Capital Inflows, Resource Reallocation and the Real Exchange Rate

Emmanuel K.K. Lartey

California State University, Fullerton

August 2008

1 I am highly indebted to Fabio Ghironi, Peter Ireland, Benn Steil, Luisa Lambertini, Christopher Baum, Matteo Iacoviello, Andrew Gill, two anonymous referees, and participants at workshops and R@BC seminars at Boston College for invaluable comments. I am responsible for all errors.

2 Correspondence: Department of Economics, California State University, Fullerton, 800 N. State College Blvd, Fullerton, CA 92834. E-mail: elartey@fullerton.edu, Tel: 714-278-7298, Fax: 714-278-3097.
Abstract

A large capital inflow to a developing economy can potentially cause a real exchange rate appreciation that is detrimental to the prospects of its tradable sector; a phenomenon known as the Dutch disease. I analyze the effects of both the level and share of capital inflow on resource reallocation and real exchange rate movements in a small open economy. I find that there exists a trade-off between resource reallocation and the degree of real exchange rate appreciation. In particular, the less labor the tradable sector loses to the nontradable sector, the greater is the real exchange rate appreciation. This result is driven by the share of investment accounted for by foreign capital, and suggests that an emerging market economy that adopts a production technique which utilizes a greater share of foreign capital relative to domestic capital will be more susceptible to the Dutch disease following an increase in capital inflow. The results also imply that a policy designed to minimize real exchange rate appreciation during capital inflow episodes should encompass measures aimed at stabilizing prices of nontradables.

JEL Classification: F40 F41

Keywords: Capital inflows, Dutch disease, Real exchange rate
1 Introduction

The macroeconomic effects of foreign capital in Asia and Latin America between the mid 1980s and early 1990s are well documented, and the largest recipients of capital inflows have experienced rising current account deficits, real exchange rate appreciation, high investment and consumption, and GDP growth. The latter part of the 1990s witnessed the integration of poor developing countries into the global economy, accompanied by a surge in private capital inflows. Net private capital inflows to developing countries increased from about US$50 billion a year over the period 1987-89 to over US$150 billion a year during 1995-97. Foreign Direct Investment (FDI) flows to poor developing countries rose from 0.4 percent of the gross domestic product (GDP) in the late 1980s to 2.8% in the late 1990s. In fact, relative to the size of their economies, poor countries now receive about the same level of FDI as middle-income countries.

There are concerns about the potential undesirable effects of capital inflows on these developing economies. Of particular interest is whether enormous capital inflows could cause a real exchange rate appreciation, and consequently depress the tradable sector of these economies. These real exchange rate effects are known as the ‘Dutch disease’, a term originally used to describe the difficulties faced by manufacturing in the Netherlands following the development of natural gas on a large scale which triggered a major appreciation of the real exchange rate. The term is now commonly used to refer to any situation in which a natural resource boom, large foreign aid or capital inflow, causes a real exchange rate appreciation that jeopardizes the prospects of manufacturing (Williamson, 1995). The Dutch disease is characterized by two concepts, namely the resource movement effect and spending effect. Corden and Neary (1982) use a small open economy model to explain the resource movement effect and spending effect following a technological progress in the tradable good sector. In response to the technology shock, the marginal product of the mobile factor (labor) in the technologically improved sector rises, drawing resources out of other sectors (resource movement). Higher real income from this sector leads to increased demand for nontradable goods and rising nontradable good prices (spending effect), which causes a further reallocation of resources toward the nontradable sector, hurting the tradable sector in the process.
In this paper, I analyze the effects of capital inflows on resource reallocation and real exchange rate movements in emerging market economies. I examine the implication for the Dutch disease, of an increase in both the level and share of foreign capital. The existing literature on general equilibrium analysis of the effects of foreign capital in small open economies has studied issues related to real exchange rate fluctuations and the current account without addressing the potential resource reallocation and spending effects. Figures 1 and 2 illustrate this point. As depicted, there was an expansion in nontradable output as a share of GDP and a decline in the production of manufactures as a share of GDP in both Argentina and the Philippines particularly during the peak inflow period of 1990-1994, with the changes being more pronounced in Argentina than in the Philippines. Past studies of capital inflows in general equilibrium settings have ignored these effects. This paper therefore departs from these studies and examines the macroeconomic consequences of an increase in capital inflows to a small open economy with a focus on Dutch disease effects.

The results reveal that an increase in capital inflow eventually causes an increase in demand for nontradables, a rise in the relative price of nontradables and an expansion of nontradable output. The increase in the relative price of nontradables culminates in an appreciation of the real exchange rate, which implies a loss of international competitiveness that is detrimental to the tradable sector. An important finding which is novel to the literature is that there is a trade-off between the resource movement effect and real exchange rate appreciation such that the lower is the extent of the resource movement toward the nontradable sector, the greater is the degree of real appreciation via higher relative nontradable prices. This result is driven by the share of foreign capital utilized in the production process: the greater is the share, the greater is the increase in labor productivity following an increased inflow of capital, as firms adopt a more capital intensive production technique. This leads to higher real wages, greater excess demand for nontradables and higher relative price of nontradables.

These finding are important as they reveal that both the level and share of foreign capital matter for the degree of appreciation of the real exchange rate and reallocation of resources into the nontradable sector of such an economy. The following are the main implications of the dynamics of the model. Foremost, the share of foreign capital an economy uses in the production process dictates the extent
to which the tradable sector loses resources to the nontradable sector as well as the degree of real exchange rate appreciation. In essence, the share of foreign capital is a crucial factor to consider in addressing some of the undesirable effects of capital inflows during such episodes. In addition, slowing the appreciation of the real exchange rate should include measures aimed at stabilizing prices of nontradable goods.

The remainder of the paper is organized as follows. Section 2 presents the details of the model, section 3 discusses the solution and the results, and section 4 presents the conclusion.

2 The Model

The structure is a two-sector small open economy inhabited by a continuum of identical infinitely lived households, and a foreign economy. The small open economy has two groups of agents, households and firms. The firms operate in two sectors; tradable goods sector and nontradable goods sector.

2.1 Households

I assume there is a continuum of households of measure unity. I however proceed with a description of a representative household. The representative household enters each time period $t$ with holdings of real foreign bonds $(B_t)$ and shares $(x_t)$ of the domestic tradable sector firm purchased from the previous period, all denominated in units of the tradable good. The household earns a real interest rate $(r_t)$ on bonds held from the previous period and a return $(v_t + d_t)$ on shares held from the previous period; $v_t$ is the period $t$ price of a claim to the tradable sector firm’s entire future profit, and $d_t$ is period $t$ dividends issued by the firm, all expressed in units of the tradable good. The household also earns labor income in a real wage $(w_t)$ in each period $t$. The representative household only consumes domestically produced tradables and nontradables. The household has preferences over a real consumption index $(C)$ and labor effort $(L)$ supplied in a competitive market, and decides on bonds and shares to take into next period, amount of tradable and nontradable good to consume, and labor effort to supply across sectors. The consumption index is a composite of the nontradable good $(C_N)$ and the tradable good $(C_T)$ given by $C_t = (C_T)^\gamma(C_N)^{1-\gamma}$, where $\gamma \in [0, 1]$ is the share of
tradables in total consumption. The consumer price index is 
\[ P_t = (P_{T,t})^\gamma (P_{N,t})^{1-\gamma}, \]
where \( P_N \) is the price of the nontradable good, and \( P_T \) is the price of the tradable good, all expressed in units of the domestic currency.

The household’s intertemporal utility function expressed in logarithmic form is
\[
E_t \sum_{i=0}^{\infty} \beta^i \left[ \gamma \log C_{T,t} + (1 - \gamma) \log C_{N,t} - \psi \frac{L_t^{1+\nu}}{1 + \nu} \right].
\] (1)

The budget constraint in real terms is
\[
B_{t+1} + \frac{\kappa}{2} (B_{t+1})^2 + C_{T,t} + p_t C_{N,t} + v_t x_{t+1} \leq (1 + r_t) B_t + (v_t + d_t) x_t + w_t L_t + T_t,
\] (2)
where \( p_t \) is the relative price of the nontradable good in terms of the tradable good, \( w_t \) is the wage in units of tradable good and \( \frac{\kappa}{2} (B_{t+1})^2 \) is the cost of adjusting bond holdings relative to zero. I introduce cost of adjustment for bonds to ensure steady-state determinacy and model stationarity in response to temporary shocks. This cost can be thought of as financial intermediation cost, where the financial intermediaries are local perfectly competitive firms owned by domestic households. \( T_t \) is rebate of financial intermediation fees to the household.

The representative household maximizes the intertemporal utility (1) subject to the budget constraint (2). The first-order conditions are:
\[
\frac{\gamma}{C_{T,t}} (1 + \kappa (B_{t+1})) = \beta E_t \left[ (1 + r_{t+1}) \frac{\gamma}{C_{T,t+1}} \right],
\] (3)
\[
\frac{\gamma}{C_{T,t}} v_t = \beta E_t \left[ (v_{t+1} + d_{t+1}) \frac{\gamma}{C_{T,t+1}} \right],
\] (4)
\[
\frac{\gamma}{C_{T,t}} = \frac{1}{p_t} \frac{1 - \gamma}{C_{N,t}},
\] (5)
\[
\psi L_t^{1+\nu} = \frac{\gamma}{C_{T,t}} w_t.
\] (6)
Condition (3) implies that the marginal utility of a unit of tradable good forgone at time $t$ as a result of purchasing a unit of foreign bonds must equal the expected discounted marginal utility of a unit of that good at time $t+1$. Condition (4) implies the same for holding shares. Equation (5) shows that the marginal utility of consuming a unit of the tradable good must be equal to the marginal utility of consuming a unit of the nontradable good measured in terms of the tradable good. Equation (6) shows that the ratio of marginal disutility from supplying a unit of labor effort to the marginal utility of consumption must equal the real wage.

Asset prices may be derived by rewriting equations (3) and (4) respectively as follows.

$$\frac{1}{1 + r_{t+1}} = E_t \left[ \beta \frac{C_{T,t+1}}{C_{T,t+1}} \frac{1}{1 + \kappa(B_{t+1})} \right],$$

$$v_t = E_t \left[ \beta \frac{C_{T,t+1}}{C_{T,t+1}} (v_{t+1} + d_{t+1}) \right].$$

The two asset price equations above imply a no-arbitrage condition:

$$E_t \left[ (1 + r_{t+1}) \frac{1}{C_{T,t+1}} \frac{1}{1 + \kappa(B_{t+1})} \right] = E_t \left[ \frac{1}{C_{T,t+1}} \frac{(v_{t+1} + d_{t+1})}{v_t} \right].$$

In the absence of uncertainty and adjustment cost of bond holding, equation (9) boils down to the standard no-arbitrage condition $1 + r_{t+1} = \frac{v_{t+1} + d_{t+1}}{v_t}$, which makes the representative household indifferent on the margin between returns on foreign bonds and domestic shares.

### 2.2 Firms

Production occurs in the tradable and nontradable sectors. The tradable sector can be thought of as consisting of two units: an investment unit and a production unit. The investment unit solves a cost minimization problem to determine demands for domestic and foreign investment inputs, whereas the level of total investment is determined by the production unit. Investment decision is subject to adjustment costs and hence implies a forward-looking behavior. Factor demands are determined in a perfectly competitive fashion in each sector. The tradable sector firm uses a constant returns to scale
technology in capital and labor to produce a single tradable good. I assume that capital is used in the tradable sector only, hence the nontradable good is produced using a single input in labor. The tradable sector firm must invest to maintain and augment the stock of capital. To account for foreign capital in the domestic economy, I further assume there is a constant returns to scale technology that combines domestic and foreign investment to produce investment \( I \). The capital stock \( K \) changes according to \( K_{t+1} = I_t + (1 - \delta)K_t \), where \( \delta \) is the depreciation rate. The installation cost of capital, measured in terms of the tradable good, is given by \( \phi \left( \frac{I_{t}}{K_{t}} - \delta \right)^2 K_t \), where \( \phi \) governs the size of the installation cost. The installation cost is applicable only to net investment \( I^n_t \), which is defined as \( I^n_t = K_{t+1} - K_t = I_t - \delta K_t \).

Labor is internationally immobile but can migrate instantaneously between sectors within the economy. This ensures the household faces the same wage \( w \) in each sector. The total domestic labor supply is \( L = L_T + L_N \), where \( L_T \) is labor devoted to the tradable sector and \( L_N \) denotes labor in the nontradable sector. I assume a unit of tradable good can be transformed into a unit of home investment without incurring any costs. Therefore the tradable good is either consumed, used for investment, or exported. The nontradable good is used for consumption purposes only. Both the tradable and nontradable goods are supplied in a perfectly competitive market. The currency price of the tradable good is determined on the world market.

The modeling innovation here involves a specification under which an investment unit combines home and foreign investment inputs to produce investment, where the price of foreign investment is considered exogenous and is represented as a stochastic process. In effect, capital inflow is captured by an increase in foreign investment in response to a negative shock to the price of foreign investment.

### 2.2.1 Tradable Sector

**Investment Unit** The investment unit uses a constant returns to scale technology that combines domestic investment \( I_H \) and foreign investment \( I_F \) to produce investment \( I \). The equation describing the technology is

\[
I_t = \left[ \mu \bar{\lambda} (I_{H,t})^{\frac{\sigma - 1}{\sigma}} + (1 - \mu) \bar{\lambda} (I_{F,t})^{\frac{\sigma - 1}{\sigma}} \right]^{\frac{1}{\sigma - 1}}, \tag{10}
\]
where \( \rho > 0 \), and \( 0 < \mu < 1 \). Associated with this investment technology is a minimized unit-cost function denoted \( P_I \), the replacement cost of capital which depends on the price ratio, \( \theta_t = \frac{P^F_{T,t}}{P^F_{T,t}} \), where \( P_T \) is the price of tradable good in units of domestic currency and \( P^F_T \) is the price of imported investment in units of domestic currency.\(^7\)

For any given rate of investment, the firm’s minimization problem is as follows:

\[
\min_{\{I_H,I_F\}} I_{H,t} + \theta_t I_{F,t} \quad s.t. \quad \left[ \mu \frac{P^F_{T,t}}{I_{H,t}} \rho^{\frac{\alpha-1}{\rho}} + (1 - \mu) \frac{P^F_{T,t}}{I_{F,t}} \rho^{\frac{\alpha-1}{\rho}} \right] \geq I_t.
\]

The optimization yields demands for home and foreign investment respectively as

\[
I_{H,t} = \mu \left( \frac{1}{P^I_{t,t}} \right)^{-\rho} I_t, \quad (11)
\]

\[
I_{F,t} = (1 - \mu) \left( \frac{\theta_t}{P^I_{t,t}} \right)^{-\rho} I_t, \quad (12)
\]

where \( \mu \) is the share of investment expenditure on the domestic component of investment, \( \rho \) is the elasticity of substitution between home and foreign investment, and \( P_I \) is the minimum unit cost function for \( I \), which is expressed as \( P^I_{t,t} = [\mu + (1 - \mu)(\theta_t)^{1-\rho}] \frac{1}{P^I_{t,t}} \).

**Production Unit** The production unit produces a tradable good \( Y_T \) according to the following constant returns to scale technology,

\[
Y_{T,t} = \exp \{ a_t \} K^\alpha_t L_{T,t}^{1-\alpha}, \quad 0 < \alpha < 1,
\]

where \( a_t \) is a productivity shock to tradable good production which follows an \( AR(1) \) process given by,

\[
a_{t+1} = \eta^a a_t + \epsilon_{a,t+1}, \quad \eta^a < 1; \epsilon_a \sim N(0,\sigma_a).
\]

\(^7\)
The unit solves the maximization problem by which total investment is determined. It maximizes the present discounted value of dividends:

\[ E_t \sum_{s=t}^{\infty} \Omega_s \left[ Y_{T,s} - P_{I,s} \left( I_s + \frac{\phi_s}{2} \left( \frac{I_s}{K_s} - \delta \right)^2 K_s \right) - w_s L_{T,s} \right], \]  

subject to,

\[ K_{t+1} = I_t + (1 - \delta)K_t. \]  

(15)

The choice variables are \( K_{t+1}, I_t \) and \( L_{T,t} \). The set of efficiency conditions are:

\[ E_t \Omega_{t+1} \left( \alpha \frac{Y_{T,t+1}}{K_{t+1}} - P_{I,t+1} \left[ \frac{\phi_{t+1}}{2} \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right)^2 - \phi \left( \frac{I_{t+1}}{K_{t+1}} - \delta \right) \frac{I_{t+1}}{K_{t+1}} \right] + \lambda_{t+1}(1 - \delta) \right) = \lambda_t, \]  

(17)

\[ P_{I,t} \left( 1 + \phi \left( \frac{I_t}{K_t} - \delta \right) \right) = \lambda_t, \]  

(18)

\[ (1 - \alpha) \frac{Y_{T,t}}{L_{T,t}} = w_t. \]  

(19)

Equation (17) is an investment Euler equation which describes the evolution of \( \lambda \), the shadow price of a unit of capital. At any time period \( t \), the shadow price of a unit of capital is the discounted sum of its marginal product and its shadow value in the period \( t + 1 \), taking into account future capital adjustment cost. Equation (18) determines the investment rate as a function of Tobin’s \( q \), where \( q = \frac{\lambda_t}{P_{I,t}} \), the ratio of the shadow price of capital to the price of new investment. Equation (19) implies that labor is demanded up to the point where the marginal product of labor equals the wage in units of the tradable good. Using the definition of net investment, equation (18) can be rewritten as

\[ \frac{I_t}{K_t} = \frac{1}{\phi} \left( \frac{\lambda_t}{P_{I,t}} - 1 \right), \]  

(20)
which shows that net investment equals zero when the shadow value of a unit of capital \((\lambda)\) equals its replacement cost, that is the price of new uninstalled capital \((P_I)\).

### 2.2.2 Nontradable Sector

The nontradable good firm produces output with a technology linear in labor, and is described by

\[
Y_{N,t} = \exp\{z_t\} L_{N,t},
\]

where \(z_t\) is the stochastic productivity to the nontradable sector which follows the AR(1) process

\[
\begin{align*}
z_{t+1} &= \eta^* z_t + \epsilon_{z,t+1}, \\
0 &< \eta^* < 1; \epsilon_z \sim N(0,\sigma_z).
\end{align*}
\]

The static efficiency condition for the choice of labor demand is

\[
p_t \frac{Y_{N,t}}{L_{N,t}} = w_t.
\]

### 2.3 Resource Constraints

The market clearing conditions are:

\[
\begin{align*}
L_t &= L_{T,t} + L_{N,t} \\
Y_{N,t} &= C_{N,t}, \\
Y_{T,t} &= C_{T,t} + I_{H,t} + X_t,
\end{align*}
\]

where \(X\) is the component of tradable sector output that is exported.
2.4 The Foreign Economy

A characteristic feature of a small open economy is that it can neither affect foreign prices nor output, and thus it takes these variables as given. Consequently, I assume that output of both the tradable good \( Y_T^F \) and nontradable good \( Y_N^F \) in the foreign economy are exogenously given with prices \( P_T^F \) and \( P_N^F \), respectively. I also assume the price of the nontradable good is fixed, and specify the price of tradables in units of foreign currency as the following exogenous stochastic process;

\[
P_{T,t+1}^F = (P_{T,t}^F)^{\eta_{p,t}} \exp(e_{p,t+1}),
\]

\[0 < \eta_{p,t} < 1; e_{p,t} \sim N(0,\sigma_{p,t}).\]

Furthermore, given that the home economy exports some of its output, it makes sense to postulate an empirically reasonable reduced-form export demand curve.\(^9\) I therefore assume demand for the small open economy’s exports \( X \) is given by

\[
X_t = \exp(GDP_t^*); \quad \varpi > 0,
\]

where \( e \) is the real exchange rate and \( GDP^* \) is aggregate output in the foreign economy.

2.5 Real Exchange Rate and Current Account

The real exchange rate \( e \), is defined as the ratio of the price of foreign consumption basket to the domestic one,\(^10\)

\[
e_t = \frac{P_t^*}{P_t},
\]

where \( P^* \) is the foreign consumer price index in units of foreign currency, which is assumed to be a composite of tradable good and nontradable good prices. Given that the import price is the only foreign price relevant to the home economy, and the assumption that the foreign nontradable good price is fixed, movements in \( P_t^* \) are entirely driven by movements in \( P_{T,t}^F \). A log-linear approximation
of equation (29) gives,
\[ \hat{e}_t = \frac{P_{F,t}}{P_{T,t}} - \bar{P}_t. \]  
(30)

Taking the log-linear versions of the price index \( P \) and the price ratio \( \theta \), and substituting into equation (30) yields a relationship between the real exchange rate on one hand, and the price ratio \( \theta \), and the relative price of nontradables \( p \) on the other hand given by
\[ \hat{e}_t = \tilde{\theta} - (1 - \gamma)\tilde{p}_t, \]  
(31)

where \( \tilde{p}_t = (P_{N,t} - P_{T,t}) \). As equation (31) shows, a rise in the relative price of nontradables leads to a decline in the real exchange which represents a real appreciation.

The current account equation for the domestic economy in real terms is
\[ CA_t = r_t B_t + X_t - \theta_t I_{F,t}. \]  
(32)

### 2.6 Equilibrium

The equilibrium is an allocation:
\[ \{I_{H,t}, I_{F,t}, I_t, C_{T,t}, C_{N,t}, Y_{T,t}, Y_{N,t}, B_t, K_t, L_{T,t}, L_{N,t}, L_t, X_t, x_t, d_t, CA_t\}_{t=0}^{\infty}, \]
and a sequence of prices:
\[ \{r_t, P_{I,t}, w_t, v_t, \lambda_t, p_t, e_t\}_{t=0}^{\infty}, \]
satisfying the first-order conditions for the household’s optimization problem, the first-order conditions for the firms’ decisions, the random stochastic processes for technologies in the domestic economy and the price of foreign tradables, the resource constraints and the current account equation. The model has a unique steady-state equilibrium which is ensured by the introduction of the adjustment cost of holding bonds.
3 Solution and Model Dynamics

I derive a solution for the model using standard linear approximation techniques. I characterize the steady state of the model, and calibrate it choosing appropriate values for the parameters. I also present an analysis of the propagation mechanisms following an exogenous shock to the foreign price, after which I provide a brief discussion on the sensitivity of the results to changes in a chosen set of parameters of the model. I further examine the model’s ability to capture business cycle properties in some emerging market economies that were recipients of foreign capital in the early 1990s.

3.1 Benchmark Calibration

I calibrate the model at quarterly frequency with the following choice of parameter values that are roughly consistent with features of the economic environment of a representative developing economy. In accordance with the real business cycle literature, I set the household discount factor $\beta = 0.99$, so that the annual real interest rate is 4%. The share of capital in tradable good production is $\alpha = 0.33$, which is also standard to the small open economy literature. The depreciation rate $\delta$, is set to 0.03 as in Devereux and Lane (2001). Following Kose and Riezman (1999) I set the elasticity of labor supply, $\nu = 0.83$. In line with the strand of literature on the stationarity properties of small open economy models, I set $\kappa$, the rate at which the marginal adjustment cost of bond holdings changes, to 0.008. The elasticity of substitution between home and foreign investment $\rho$, is set to 1, the parameter associated with the disutility of labor supply $\psi$, is set to 1, and the share of tradable good in consumption basket is set to $\gamma = 0.45$, all following Devereux and Lane (2003). I set as a benchmark value for the share of home investment in investment good production, $\mu = 0.5$. I choose a value for the parameter associated with the adjustment cost of capital, $\phi = 2.2$, as in Kose and Riezman (1999). The degree of persistence for all exogenous stochastic processes is set to 0.95.

3.2 Impulse Response Analysis

I analyze impulse responses of variables following a 1 percent shock to the price of foreign investment. Figure 3 shows the dynamics generated by the shock under 3 scenarios. The objective is to draw
implications of the model with respect to the presence of Dutch Disease effects.

3.2.1 Responses to foreign price shock

A temporary negative shock to the foreign price results in a rise in the level of foreign investment. There is a complementary increase in home investment as well since the shock also induces a fall in the price of investment, which is directly related to the foreign price. A lower price of investment causes an increase in the expected shadow value of capital. Since investment behavior is forward looking, expectations about future value of capital and the adjustment cost factor into the firm’s decision to add to capital stock. In response to the combined effect of an increase in the expected shadow value of capital and fall in the price of investment, there is an increase in investment, and subsequently an increase in the capital stock upon impact of the shock. As the shadow value of capital declines below its steady state level and investment price rises in the subsequent period, the capital stock gradually reverts to its steady state level over the medium-run.

These dynamics imply that in response to the shock, total investment increases over and above depreciated capital. However, this increase is barely significant. The increase in the capital stock generates a complementary increase in demand for tradable sector labor and consequently a fall in nontradable sector labor. As a consequence, tradable sector output increases whereas output of nontradables decreases. The movements in the output of these sectors are virtually dictated by responses in the labor units associated with the each of the sectors. The real wage falls in response to the shock because of the relative magnitudes of the changes in tradables consumption and labor supply. The fall in tradables consumption is greater than the rise in labor supply and therefore the marginal utility of a unit of tradables consumption forgone exceeds the marginal disutility of a unit of labor supplied, which implies lower real wage. The initial fall in consumption of tradables occurs because more units of the available output of tradables are allocated to home investment at the expense of consumption. The relative price of nontradables decrease as the demand for nontradables fall, following a decline in demand for tradables. The real exchange rate appreciates due to the fall in foreign price but this is moderated by the initial fall in the price of nontradables. The current account deteriorates upon impact of the shock. This initial negative response in the current account is mainly due to increased
foreign borrowing by the household and the increase in foreign investment.

In the period following the impact of the shock, wages increase leading to an increase in total consumption demand. Consequently, the relative price of nontradable output which is labor intensive increases due to higher production costs and higher demand for nontradables, which in turn leads to an increase in output of nontradables. The increase in output of nontradables requires an increase in nontradable sector labor and a reduction in tradable sector labor. Thus output of tradables contracts, as nontradables output expands over the medium-run. The sustained increase in the relative price of nontradables causes the observed initial appreciation in the real exchange rate to be persistent over the medium-run.

These dynamics provide evidence for Dutch Disease effects. There is a fall in labor units used in the tradable sector and a rise in nontradable sector labor, accompanied by an increase in nontradables production and a fall in output in the tradable sector. The observed initial increase in the output of the tradable sector, the recipient sector of foreign investment, is marginal and short-lived. The increase in foreign investment translates into increased capital accumulation, which as expected, contributes to an initial expansion of the tradable sector. However, with the subsequent decline in tradable sector labor being of a magnitude greater than increase in the capital stock, tradable sector output declines over the medium-run. This represents the resource movement effect. There is also evidence for the spending effect; an increase in demand for nontradables leads to a higher relative price of nontradables, which causes the real exchange rate to remain appreciated over the medium-run.

3.3 Sensitivity Analysis

This section examines the model's dynamics for alternative values of certain key parameters. I vary values for parameters associated with the share of home investment ($\mu$), and the parameter associated with the rate of depreciation ($\delta$). Firstly, I choose a value of $\mu = 0.25$ while maintaining all other parameter values from the benchmark calibration. A lower value of $\mu$ allows me to analyze the dynamics of the model pertaining to the case where the share of foreign investment is greater. Secondly, I examine the sensitivity of the model’s dynamics to the parameter associated with the depreciation
rate of capital. I set $\delta = 0.05$, while leaving all parameter values from the first exercise unchanged. The objective is to compare the differences in behavior of the variables key to the Dutch Disease in each of these scenarios relative to the dynamics under the benchmark calibration.

### 3.3.1 Sensitivity to degree of openness

A greater share of foreign investment makes foreign investment, home investment and total investment, all more sensitive to the shock, each exhibiting an initial response greater in magnitude. The response in foreign investment is less persistent. The greater response in total investment results in a greater response in the capital stock relative to the benchmark case. The greater increase in the capital stock causes a greater demand for tradable sector labor generating an expansion in the tradable sector that is of a slightly greater magnitude. The decline in tradable sector labor in the period following the shock is smaller as the increase in the real wage is higher and therefore dampens the magnitude of the increase in nontradable sector labor. The combined effect of the different magnitudes of the reduction in tradable sector labor (smaller) and increase in the capital stock (greater) causes the contraction in tradable sector output to be smaller. In effect, the model's prediction with respect to the resource movement effect is smaller in magnitude as the observed contraction in tradable sector labor and expansion in nontradable sector labor are dampened vis-a-vis the benchmark impulse responses.

The spending effect in terms of the response of the relative price of nontradables is marginally greater compared to the benchmark case. This could be attributed to excess demand for nontradables due to greater increase in the real wage as well as greater expected returns from investing in the tradable sector. The movement in the real exchange rate is again driven by movements in the relative price of nontradables over the medium-run. Finally, the initial response in the current account is greater because of the greater response in both foreign investment and bond holdings.

### 3.3.2 Sensitivity to depreciation rate of capital

Given the choice of a higher parameter value for the depreciation rate, a temporary negative shock to the foreign price results in an amplification in the responses for foreign investment, home investment and total investment. The tradable sector firm incorporates its knowledge of the higher depreciation...
rate to take advantage of the resultant lower price of investment to increase the investment rate. Because the decline in the investment price is greater, the increase in the expected shadow value of capital is also greater. Capital accumulation is more pronounced and persistent in this case, being the greatest response relative to all the other cases considered. Consequently, the tradable sector expands by the greatest magnitude. Over the medium-run, output of nontradables increases and so do nontradable consumption and nontradable sector labor, but each of these responses is of a slightly smaller magnitude relative to the other cases studied. The relative price of nontradables also increases by the greatest magnitude.

The expansion observed in the tradable sector is quite persistent because the effect of the increase in the capital stock dominates the decline in tradable sector labor. It should be noted that less tradable sector labor is lost to the nontradable sector in this case. The combination of all these effects results in a contraction in tradable output that is least, as well as short-lived, compared to the other cases. The real exchange rate exhibits an almost identical behavior as in the previous cases. It could however be inferred from the movement in the relative price of nontradables that the appreciation of the real exchange rate is most persistent in this case. The current account balance deteriorates the most here because the increase in foreign investment and decline in bond holdings are the greatest.

3.4 Business Cycle Properties

I analyze the business cycle properties of the model economy by drawing comparisons with the quantitative and qualitative features of the business cycle in some emerging market economies that were recipients of foreign capital in the early 1990s. From a quantitative standpoint, the focus is on the model’s prediction with respect to the volatility of key macroeconomic variables and their contemporaneous correlations with aggregate output. In order to compute moments I assume the following standard deviations for innovations: $\sigma_a = .007$ and $\sigma_z = .0035$ for tradable sector productivity and nontradable sector productivity respectively, and $\sigma_{pf} = .005$ for the foreign price shock. Tables 2 and 3 show business cycle statistics for Argentina and the Philippines, and theoretical moments from the model.
Table 2 shows the standard deviations for consumption, investment, output, current account, real exchange rate, tradables production, and the relative standard deviations of consumption and investment with respect to output. The model does not reproduce the observed volatility in consumption and aggregate output. Rather, it predicts a higher volatility in these two variables in comparison to the observed volatility in Argentina and the Philippines. It also overpredicts the volatility in investment, real exchange rate and tradables production vis-a-vis the observed volatility in the two emerging market economies. The predicted volatility of the current account is greater than observed in Argentina but smaller than observed in the Philippines. In terms of the relative standard deviations, the model predicts a volatility of consumption relative to output which is lower in comparison to the case of Argentina, but which is identical to that in the Philippines. It however predicts a greater volatility of investment relative to output than observed in both economies. The differences across the two countries in terms of volatility in some of the key variables including consumption, investment and the real exchange rate could be explained by the fact that the FDI/GDP ratio in Argentina is greater than in the Philippines. It could be asserted that the greater inflow of FDI to Argentina may have induced the relatively greater variability in these variable.

Table 3 presents the contemporaneous correlation of each variable with output. The model does well in matching the consumption-output correlation, producing a coefficient that lies between the observed values for Argentina and the Philippines. The investment-output correlation is identical to the coefficient in the Philippines. The real exchange rate-output correlation produced by the model is lower compared to what is observed in the data for Argentina but bears the same sign; the negative coefficient being indicative of the presence of a relatively stronger spending effect. The coefficient for the Philippines is however positive, which suggests an increase in output possibly generates an increase in import that leads to a real depreciation. The predicted correlation coefficient between the current account and output is negative as in the data and lies between the estimates for the reference economies. Furthermore, the model overpredicts the correlation between tradables production and total output, but the coefficient is not very different from those observed in the two economies. The model generally does well in terms of matching the respective correlations between aggregate output.
and each of the other variables but does not perform as well in terms of matching empirically observed volatility of key macroeconomic variables.

From a qualitative standpoint, the model delivers features that are consistent with several stylized facts on the experiences of the largest recipients of capital inflows in Asia and Latin America. These include current account deficits, increased borrowing, increased private consumption, increased share prices and real exchange rate appreciation. As the discussion of the impulse responses in the previous section indicates, the model economy exhibits all these features in response to increased capital inflow. It also delivers features of the tradable and nontradable sectors in the reference economies, as depicted in Figures 1 and 2.

4 Conclusion

A large capital inflow to a developing economy can potentially cause a real exchange rate appreciation that is detrimental to the prospects of its tradable sector; a phenomenon known as the Dutch disease. This paper examines the effects of an increase in both the level and share of foreign capital on resource reallocation and the real exchange in a small open economy within the context of the Dutch disease. The results reveal that an increase in capital inflow eventually causes an increase in demand for nontradables, a rise in the relative price of nontradables and an expansion of nontradable output. The increase in the relative price of nontradables culminates in an appreciation of the real exchange rate, which implies a loss of international competitiveness that hurts the tradable sector.

A notable finding which is novel to the literature is that there exists a trade-off between the extent of resource reallocation into the nontradable sector and the degree of real exchange rate appreciation, such that the less labor the tradable sector loses to the nontradable sector, the greater is the real appreciation. This result is underpinned by the rate of capital accumulation, which hinges on the share of foreign capital utilized in the production process. Intuitively, the greater is this share, the more the tradable sector tends towards a capital intensive mode of production following an inflow of capital. The sector therefore retains a significant share of labor resources as real wages increase. The higher income however, leads to excess demand for nontradables and consequently higher relative
prices of nontradables, which represents an appreciation of the real exchange rate.

Thus massive capital inflows to developing economies present policy challenges similar to those that confronted middle income countries in the 1990s with respect to reconciling international capital mobility, international competitiveness and domestic macroeconomic stability. The critical issue that emerges then, is finding the right policy mix to mitigate the undesirable effects of capital inflows. The policy implications from this study are clear. The results suggest that an emerging market economy that adopts a production technique that utilizes a greater share of foreign capital relative to domestic capital will be more susceptible to the hazards posed by a real exchange rate appreciation following an increase in capital inflow. In essence, the share of foreign capital employed in the production process is a crucial factor to consider in addressing some of the undesirable effects of capital inflow episodes in recipient economies. Secondly, an attempt to minimize reallocation of resources to the nontradable sector following capital inflow would create a policy dilemma, as it would boost tradable sector production initially but cause a greater real appreciation eventually. Lastly, a macroeconomic policy that is designed to reduce appreciation of the real exchange rate during capital inflows should include measures aimed at stabilizing prices of nontradables.
Notes

1 The largest recipients of capital inflows include Argentina, Brazil, Chile, Colombia, Indonesia, Malaysia, Mexico, Philippines and Thailand.

2 A point to note here is that of the total amount of capital inflow received, the mean value of FDI as a percentage of GDP for the period 1990-2000 was 2.7 and 1.8 for Argentina and the Philippines respectively.

3 The assumption that the household consumes domestic tradables only in this set up is inherently equivalent to assuming that tradable consumption is a composite of home and foreign goods whose prices are given in the world market. This is because since all variables are expressed in terms of tradables (the numeraire), the domestic relative price of nontradables is what drives consumption and labor decisions; see Obstfeld and Rogoff (1996) for a related representation. Thus even if the household is explicitly assumed to consume foreign tradables, such a good would be distinctly different from the imported investment good described in section 2.2, and thus following this distinction, changes in the price of the imported investment good will not have a direct impact on the demand for the foreign consumption good, and will not change the dynamics of the model.

4 The assumption that the imported good is strictly for investment purposes is made in order to avoid end use competition, which would exist if such a good were simply a tradable good that could either go into consumption or investment. It consequently makes possible the generation of a capital-inflow-induced boom in one sector in order to capture the Dutch disease phenomenon. A caveat here is that the preferred modeling strategy yields the result that consumption declines in response to capital inflow, which may appear counter-intuitive, but is necessary to generate a boom in the tradable sector.

5 An exogenous decline in the price of foreign investment could be interpreted more broadly as an exogenous reduction in taxes or barriers to entry that result in a decline in the domestic effective price of foreign investment.

6 It has been documented that FDI flows to emerging market economies have financed increases in investment with a high imported capital content (Montiel and Reinhart (1999)); an increase in the import content of investment could be interpreted as increase in FDI inflow.

7 For a related treatment of investment in studies that do not focus on Dutch disease effects, see Gertler, Gilchrist and Natalucci (2007) and Devereux, Lane and Xu (2006).

8 The specification for the value of the production unit is obtained by deriving equation (15) from (4): \( v_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} \frac{C_t}{C_t} \frac{d_s}{d_s} \), where \( \beta^{s-t} \frac{C_t}{C_t} = \Omega_s \) for \( s = t, t+1, t+2, \ldots \) is the stochastic discount factor; and \( d_s = Y_T - P_T (I_s + \phi (I_s K_s - \delta)^2 K_s) - w_s L_T \) is dividends.

9 This specification follows Gertler, Gilchrist and Natalucci (2007).

10 By definition, the real exchange is given by \( \varepsilon_t = \frac{v_t P_t^*}{P_t} \), where \( \varepsilon \) is the nominal exchange rate but for the sake of conducting the analysis in real variables, I normalize the nominal exchange rate to a value of unity.

11 Figure showing the impulse response functions is presented in the appendix.

12 The motivation for analyzing the sensitivity of the model's dynamics to the depreciation rate stems from Kose and Riezman (1999) who set \( \delta = 0.1 \) in the calibration of their model. Arguably, a value of \( \delta \) between 0.025 (the standard choice in the RBC literature) and 0.1 is plausible for the sake of this analysis.

13 Aggregate output (GDP) in the model is defined as the sum of output of all sectors: \( GDP = Y_T + pY_N \).
References


5 Tables and Figures

Table 1: Benchmark Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.99</td>
<td>Household’s discount factor</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>0.45</td>
<td>Share of tradable good</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>0.008</td>
<td>Coefficient on adjustment cost for bond holding</td>
</tr>
<tr>
<td>$\psi$</td>
<td>1</td>
<td>Coefficient on labor in utility</td>
</tr>
<tr>
<td>$\rho$</td>
<td>1</td>
<td>Elasticity of substitution between home and foreign investment</td>
</tr>
<tr>
<td>$\nu$</td>
<td>0.83</td>
<td>Elasticity of labor supply</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.33</td>
<td>Share of capital in tradable sector</td>
</tr>
<tr>
<td>$\phi$</td>
<td>2.2</td>
<td>Elasticity of investment rate with respect to Tobin’s $q$</td>
</tr>
<tr>
<td>$\mu$</td>
<td>0.5</td>
<td>Share of home investment</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.03</td>
<td>Rate of capital depreciation</td>
</tr>
</tbody>
</table>

Table 2. Standard Deviations and Relative Standard Deviations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Argentina</th>
<th>Philippines</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>0.04</td>
<td>0.01</td>
<td>0.82</td>
</tr>
<tr>
<td>Consumption</td>
<td>0.05</td>
<td>0.01</td>
<td>0.72</td>
</tr>
<tr>
<td>Investment</td>
<td>0.09</td>
<td>0.08</td>
<td>6.50</td>
</tr>
<tr>
<td>Consumption/Output</td>
<td>1.38</td>
<td>0.88</td>
<td>0.87</td>
</tr>
<tr>
<td>Investment/Output</td>
<td>2.53</td>
<td>6.29</td>
<td>7.88</td>
</tr>
<tr>
<td>Current Account</td>
<td>1.04</td>
<td>7.84</td>
<td>3.41</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>0.21</td>
<td>0.06</td>
<td>1.16</td>
</tr>
<tr>
<td>Tradables</td>
<td>0.59</td>
<td>0.29</td>
<td>1.82</td>
</tr>
</tbody>
</table>
Table 3. Contemporaneous Correlation with Output

<table>
<thead>
<tr>
<th>Variable</th>
<th>Argentina</th>
<th>Philippines</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>0.90</td>
<td>0.55</td>
<td>0.67</td>
</tr>
<tr>
<td>Investment</td>
<td>0.96</td>
<td>0.62</td>
<td>0.60</td>
</tr>
<tr>
<td>Current Account</td>
<td>-0.78</td>
<td>-0.50</td>
<td>-0.68</td>
</tr>
<tr>
<td>Real Exchange Rate</td>
<td>-0.40</td>
<td>0.60</td>
<td>-0.20</td>
</tr>
<tr>
<td>Tradables</td>
<td>0.66</td>
<td>0.78</td>
<td>0.84</td>
</tr>
</tbody>
</table>

Note:
Sample moments for Argentina and The Philippines in Tables 2 and 3 are calculated using data with a sample length from 1993Q1 to 2003Q1. The data come from combined sources i.e IFS online, website of Ministry of Economy and Production-Argentina and data used by Aguiar and Gopinath (2004). All series are logged (except current account) and filtered using HP filter with a smoothing parameter of 1600. Theoretical moments are also HP-filtered and are calculated based on parameter values reported in Table 1. Manufacturing sector output is used as proxy for tradables in computing empirical moments.
Fig 1. Argentina

Fig 2. Philippines

Figure 3: Impulse Response Functions
Benchmark calibration (circles); mu=0.25 (triangles); delta=0.05 (squares)
Figure 3 continued