Globalisation and the international monetary transmission *

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Abstract

This contribution introduces multinational production and trade costs in a dynamic open economy in the tradition of the new open macroeconomics, so as to analyse the impact of exports and foreign direct investments on exchange rates and prices. The mode of foreign market access is shown to play a key role in the international transmission of productivity and policy shocks, such as changes in transport costs and the global monetary stance. A generalised policy of trade liberalisation, by deteriorating the terms of trade of host relative to source countries, is shown to favour consumers in the developed (investing) world. Similarly, an easing of the global monetary stance has asymmetric effects in borrowing and investing countries. A depreciation of the home currency reduces the purchasing power of domestic consumers in open economies that mainly host foreign direct investments.

Keywords: FDI, multinationals, monetary policy

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1 Introduction

Foreign direct investments (FDI) have grown tremendously in the past two decades and multinational sales have even outpaced the remarkable expansion of trade in manufactures. Horizontal FDI, namely investment in foreign facilities that are designed to serve foreign customers, has played a starring...
role, with most FDI flows concentrated among developed countries. Consequently, the mode of foreign market access has attracted a growing attention in the trade literature. Firms can serve foreign customers through a variety of channels: they can export their products to foreign consumers, serve them through foreign subsidiaries or affiliates, and license or contract foreign firms to produce or sell their products.

Much less attention has been devoted to foreign market servicing in the macroeconomic and monetary literature. Yet monetary aspects, such as exchange rate uncertainty, do play a significant role in explaining cross-country asymmetries in the pattern of trade and foreign direct investment. International capital flows, on the other hand, may fuel exchange rate volatility and even trigger exchange rate crises.

Introducing multinational production and trade costs in a dynamic open economy in the tradition of the new open macroeconomics, this contribution provides a simple framework for the analysis of the international cyclical transmission when foreign markets can be served through exports and direct investments. The paper will focus on the implications of exports and horizontal FDI for international prices and exchange rates in the short as well as in the long run.

The mode of foreign market access is shown to play a key role in the international transmission of productivity and policy shocks, such as changes in transport costs and the global monetary stance.

A decline in domestic productivity may be associated with a permanent deterioration or an improvement in the country’s terms of trade depending on whether foreign markets are mainly served through, respectively, direct

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1 Over the period 1986-2000, developed countries have received more than 70 percent of FDI inflows.

2 Recent developments in this literature include, among many others: Helpman, Mélitz and Yeaple for a model that incorporates horizontal FDI and trade (2003), Yeaple (2003) and Aizenman and Marion (2004) for the choice between horizontal and vertical FDI and Antràs and Helpman (2003) for the outsourcing alternative.

3 The implications of foreign direct investment for optimal monetary rules are investigated by Cavallari (2004) and Devereux and Engel (2001). Ricci (1997) studies firms’ location choices and countries’ specialisation patterns under alternative exchange rate regimes.


5 The abrupt reversal in the flow of foreign direct investments towards East-Asian economies has played a key role in the currency turmoil in the late 90’s.
investments or exports.

When countries engage in large bilateral multinational activities, the fall in home productivity raises the domestic-currency price for domestic and foreign goods while leaving the foreign-currency price of these goods unchanged. The deterioration of the home terms of trade reduces the purchasing power of domestic consumers. The opposite occurs in countries that mostly trade among each others. Higher marginal costs at home raise the price of home goods for domestic as well as foreign consumers in this case. The rise in the home terms of trade, by re-directing world expenditure in favour of foreign goods, allows to spread part of the costs of the productivity slowdown around the world.

An easing of the global monetary stance, wherever it is originated, boosts world demand and output as long as prices are sticky. A domestic monetary expansion, however, mainly raises consumption and employment at home when bilateral FDI flows are large, while spreading its effect on foreign agents under international trade.

Finally, a generalised policy of trade liberalisation may turn counterproductive for countries that mainly host foreign direct investments. A drop in trade costs, by deteriorating the terms of trade of borrowing relative to investing countries, mostly favours consumers in the developed (investing) world.

The paper is structured as follows. Section 2 models the world economy. Section 3 discusses the long-run implications of the model. Section 4 analyses the international monetary transmission under different modes of serving foreign customers. Section 5 concludes.

2 The model

The world economy comprises a home and a foreign country. Drawing on Corsetti and Pesenti (2002), we assume that countries are fully specialised in the production of one type of good, which can appear in an infinite variety of imperfectly substitutable brands. All varieties of goods are traded across countries. The well-known analytical properties in this class of models allow us to avoid a detailed derivation of the solution so as to focus on the most novel implications of our specification.

In what follows, foreign variables are denoted by asterisks. Unless otherwise stated, foreign prices and quantities coincide with the corresponding domestic variables and will not be explicitly indicated.
2.1 Consumers’ preferences and intra-temporal choices

Each country is inhabited by a continuum of agents of unit mass. Expected lifetime utility of a typical home agent \( i \) is defined as:

\[
\Omega_{it} = E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} U_{it}(C^i_t, \frac{M^i_t}{P_t}, L^i_t)
\]  

(1)

where flow utility is a positive function of real consumption, \( C^i_t \), and real money balances, \( M^i_t / P_t \), a negative function of labour effort, \( L^i_t \), and \( \beta \) is the discount factor. In order to keep algebraic complexity at a bare minimum, we adopt the additively-separable specification:

\[
U_{it} = \ln C^i_t + \ln \frac{M^i_t}{P_t} - \kappa L^i_t
\]  

(2)

where \( \kappa \) is a real or productivity shock which can be interpreted as a shock to the natural rate of output, and \( \chi \) is a nominal disturbance or velocity shock.

The real consumption basket \( C \) aggregates consumption of the the home, \( C_H \), and the foreign good, \( C_F \) according to the Cobb-Douglas index:

\[
C = \frac{C^i_H C^{1-\gamma}_F}{\gamma^\gamma (1 - \gamma)^{1-\gamma}}
\]  

(3)

Foreign goods distributed in the home market can be produced either abroad by foreign exporters or in the home country by local subsidiaries of foreign firms. We assume that goods produced in different locations are perceived as imperfect substitutes by final consumers:

\[
C_F = C^{1-\Psi^*}_F C^{\Psi^*}_H
\]  

(4)

where \( C_{FF} \) is consumption of the foreign imported good and \( C_{FH} \) is consumption of the foreign good produced in the home country. The parameter \( \Psi^* \) captures the degree of internationalisation of foreign production: the closer is \( \Psi^* \) to one the higher the share of foreign firms that serve the home market through subsidiaries located in the home country.

Imperfect substitutability between imported and locally produced goods may be due to differences in the distribution strategies of importers and multinational firms. \(^6\) Once goods reach the consumer, in fact, they incorporate a substantial local marketing input and may pass through non-competitive retailing networks, so that final goods become effectively differentiated.

\(^6\)Importers, for example, may act as distributors that add some non-traded component in final consumption goods (see Corsetti and Dedola (2003)).
Domestic as well as each type of foreign goods appear in an infinite variety of imperfectly substitutable types, indexed by \( h \in [0, 1] \) in the home country and \( f \in [0, 1] \) in the foreign country. All varieties are consumed in the world economy. The following consumption sub-indexes are defined:

\[
C_H = \left[ \int_0^1 C_H(h) \frac{\phi-1}{\sigma} dh \right]^{\frac{\phi}{(\sigma-1)}}
\]

\[
C_{FH} = \left[ \int_0^{\Psi^*} \left( \frac{1}{\Psi^*} \right)^{\frac{1}{\phi'}} C_{FH}(f) \frac{\phi'-1}{\sigma'} df \right]^{\frac{\phi^*}{(\sigma'-1)}}
\]

\[
C_{FF} = \left[ \int_{\Psi^*}^1 \left( \frac{1}{1-\Psi^*} \right)^{\frac{1}{\phi'}} C_{FF}(f) \frac{\phi'-1}{\sigma'} df \right]^{\frac{\phi^*}{(\sigma'-1)}}
\]

where \( \phi > 1 \) and \( \phi^* > 1 \). The parameters \( \phi \) and \( \phi^* \) capture the elasticity of substitution among different brands of, respectively, home and foreign goods.

Demands for the different types of consumption goods can be easily derived as follows:

\[
P_H C_H = \gamma PC
\]

\[
P_F C_F = (1-\gamma) PC
\]

\[
P_{FH} C_{FH} = \Psi^* P_F C_F
\]

\[
P_{FF} C_{FF} = (1-\Psi^*) P_F C_F
\]

\[
C_H(h) = \left( \frac{P_H(h)}{P_H} \right)^{-\phi} C_H
\]

\[
C_F(f) = \left( \frac{P_F(f)}{P_F} \right) C_F
\]

where the corresponding price indexes are:

\[
P = P_H^{\gamma} P_F^{1-\gamma}
\]

\[
P_F = P_{FH}^{\Psi^*} P_{FF}^{1-\Psi^*}
\]
\[ P_H = \left[ \int_0^1 P_H(h)^{1-\phi} dh \right]^{1-\phi} \]  
\[ P_{FH} = \left[ \frac{1}{\Psi^*} \int_0^{\Psi^*} P_{FH}(f)^{1-\phi^*} df \right]^{1-\phi^*} \]  
\[ P_{FF} = \left[ \frac{1}{1-\Psi^*} \int_{\Psi^*}^1 P_{FF}(f)^{1-\phi^*} df \right]^{1-\phi^*} \]

### 2.2 Individual budget constraint and inter-temporal choices

Each Home resident holds home currency, two international bonds, \( B_h^i \) and \( B_f^i \), respectively denominated in home and foreign currency, and an equal share in all domestic firms. He receives labour income at the wage rate \( W \) for services provided to domestic as well as foreign firms, a share in the profits of home firms, \( \Pi \), and pays non-distortionary net taxes, \( T \), to the government. The flow budget constraint of agent \( i \) is:

\[ B_{Ht+1} + \varepsilon_t B_{Ft+1} + M_{t+1} \leq B_{Ht}^i (1 + i_{t+1}) + \varepsilon_t B_{Ft}^i (1 + i_{t+1}) + M_i^t \]  
\[ + W_t (L_{ht} + L_{ft}) + \Pi_t^i - P_t^i C_t^i - T_t^i \]  

where \( i \) and \( i^* \) are, respectively, home and foreign nominal interest rates and \( \varepsilon \) the nominal exchange rate defined in terms of home currency.

Home agents maximize utility (2) subject to (12) over their whole life horizon. Aggregating the first order conditions across agents, we derive the money demand:

\[ \frac{M_t}{P_t} = \chi C_t \frac{1 + i_{t+1}}{i_{t+1}} \]  

and the risk-adjusted uncovered interest rate parity:

\[ E_t \left( \frac{\varepsilon_t}{P_{t+1} C_{t+1}} \right) = E_t \left( \frac{\varepsilon_{t+1}}{P_{t+1} C_{t+1}} \right) \frac{1 + i_{t+1}^*}{1 + i_{t+1}} \]  

Finally, labour is supplied up to the point where the marginal increase in wage income equals the marginal disutility of labour effort:

\[ \frac{W_t}{P_t} = \kappa C_t \]
2.3 Firms

Each firm $h$ is the sole producer of the corresponding variety of the home good. All home firms sell their products in domestic and foreign markets. A share $\Psi$ of domestic firms serve foreign customers through subsidiaries located abroad and the remaining share operate via exports. Exports are gravated by iceberg-type transport costs. For one unit of the final good to arrive at a foreign destination $\tau > 1$ units must be sent. These shipping costs capture a variety of (variable) costs associated with international trade and not associated with foreign direct investment.

As will become apparent later, foreign direct investments play a role akin to the one of non traded goods: whenever trade barriers are too high, goods are not traded internationally and foreign customers are directly served by subsidiaries of multinational firms. Direct access to foreign markets implies segmentation in world markets and deviations from the law of one price.

2.3.1 Production location

Technology is linear in labour and symmetric across countries and varieties. The production function of firm $h$ for sales to domestic residents and exports is given by:

$$Y(h) = L^1_h$$

where $L^1_h$ is the home labour input.

The production function of the home firm $h$ for direct sales to foreign residents is given by:

$$Y^*(h) = L^*_h$$

where $L^*_h$ is the foreign labour input.

2.3.2 Pricing strategy

Monopolistic competitors set prices so as to maximize the expected present value of profits given market demand. In the absence of nominal rigidities,

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7 Allowing for heterogeneous firms, Ghironi and Mélitz (2004) show that in equilibrium only the more profitable firms access foreign markets.

8 Despite the post-war trend towards trade liberalisation, international goods markets appear to remain remarkably segmented. Tariff barriers range on average between 4 and 5 per cent of the price of traded goods, while trade costs - including tariff and non-tariff barriers, shipping and distribution costs - vary greatly across classes of goods (Hummels (1999, 2001).

9 Since the classical contribution by Markusen (1984) horizontal multinational activity is mainly motivated by accessing markets in the presence of trade frictions.
optimal prices mark up nominal marginal costs:

$$\tilde{P}_{Ht} = \Phi W_t \quad \tilde{P}_{H*Ht} = \frac{\Phi \tau W_t}{\varepsilon_t} \quad \tilde{P}_{H*Ft} = \Phi W_t^* \quad (16)$$

$$\tilde{P}_{Ft}^* = \Phi^* W_t^* \quad \tilde{P}_{F*Ht} = \Phi^* W_t \quad \tilde{P}_{F*Ft} = \Phi^* \tau \varepsilon_t W_t^*$$

where $\Phi \equiv \phi/(\phi - 1)$ and $\Phi^* \equiv \phi^*/(\phi^* - 1)$ are indexes of monopoly distortions.\(^{10}\)

Our model allows for nominal rigidities by assuming that agents set the price of their product at the beginning of each period, before shocks realize, and are committed to meet market demand at the given price for one period.

We assume that goods produced in the sales markets are priced in the currency of consumers. This is obviously true for domestic firms selling to domestic residents, which would have no reason to set prices in a foreign currency. Subsidiaries of foreign firms, could in principle set prices in their own currency and let the local currency price of their products vary with the nominal exchange rate. Most multinational firms with sales facilities in foreign markets, however, appear to apply local currency pricing (Lipsey, 1999).

Optimal pre-determined prices for goods produced in the sales markets are set as a mark-up on expected nominal marginal costs:

$$\bar{P}_{Ht} = \Phi E_{t-1}(W_t) \quad \bar{P}_{H*Ft} = \Phi E_{t-1}(W_t^*) \quad (17)$$

$$\bar{P}_{Ft}^* = \Phi^* E_{t-1}(W_t^*) \quad \bar{P}_{F*Ht} = \Phi^* E_{t-1}(W_t)$$

A different assumption is made for traded goods, whose price can be set in the currency of consumers, in the one of producers or according to any combination of these two pricing strategies. Empirical evidence on traded good prices, as documented by, among others, Goldberg and Knetter (1997), Engel (1999), Parsley and Wei (2001) and, more recently, Campa and Goldberg (2004) points to a degree of exchange rate pass-through into import prices which is higher than zero on average although far below unity.\(^{11}\) Following Corsetti and Pesenti (2001), we assume that firms set the foreign-currency price for their products according to the following scheme:

\(^{10}\)All firms face similar pricing problems and, therefore, set identical prices in a symmetric equilibrium. This fact is used in deriving equations (16), (17) and (19).

\(^{11}\)The extent to which movements in the nominal exchange rate pass through into final prices vary substantially across sectors.
\[ P_H^*(h) = \hat{P}_H(h) \varepsilon^{-\eta^*} \]
\[ P_F^*(f) = \hat{P}_F(f) \varepsilon^\eta \]  

(18)

where \( \hat{P}_H(h) \) is the pre-determined price for good \( h \) in home currency and \( \hat{P}_F(f) \) the pre-determined foreign-currency price for good \( f \). In this setting, \( \eta^* = \eta = 0 \) corresponds to local currency pricing: firms set prices in the consumers’ currency, so that prices consumers face do not respond to movements in the exchange rate. The case \( \eta = \eta^* = 1 \) corresponds to producers’ currency pricing: producers set the price in their own currency, implying that import prices move in the same proportion as the nominal exchange rate.

Optimal price setting for sales in foreign markets yields:

\[ \bar{P}_{HHt}^* = \frac{\Phi^* \tau E_{t-1} (W_t P_t^* C_t^{*1-\eta^*})}{\varepsilon_t^{\eta^*} E_{t-1} (P_t^* C_t^{*})} \]  
\[ \bar{P}_{FFt}^* = \frac{\Phi^* \tau E_{t-1} (W_t^* P_t^* C_t^{*1-\eta})}{\varepsilon_t^{-\eta} E_{t-1} (P_t C_t^{*})} \]  

(19)

In foreign markets, the ex post mark-up is inversely related with nominal marginal costs as well as with the nominal exchange rate. An exchange rate appreciation, a fall in \( \varepsilon \), by reducing sales revenue in foreign currency, induces foreign exporters to set domestic-currency prices at a premium as a hedge against declining profits.

Optimal prices (19) and (17) are valid for any distribution of the underlying shocks, provided the participation constraints are not violated:

\[ \bar{P}_H \geq W \quad \hat{P}_H \geq W \tau \quad \bar{P}_{HF}^* \geq W^* \]
\[ \bar{P}_F^* \geq W^* \quad \hat{P}_F^* \geq W^* \tau \quad \bar{P}_{FH} \geq W \]  

(20)

In what follows, the domain of real and nominal shocks is restricted so that the above constraints are always satisfied.

### 2.4 Government’s budget constraint

The domestic government rebates all seignorage revenue in lump-sum transfers to households:

\[ \int_0^1 M_{it} - M_{it-1} dt + \int_0^1 T_{it} dt = 0 \]  

(21)
Governments affect the stock of domestic monetary assets by controlling the short-term interest rate. Following Corsetti and Pesenti (2001), it is useful to define an index of monetary stance \( \mu \) in the home country such that:

\[
\frac{1}{\mu_t} = \beta(1 + i_{t+1})E\left[\frac{1}{\mu_{t+1}}\right]
\]  

(22)

In equilibrium, it is immediate to derive \( \mu \) as the inverse of the marginal utility of consumers’ wealth, \( PC \). Expression (22) links a given time path of \( \mu \) to a corresponding sequence of home nominal interest rates: a monetary expansion is associated with a higher \( \mu \) and a lower \( i \).

2.5 Aggregate resource constraints

Asset markets’ equilibrium requires that international bonds are in zero net supply:

\[
\int_0^1 B_H^i di + \int_0^1 B_H^{ii} di = 0 \quad \int_0^1 B_F^i di + \int_0^1 B_F^{ii} di = 0
\]

(23)

Goods market clearing in the home country requires that the aggregate supply of home goods coincides with world demand:

\[
Y_H \geq C_H + C_H^*
\]

(24)

Equilibrium in the labour market yields:

\[
L \geq C_H + C_{HH} + C_{FH}
\]

(25)

where \( L = \int_0^1 L^i di \).

Aggregating the budget constraints (12) across home agents and using the government (21) and resource constraints (24) and (25), yields the aggregate accounting equation for the home economy:

\[
PC = P_H C_H + \varepsilon P_H^* C_H^* + WC_{FH} - \varepsilon W^* C_{HF}^*
\]

(26)

where use has been made of the assumption of initial financial autarky in every country, i.e. \( B_{H0} = B_{F0} = 0 \). As usual in this class of models, net assets are zero in any point in time provided initial non-monetary wealth is zero.\(^1\)

\(^1\)We have recursively used the index of monetary stance in the Euler equation (14).

\(^2\)As pointed by Corsetti and Pesenti (2002), a balanced current account is the result of three hypothesis: i) a Cobb-Douglas consumption index ii) logarithmic utility in consumption and iii) zero initial net assets.
3 The flexible price benchmark

Using demands (6) and (7) and flexible prices (16) into the aggregate accounting equation (26) yields the equilibrium exchange rate:

\[ \frac{\gamma}{\mu^*} \frac{1 - \gamma}{1 - \frac{\psi^*}{\psi}} \]

(27)

In the absence of nominal rigidities, the nominal exchange rate is proportional to the relative monetary stance. A domestic monetary expansion, an increase in \( \mu \), leads to an exchange rate depreciation, an increase in \( \tilde{e} \). The response of the exchange rate to domestic monetary conditions is larger in open and highly integrated economies.

Equilibrium prices and quantities in the world economy are given by:

\[ \tilde{P}_H = \Phi K \mu \]  
\[ \tilde{P}_{HH} = \frac{\Phi \tau K \mu}{\varepsilon} \]  
\[ \tilde{P}^{*}_{HF} = \Phi K^* \mu^* \]  
\[ \tilde{P}_{FF} = \Phi^* \tau K^* \mu^* \]  
\[ \tilde{P}_{FH} = \Phi^* K \mu \]  
\[ \tilde{P}^* = \Phi^* K^* \mu^* \]

\[ \tilde{L} = \frac{1}{\kappa} \left( \frac{\gamma}{\Phi} \frac{1 - \gamma}{1 - \frac{\psi^*}{\psi}} + \frac{1 - \gamma}{\Phi^*} \frac{\gamma(1 - \Psi^*)(1 - \frac{\Psi}{\Psi^*}) + \gamma \Psi}{\Phi^*} \right) \]

(29)

\[ \tilde{L}^* = \frac{1}{\kappa^*} \left( \frac{1 - \gamma}{\Phi^*} \frac{1 - \gamma}{1 - \frac{\psi^*}{\psi}} + \gamma \Psi \right) \]

\[ \tilde{C} = \frac{1}{\Phi W} \left( \frac{1 - \gamma}{\tau \gamma (1 - \frac{\psi}{\psi^*})} \right)^{1 - \Psi^*} \gamma^{1 - \gamma} \Psi^* \left( \frac{1}{\kappa} \right) \left( \frac{1}{\kappa^*} \right)^{1 - \gamma} \gamma \Psi \]

(30)

\[ \tilde{C}^* = \frac{1}{\Phi W} \left( \frac{1 - \gamma}{\tau \gamma (1 - \frac{\psi}{\psi^*})} \right)^{1 - \Psi^*} \gamma^{1 - \Psi^*} \left( \frac{1}{\kappa} \right) \left( \frac{1}{\kappa^*} \right)^{1 - \gamma + \gamma \Psi} \]

In the flexible-price benchmark, employment is exclusively determined by country-specific real shocks. A negative shock to home productivity, an
increase in $\kappa$, leads to a fall of domestic employment. In the attempt to smooth labour effort along time, agents rationally reduce the supply of labour thereby reducing the amount of goods available for consumption. Furthermore, employment is negatively associated with monopolistic distortions in domestic and foreign goods markets. A high degree of monopoly power in foreign markets affects domestic employment whenever foreign firms serve home customers through local subsidiaries.

Consumption in the world economy is a function of global monopolistic distortions and global shocks. World consumption is low when monopolistic distortions are high anywhere in the world. Movements of the terms of trade ensure that the benefits and costs from country-specific productivity shocks spread around the world, through changes in the composition of world spending. It is easy to verify that the home terms of trade, defined as the home-currency price of exports in terms of imports, are given by:

$$\tilde{Q} = \tau^{\Psi - \Psi} \Phi \left( \frac{(1 - \frac{\Psi}{\Psi^*}) (1 - \gamma) \kappa^*}{(1 - \frac{\Psi}{\Psi^*}) \gamma \kappa} \right)^{\Psi - 1 + \Psi^*}$$

(31)

Observe first, that countries characterised by a net inflow of direct investments, $(\Psi^* > \Psi)$, may be vulnerable to a policy of trade liberalisation as represented by a symmetric, worldwide decrease in iceberg-type transport costs. As (31) shows, a drop in transportation costs $\tau$ deteriorates the terms of trade of host relative to source countries: the relative fall in the price of traded goods mostly favours consumers in the developed (investing) world. Moreover, insofar as falling trade costs reduce the profitability of foreign direct investments relative to exports, borrowing and investing countries may be affected in a different way. Remarkable differences in the FDI experience of less developed and developed countries are actually documented in recent empirical studies as regards both the factors that determine the location of FDI activities across countries and the macroeconomic impact of foreign investments.

14 This is reminiscent of the long-lasting debate on the secular deterioration of the terms of trade of developing countries initiated by Singer (1950). It is currently widely accepted that the terms of trade across developed and less developed countries move to a much lesser extent than previously thought and may not have a secular trend, once transport costs, product quality and cross-country specialisation patterns are accounted for (Salvatore, 2001).

15 Blonigen and Wang (2004) suggest that FDI activities mainly favour less developed countries, where foreign investments are more likely to crowd in domestic investments relative to developed countries. Furthermore, a positive impact of FDI on output growth seems to be supported for the former group only.
Second, a change in relative productivity may be associated with a deterioration or an improvement in the country’s terms of trade depending on the degree of internationalisation in production across countries.

In less integrated and symmetric economies ($\Psi^* = \Psi \approx 0$), a decline in domestic productivity raises the relative price of home exports, partially shifting the costs of the productivity slowdown abroad. The deterioration of the foreign country’s terms of trade, in fact, reduces the purchasing power of foreign consumers. It follows that consumption falls in both countries.\(^\text{16}\)

Among highly integrated and similar economies ($\Psi = \Psi^* = 1$), a fall in productivity at home implies a decrease (deterioration) in the domestic terms of trade. High marginal costs at home raise the price for domestic as well as foreign goods, thereby reducing the purchasing power of domestic consumers. The decline in home productivity does not affect the foreign-currency price of home and foreign goods (the “internal” terms of trade in the foreign country): the expenditure switching channel of international cyclical transmission is completely obscured in this case. As long as bilateral foreign direct investments are large relative to trade flows, domestic consumption is effectively isolated from world cyclical conditions.

One notable feature of the equilibrium outcome in strongly integrated and symmetric economies is that aggregate output is much more correlated across countries than consumption, as it is true in the data for most industrialised countries. Whenever $\Psi = \Psi^* = 1$, equations (30) and (29) imply that aggregate output is equalised across countries:

$$Y_H = Y_F^* = \frac{1}{\Phi_W} \left( \frac{1}{\kappa} + \frac{1}{\kappa^*} \right)$$

while consumption is proportional to relative productivity shocks:

$$\frac{C}{C^*} = \frac{\kappa^*}{\kappa}$$

The higher cross-country correlation of output than consumption, the so-called consumption-output anomaly, is one of several puzzles in international macroeconomics. The paradox arises as one would expect world consumption to be stabilised. Risk-sharing with complete asset markets automatically

\(^{16}\)When $\Psi = \Psi^* = 0$, consumption is fully stabilised in the world economy (perfect risk-sharing):

$$\frac{C}{C^*} = \frac{1 - \gamma}{\gamma} \tau^{2\gamma - 1}$$

More open economies obtain a larger share of world consumption and the more so the smaller transport costs. Our model is isomorphic to Obstfeld (2001) in this case.
yields perfect correlation among consumption differentials across countries, as predicted by standard real business cycle models (Backus, Kehoe and Kydland (1992)). In our framework of effectively complete markets, less than perfect risk-sharing in consumption is the result of market segmentation due to direct servicing of foreign customers. A decline in home productivity does not affect the purchasing power of foreign consumers as long as they attach a positive value to the distribution services of local subsidiaries of home firms. The price of home goods produced abroad is invariant to a change in home productivity. The cross-country output correlation, instead, is positively associated with the degree of internationalisation in production. The home productivity slowdown reduces the amounts of goods produced out of domestic labour services in domestic firms as well as in home subsidiaries of foreign firms.

Equation (31) further shows that the response of the terms of trade to productivity disturbances is higher the more similar the mode of foreign market access across countries. As already shown, the costs and benefits of a change in domestic productivity are more likely to spread their effects outside the domestic borders among economies with strong bilateral trade ties, while mostly remaining inside the domestic borders in case of large bilateral investments flows.

Among borrowing and investing countries, on the other hand, relative international prices are almost invariant to country-specific productivity shocks. Despite lower trend productivity, less developed (borrowing) countries need not experience a secular deterioration in their terms of trade relative to the developed world, as it appears in long-horizon terms of trade data for the two groups of countries (see footnote 14).

Finally, consider the real exchange rate $R \equiv \varepsilon P^*/P$ as defined using the consumption-based price indexes in the two economies. These price indexes change over time as a result of movements in transportation costs as well as changes in the world cyclical conditions. Using equilibrium prices (28) and the nominal exchange rate (27) yields the real exchange rate under flexible prices:

$$\tilde{R} = \frac{1 - \gamma (1 - \frac{\Psi^*}{\Psi})}{\gamma (1 - \frac{\Psi^*}{\Psi})} \left( \frac{\kappa}{\kappa^*} \right)^{-\Psi^*/(1-\gamma)} \tau^{(1-\Psi)/(1-\Psi^*)/(1-\gamma)}$$

(32)

Despite price flexibility, purchasing power parity may not hold, $R \neq 1$. Many studies document that real exchange rate movements are highly incomplete asset markets are not as pervasive as implied by actual macroeconomic data. Moreover, the gain from international risk-sharing appear to be negligible (Cole and Obstfeld (1991)).
persistent, so much that the hypothesis of unit roots in real exchange rate
data can hardly be rejected for most industrialised and developing countries,
implies a violation of the purchasing power parity. 18 Recently, tests for
(mean or trend) stationarity in long-horizon time series have been developed
that take into account the possibility of structural breaks, namely a change in
the mean or the trend or both the mean and trend of the data. 19 Allowance
for structural changes strongly improves the results in favour of stationary
real exchange rates, implying a weak form of purchasing power parity for
most industrialised countries (Papell and R. Prodan (2003)). Nonetheless,
the convergence to parity is very slow: it takes more than 5 years on average
for the exchange rate to return to its long-run mean or trend (Murray and
Papell (2002), Lothian and Taylor (1996)).

Deviations from purchasing power parity may arise from transport costs
and foreign direct investment in our model. In a less integrated world, \( \Psi = \Psi^* \simeq 0 \), failures of the law of one price are mainly due to trade costs:

\[
\tilde{R} = \tau^{2\gamma - 1}
\]

It is worth stressing that a rise in trade frictions is associated with an ap-
preciation of the real exchange rate of relatively large and closed economies
\( (\gamma > 1/2) \) and a depreciation otherwise.

A high degree of global production, \( \Psi = \Psi^* \simeq 1 \), implies that violations
of the purchasing power parity are positively associated with cross-country
differences in size, cyclical conditions and monopoly distortions:

\[
\tilde{R} = \frac{(1 - \gamma) \phi R^*}{\gamma \phi R^*}
\]

4 International monetary transmission

Using demands (6) and (7) and optimal pre-determined prices (17) and (19)
into the aggregate accounting equation (26) gives the nominal exchange rate
when prices are pre-determined:

\[
\tilde{R}_t = 1 - \gamma \mu_t \left(1 - \frac{\Psi R^* \mu_t}{\Phi E(\kappa R^*)}\right)
\]

Comparing equations (33) and (27) reveals that the short- and long-run nom-
inal exchange rates are equalised when production is entirely domestic. De-

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18 Early stationarity tests for real exchange rate data are surveyed in Rogoff (1996). See
Froot and Rogoff (1996) for a very long-run perspective on PPP.
spite price rigidities and incomplete pass-through, the nominal exchange rate immediately jumps on its new steady-state value following a change in the global monetary stance in this case. As trade and the current account are invariably balanced when all production costs are incurred at home, countries consume precisely their sales revenue: the nominal exchange rate is proportional to the relative monetary stance at any point in time.

A richer exchange rate dynamics materialises in a globalised world with nominal rigidities. As shown in (33), the nominal exchange rate might respond to other cyclical conditions than monetary policy as well as react in a non-linear way to a change in the relative monetary stance provided $\Psi^* \neq 0$. 20

Exchange rate over- or under-shooting is the result of short-run capital flows due to profit transfers across countries. Suppose that home productivity unexpectedly rises. In the absence of nominal rigidities, world demand switches from foreign to domestic goods, leaving the nominal exchange rate unaffected. With sticky domestic prices, instead, demands for the different varieties of domestically produced goods do not change. The main economic effect of the productivity change will be on the profits of the firms located in the home country, either national or multinational firms. As local affiliates of foreign multinationals repatriate their unexpectedly high profits, capital outflows towards the foreign country depreciate the home currency. It is worth noticing that the exchange rate moves in the opposite direction following a change in expected productivity. The expectation of lower nominal marginal costs at home induces foreign multinationals to charge lower prices onto home consumers, shifting expenditure towards home goods and appreciating the home currency.

A unilateral monetary expansion is associated with a more or less than proportional depreciation of the home currency depending on cross-country differences in the pattern of foreign direct investments. With sluggish local prices, a depreciation of the home currency reduces the profits of foreign affiliates measured in foreign currency and raises those of domestic affiliates in domestic currency. Borrowing countries will then experience a fall in capital outflows that helps dampening the depreciation of the domestic currency. The opposite occurs in investing countries.

Equilibrium prices and quantities are given by:

20Exchange rate deviations from fundamentals are temporary: inspection of equations (33) and (27) immediately reveals that the short and long-run exchange rates coincide on average. Once prices adjust, profits are stabilised across countries and both the trade and the current account are invariably balanced without any need for a change in the exchange rate.
As long as prices are sticky, consumption and employment in the world economy are determined by global monetary conditions: nominal spending is controlled by governments through monetary policy and output accommodates any change in aggregate demand. Productivity shocks affect current consumption and employment only indirectly through movements in the nominal exchange rate, while feeding completely into expected consumption and employment and into labour effort.

The minor role of supply shocks in driving aggregate consumption and output is consistent with the so-called New Keynesian view of the business cycle, as synthesised by Clarida, Galí and Gertler (1999). An unexpected shock to productivity leads to a very small, if any, change in relative prices, which in turn implies that the supply of goods available for consumption does not change by much. 21

\[\bar{P}_H = \Phi E_{t-1}(\kappa_t\mu_t)\]

\[\bar{P}^*_{HH} = \frac{\Phi \tau E_{t-1}(\kappa_t\mu_t)\kappa^*_t\xi^1_{\eta}}{\xi_{\tau}^* E_{t-1}(\kappa^*_t\mu^*_t)}\]

\[\bar{P}^*_{HF} = \Phi E_{t-1}(\kappa^*_t)\]

\[\bar{P}^*_F = \Phi^* E_{t-1}(\kappa^*_t)\]

\[\bar{P}_{FF} = \Phi E_{t-1}(\kappa_t\mu_t)\]

\[\bar{L} = \left(\frac{\gamma\mu_t}{\Phi E_{t-1}(\kappa_t\mu_t)} + \frac{(1 - \Psi)\gamma}{\Phi_{\tau}} E_{t-1}(\kappa_t\mu_t)\mu_t\xi^1_{\eta} + (1 - \gamma) \Psi^* \frac{\mu}{E_{t-1}(\kappa_t\mu_t)}\right)\]

\[\bar{L}' = \left(\frac{(1 - \gamma)\mu_t}{\Phi^* E_{t-1}(\kappa^*_t\mu^*_t)} + \frac{(1 - \Psi^*)\gamma}{\Phi_{\tau}^*} E_{t-1}(\kappa_t\mu_t)\mu_t\xi^1_{\eta} + \gamma \Psi^* \frac{\mu^*_t}{\Phi E_{t-1}(\kappa^*_t\mu^*_t)}\right)\]

\[\bar{C} = \frac{\mu_t\xi^1_{\eta}}{\Phi W_t} \left((E_{t-1}(\kappa_t\mu_t))^{1+(1-\Psi^*)} \left(\frac{\tau E_{t-1}(\kappa_t\mu_t)\kappa^*_t\xi^1_{\eta}}{E_{t-1}(\kappa^*_t\xi_{\tau}^*)}\right)^{1-(1-\Psi^*)}\right)^{-1}\]

\[\bar{C}^* = \frac{\mu_t\xi^1_{\eta}}{\Phi W_t} \left((E_{t-1}(\kappa^*_t))^{1+(1-\Psi)} \left(\frac{\tau E_{t-1}(\kappa_t\mu_t)\kappa^*_t\xi^1_{\eta}}{E_{t-1}(\kappa^*_t\xi_{\tau}^*)}\right)^{1-(1-\Psi)}\right)^{-1}\]

\[\bar{C}_{t-1}(\kappa^*_t) = \tau E_{t-1}(\kappa_t\mu_t)\kappa^*_t\xi^1_{\eta} \left(\frac{\tau E_{t-1}(\kappa_t\mu_t)\kappa^*_t\xi^1_{\eta}}{E_{t-1}(\kappa^*_t\xi_{\tau}^*)}\right)^{1-(1-\Psi)}\]

21 All prices in (34) respond to real shocks via exchange rate changes.
Monetary policy is transmitted in the world economy through changes in world demand and the terms of trade. An easing of the global monetary stance, wherever it is originated, boosts world demand and output.

The capacity of monetary authorities to affect international prices and re-direct expenditure across countries depends on the pricing strategies of exporters and affiliates, while the degree of internationalisation in production is key to the employment consequences of monetary policy.

In a high pass-through environment, i.e. when $\eta = \eta^* \simeq 1$, a domestic monetary expansion raises consumption worldwide. The deterioration of the home terms of trade switches world expenditure in favour of home goods with unit elasticity. Since domestic prices are pre-determined, home consumer prices rise and foreign consumer prices fall in the same proportion, raising consumption in both countries.

Worldwide employment must increase as well, so as to provide a larger amount of goods for consumption. When production is less integrated worldwide, $\Psi = \Psi^* \simeq 0$, it is mostly domestic employment that bears the burden of adjustment. The domestic monetary expansion undoubtedly favours foreign residents in this case, while turning potentially harmful for domestic consumers. The monetary easing is more likely to be a “beggar myself ” policy in an overheated scenario, when the welfare loss from increasing labour effort more than compensates the welfare gain from higher consumption. In highly integrated economies, the upsurge in world demand can be partly accommodated by subsidiaries of home firms located in the foreign economy. An easing of the domestic monetary stance raises foreign employment in this case.

When local prices are invariant to exchange rate movements, as it is the case when prices are mainly set in the consumers’ currency ($\eta = \eta^* \simeq 0$), an easing of the home monetary stance boosts domestic consumption only.

Despite fixed local prices, however, international monetary spillovers may be not negligible. First, a home monetary easing may lead to a rise in foreign employment, providing the case for a “beggar thy-neighbour” policy. This may occur whenever production is not entirely globalised, so that foreign exporters raise production and employment abroad in order to meet the temporary boost in external demand.

Second, the global monetary stance affects expected consumption and employment. A monetary policy regime shift, as the move from flexible to fixed exchange rates, may affect world welfare through a change in the level and volatility of consumption and employment.

Finally, it is easy to show that nominal and real exchange rates move together:
High correlation between changes in nominal and real exchange rates is a well-known fact in international macroeconomics and finance. As documented by Mussa (1986), real exchange rates become much more volatile when nominal exchange rates are allowed to float. Moreover, real exchange rate variability tends to reflect almost perfectly nominal rate variability, with independent movements in price levels playing a minor role, if any, along the business cycle.

As apparent in equation (37), nominal and real exchange rate movements are almost perfectly correlated among countries characterised by a similar mode of foreign market access. A depreciation of the home currency, instead, may be associated with a less than proportional real depreciation when the pattern of foreign direct investments varies substantially across countries.

Consider for instance the case of unilateral direct investments from the home country, i.e. $\Psi = 1$ and $\Psi^* = 0$. A one percent depreciation of the home currency raises home import prices by $\eta$ percent while leaving foreign-currency prices unaffected. Consequently, the home real exchange rate depreciates by one percent when the degree of exchange rate pass through is zero and by $\gamma$ percent when pass through is complete. A unilateral monetary expansion then reduces the purchasing power of domestic consumers, particularly so in large and relatively closed countries, namely when $\gamma \to 1$. By the same token, a depreciation of the home currency triggers a rise (depreciation) of the real exchange rate that varies between one and $1 - \gamma$ percent in borrowing countries. Trade openness puts a check on the incentive to ease monetary policy in this case.

The asymmetric effects of an easing of the monetary stance in borrowing and investing countries is consistent with the empirical evidence documented in Terra (1998), showing that there is a strong negative relation between inflation and openness among highly indebted countries during the debt crisis while this correlation is not observed among creditor countries nor during the pre-crisis period.

5 Conclusions

This contribution has introduced foreign direct investments in a simple model in the tradition of the new open economy literature so as to investigate the implications of the mode of foreign market access for the international transmission of policy and productivity shocks.
A number of well-known facts in international macroeconomics can be replicated in our theoretical model, with the mode of foreign market access playing a key role in the results.

In the absence of nominal rigidities, asymmetric cyclical developments, as represented by cross-country productivity differentials, trigger permanent movements in the terms of trade of countries characterised by a similar mode of foreign market access.

The costs and benefits of a change in domestic productivity are shown to spread their effects outside the domestic borders among economies with strong bilateral trade ties, while mostly remaining inside the domestic borders in case of large bilateral investments flows. Foreign direct investments effectively shut down the terms of trade channel of international cyclical transmission and result in higher cross-country correlation of output than consumption, the so-called consumption-output anomaly, as it appears in the data for most industrialised countries.

In case of unilateral investment flows, as among borrowing and investing countries, international prices turn out to be almost invariant to country-specific productivity shocks. Despite lower trend productivity, less developed (borrowing) countries need not experience a secular deterioration in their terms of trade relative to the developed world, as it appears in long-horizon terms of trade data for the two groups of countries.

In a globalised world with nominal rigidities, we show that nominal exchange rate over-shooting (or under-shooting) may occur as a result of short-run capital flows due to profit transfers across countries. Short-run excess volatility in nominal exchange rates is generally associated with a corresponding variability in real exchange rates, although the degree of correlation between nominal and real exchange rates varies substantially across investing and borrowing countries. In investing countries, a depreciation of the home currency triggers a less than proportional real depreciation and the more so the more open the economy. The opposite is true in borrowing countries, where nominal and real exchange rates are almost perfectly correlated when trade openness is high.

Our analysis can be extended along at least two directions. First, institutional aspects of monetary policy, such as the exchange rate regime or the degree of monetary conservativeness, might play a role in the choice of the most convenient way to serve foreign customers. The model presented in this paper can be easily amended so as to compare the profitability of exports and direct investments across monetary policy regimes.

Second, modeling the choice of foreign market access is a priority in this research program: times are ripe for bridging the gap between trade and monetary theory and considering the whole variety of modes of foreign market access.
access in a world with nominal rigidities.
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