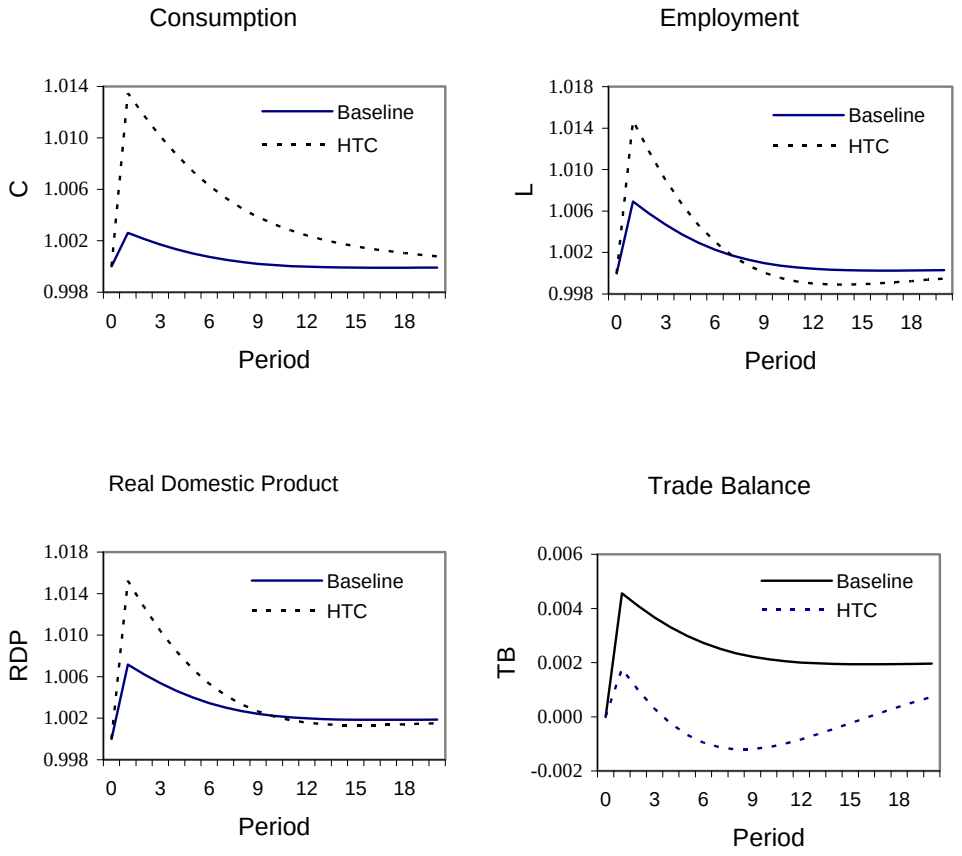


Figure 8: Welfare Analysis with Varying Relative Productivity of Foreign Firms

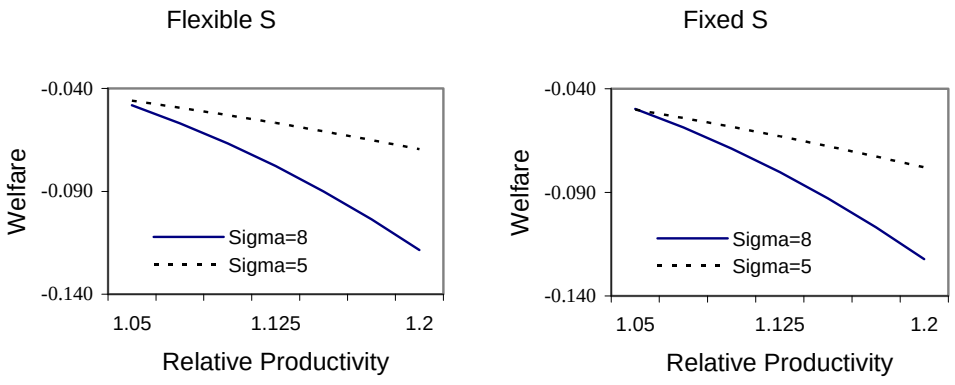


Table 1. Baseline Model: Parameter Values and Normalizations

Shares	$\chi_N = 0.6, \chi_T = 0.4, \chi_M = 0.5, \chi_X = 0.5$
Utility Parameters	$\theta = 2.0, \mu = 4.0, , \ \beta = 1.0/1.01$
Elasticities of Substitution	$\gamma = 1.1, \eta = 2.0, \sigma = \varepsilon = 8.0$
Adjustment and Transaction Costs	$\omega_P = \omega_W = 1400, \phi_1 = \phi_2 = 0.01$
Technology Parameters	$A_N = A_X = 1.0, A'_N = A'_X = 1.1$
Initial Steady-State Values	$\bar{C} = \bar{L} = 1.0$ $\bar{S} = \bar{P} = \bar{P}_N = \bar{P}_T = \bar{P}_M = \bar{P}_X = 1.0$ $n = \nu = 1, n' = \nu' = 0$

Table 2. Welfare Effects of the FDI Surge

	Welfare index as % of initial national income [$(\alpha / \bar{C})100$]	
	Fixed Exchange Rates	Flexible Exchange Rates
Baseline Model		
1. With wage-price adjustment costs	-0.069	-0.067
2. Without wage-price adjustment costs	-0.068	-0.068
Variations		
3. FDI in the export sector	-0.090	-0.089
4. FDI in the nontraded sector	-0.041	-0.038
5. Higher new entry-acquisition ratio	-0.066	-0.066
6. Lower new entry-acquisition ratio	-0.069	-0.067
7. High Financial transactions costs	-0.046	-0.044