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Globalisation and the international monetary transmission *

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Abstract

This paper examines how differences in the integration strategies followed by firms active in foreign markets affect the transmission of productivity and policy shocks worldwide. The analysis focuses on frictions in international goods markets by incorporating costly trade and local sales by multinational firms in a general-equilibrium open economy macroeconomic model. The mode of foreign markets access is shown to play a key role in the way country-specific shocks spread their effects worldwide. Productivity shocks are found to determine a permanent rise in international prices when foreign markets are mainly served via sales by overseas branches of multinational firms, hence obscuring the expenditure switching channel of international transmission. Multinational firms, by optimally discriminating prices across countries, contribute to insulate the domestic economy from world cyclical conditions. Our results further show that accounting for differences in the integration strategies worldwide considerably improves

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the match between theoretical predictions and actual business cycle data.

Keywords: multinational firms, trade costs, internationalised production, monetary policy, international cyclical transmission

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1 Introduction

This paper examines how differences in the integration strategies followed by firms active in foreign markets affect the transmission of productivity and policy shocks worldwide. The analysis focuses on frictions in international goods markets as represented by costly trade and local sales by multinational firms. The emphasis on trade frictions is motivated by the well documented fact that despite the secular tendency towards falling trade and transport costs segmentation in international goods markets remains remarkably high in the world economy. At the same time, however, the pace of globalisation does not seem to slow down: the volume of sales by affiliates of multinational enterprises has grown tremendously in the past two decades, even outpacing the noticeable espansion of trade in manufactures that has occurred in the period.

The mode of foreign market access has attracted a growing attention in the trade literature, with a number of recent contributions focusing on entry behaviour by multinational firms.[1] Much less attention has been devoted to foreign market servicing in the macroeconomic literature, at least until recently when a new generation of general-equilibrium open-economy models has emerged which explicitly incorporates internationalised production and

[1] Recent contributions that examine the choice of foreign market access include, among many others: Helpman, Mélitz and Yeaple (2005) for a model that incorporates horizontal FDI and trade, Yeaple (2003) and Aizenman and Marion (2004) for the choice between horizontal and vertical FDI and Antràs and Helpman (2004) for the outsourcing alternative.

foreign market access.[2] This paper contributes to such line of research by providing a convenient framework for the analysis of the macroeconomic consequences of trade costs and internationalised production. The main advantage of our specification is that it encompasses a variety of integration strategies worldwide yet maintaining the analitical framework solvable in close form.

The paper considers a two-country world economy in the tradition of the "new open economy" literature where markets are characterised by monopoly distorsions and prices are sticky. The model rests on two basic premises. First, consumers attach a value to the fact that a good is produced in their own country, implying that imported goods and goods produced by local affiliates of foreign firms are imperfectly substitutable. The assumption captures the fact that producing in the sales market helps tailor a firm's product to the preferences of local consumers. Second, there are two types of firms: national firms, which serve foreign customers through exports, and multinational firms which use production facilities located in the sales market. Firms have access to the same technology worldwide and are identical in any respect except for the mode of serving foreign customers. We purposely overlook potential sources of firms' heterogeneity which might explain why some firms become multinational and focus instead on the behaviour of firms which are already active in foreign markets.[3]

[2] A number of contributions in this area analyse the macroeconomic implications of firms' entry and exit decisions in foreign markets, stressing the common forces behind the movements in international prices and the dimension of markets (see, among others, Russ (2004), Ghironi and Mélitz (2005), Corsetti, Pesenti and Martin (2005) and Bergin and Glick (2004a, 2004b)). A non-exhaustive list of papers that incorporate multinational production include Devereux and Engel (2001), Russ (2004) and Cavallari (2004, 2005).

[3] This has no practical consequences for the transmission of monetary policy shocks insofar as there are lags in the entry mechanism. The main implications of entry decisions in foreign markets would be on the long-run equilibrium, where firms might optimally decide whether to become multinational. In a companion paper, I extend the model so

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. Moreover, accounting for differences in the integration strategies worldwide turns out to improve considerably the match between theoretical predictions and actual business cycle data.

A decline in domestic productivity is associated with a permanent increase in domestic prices as long as countries engage in large bilateral multinational activities, while leaving foreign-currency prices unchanged. Intuitively, this is due to the fact that the productivity slowdown will affect the firms active in the home economy, namely domestic firms and affiliates of foreign multinationals. As a consequence of internationalised production, output will move together in the two countries while consumption will decrease in the home economy only. This in turn implies a higher cross-country correlation of output than consumption, as it is true in the data for most industrialised countries. In countries that mostly trade among each-others, instead, higher marginal costs at home raise the price that both domestic and foreign consumers face for home goods. The consequent improvement 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.

A policy of trade liberalisation, as represented by a symmetric worldwide decrease in trade costs, is shown to have asymmetric effects across countries depending on their degree of integration in the world economy. The drop in trade costs might turn counter-productive for countries that mainly host foreign multinationals, as it will reduce the price of domestic goods in international markets. As a consequence of the trade policy, domestic agents

that the share of multinational firms is determined endogenously (Cavallari (2005)). Entry effects are shown to reinforce our main results.

will have to supply more labour effort in order to buy a given unit of the foreign good.

Finally, an easing of the global monetary stance, wherever it is originated, boosts world demand and output as long as prices are sticky. The paper shows that a domestic monetary expansion mainly raises consumption and employment at home when bilateral multinational sales are large. Multinational firms, in fact, find it optimal to discriminate prices across countries and in so doing they help insulate the domestic economy from world cyclical conditions. Multinational enterprises, on the other hand, will also move profits across borders, affecting the countries' current account positions and hence the exchange rate. Any unexpected change in the profits of overseas branches of multinational firms will then be associated with a corresponding movement in the exchange rate, so as to maintain a balanced current account. This implies that the exchange rate might eventually overshoot its long-run equilibrium level.

The paper is structured as follows. Section 2 models the world economy. Section 3 derives the equilibrium allocation when prices are flexible and discusses the long-run implications of the model. Section 4 examines the world equilibrium and the international monetary transmission under sticky prices. 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 while focusing 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:

$$\Omega_{it} = E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} U_{it}(C^i, \frac{M^i}{P}, L^i) \tag{1}$$

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

$$U_{it} = \ln C_{it} + \chi \ln \frac{M_{it}}{P_t} - \kappa L_{it} \tag{2}$$

where κ is a real or productivity shock which can be interpreted as a shock to the natural rate of output, and χ is a nominal disturbance or velocity shock.

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

$$C = \frac{C_H^{\gamma} C_F^{1-\gamma}}{\gamma^{\gamma} (1-\gamma)^{1-\gamma}} \tag{3}$$

The foreign goods distributed in the home market can be produced either abroad 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:

$$C_F = C_{FF}^{1-\Psi^*} C_{FH}^{\Psi^*} \tag{4}$$

where C_{FF} is consumption of the foreign imported good, C_{FH} is consumption of the foreign good produced in the home country and the parameter Ψ^* is the degree of internationalisation of foreign production: a value of Ψ^* close to one implies that almost all foreign firms are multinationals that serve the home market through subsidiaries located in the home country. The price index (4) captures a particular type of love for variety, where goods' varieties depends on where production is located. The idea is that consumers attach a value to the fact that a good is produced in the sales market and can be better tailored to their tastes. Goods can be differentiated across locations, for example, by incorporating a substantial local marketing input or passing through non-competitive local retailing networks.

Domestic and 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, where all varieties are consumed in the world economy. Consequently, the following consumption sub-indices can be defined:

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

$$C_{FH} = \left[\int_0^{\Psi^*} \left(\frac{1}{\Psi^*}\right)^{\frac{1}{\phi^*}} C_{FH}(f)^{\frac{\phi^*-1}{\phi^*}} df\right]^{\frac{\phi^*}{(\phi^*-1)}} \tag{5}$$

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

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

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

$$\begin{aligned} P_H C_H &= \gamma PC \\ P_F C_F &= (1-\gamma)\, PC \end{aligned} \tag{6}$$

$$\begin{aligned} P_{FH}C_{FH} &= \Psi^* P_F C_F \\ P_{FF}C_{FF} &= (1-\Psi^*) P_F C_F \end{aligned} \tag{7}$$

$$\begin{aligned} C_H(h) &= \left(\frac{P_H(h)}{P_H}\right)^{-\phi} C_H \\ C_F(f) &= \left(\frac{P_F(f)}{P_F}\right)^{-\phi^*} C_F \end{aligned} \tag{8}$$

where the corresponding price indices are:

$$P = P_H^{\gamma} P_F^{1-\gamma} \tag{9}$$

$$P_F = P_{FH}^{\Psi^*} P_{FF}^{1-\Psi^*} \tag{10}$$

$$\begin{aligned} P_H &= \left[\int_0^1 P_H(h)^{1-\phi} dh\right]^{\frac{1}{1-\phi}} \\ P_{FH} &= \left[\frac{1}{\Psi^*}\int_0^{\Psi^*} P_{FH}(f)^{1-\phi^*} df\right]^{\frac{1}{1-\phi^*}} \\ P_{FF} &= \left[\frac{1}{1-\Psi^*}\int_{\Psi^*}^1 P_{FF}(f)^{1-\phi^*} df\right]^{\frac{1}{1-\phi^*}} \end{aligned} \tag{11}$$

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 the domestic and foreign firms active in the home country, a share in the profits of home firms, Π, and pays non-distortionary net taxes, T, to the government. The flow budget constraint of agent i is:

$$B^i_{Ht+1} + \varepsilon_t B^{*i}_{Ft+1} + M^i_{t+1} \leq B^i_{Ht}(1+i_{t+1}) + \varepsilon_t B^{*i}_F(1+i^*_{t+1}) + M^i_t \quad (12)$$
$$+W_t\left(L^i_{ht} + L^i_{ft}\right) + \Pi^i_t - P^i_t C^i_t - T^i_t$$

where i and i^* are, respectively, home and foreign nominal interest rates and ε is the nominal exchange rate defined as units of home currency for one unit of foreign currency.

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

$$\frac{M_t}{P_t} = \chi C_t \frac{1+i_{t+1}}{i_{t+1}} \quad (13)$$

and the risk-adjusted uncovered interest rate parity:

$$E_t\left(\frac{\varepsilon_t}{P_{t+1}C_{t+1}}\right) = E_t\left(\frac{\varepsilon_{t+1}}{P_{t+1}C_{t+1}}\right)\frac{1+i^*_{t+1}}{1+i_{t+1}} \quad (14)$$

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

$$\frac{W_t}{P_t} = \kappa C_t \quad (15)$$

2.3 Firms

The representative home firm h is the sole producer of the corresponding variety of the home good. We assume that a share Ψ of domestic firms serve foreign customers through subsidiaries located abroad and the remaining share operate via exports. The parameter Ψ may be thought of as a proxy for firms' heterogeneity, due, for example, to differences in the level and dispersion of productivity across firms. A number of contributions in the new trade theory stresses the role of firms' heterogeneity in explaining the

structure of international trade and the mode of foreign market access.[4] A common finding in this literature is that only the most productive firms access foreign markets and only the most productive among those operating in foreign markets engage in multinational activities.

As it is common in proximity-concentration models, we further assume that exports entail iceberg-type transport costs, so that 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.[5] The presence of trade frictions typically provides a motive for multinational activities, as firms invest in sales facilities abroad whenever the gains in avoiding shipping costs outweigh the sunk costs of maintaining capacity in multiple locations (the proximity-concentration trade-off).

2.3.1 Production location

Technology is linear in labour and symmetric across countries and goods' varieties. The production function of a national home firm for sales to domestic residents and exports is given by:

$$Y(h) = L_h^i$$

where L_h^i is the home labour input.

As in Devereux and Engel (2001), we assume that production by multinational firms is located in the sales market, so that a multinational home firm faces the following technology when selling to foreign residents:

$$Y^*(h) = L_h^{i^*}$$

where $L_h^{i^*}$ is the foreign labour input. The structure of technology captures the fact that the multinational firm incurs some production costs abroad

[4] The original contribution is due to Mélitz (2003).

[5] Tariff barriers range on average between 4 and 5 per cent of the price of traded goods. Trade costs - including tariff and non-tariff barriers, shipping and distribution costs - vary greatly across classes of goods.

and is therefore directly affected by foreign productivity shocks as well as by a change in the nominal exchange rate.

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, optimal prices mark up nominal marginal costs:

$$\begin{aligned} \widetilde{P}_{Ht} &= \Phi W_t \quad \widetilde{P}^*_{HHt} = \frac{\Phi \tau W_t}{\varepsilon_t} \quad \widetilde{P}^*_{HFt} = \Phi W^*_t \\ \widetilde{P}^*_{Ft} &= \Phi^* W^*_t \quad \widetilde{P}_{FHt} = \Phi^* W_t \quad \widetilde{P}_{FFt} = \Phi^* \tau \varepsilon_t W^*_t \end{aligned} \tag{16}$$

where $\Phi \equiv \phi/(\phi-1)$ and $\Phi^* \equiv \phi^*/(\phi^*-1)$ are indices of monopoly distortions in, respectively, the home and foreign markets.[6]

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 local currency. This is obviously true for domestic firms selling to domestic residents, as there would be no reason to set prices in a foreign currency. Subsidiaries of foreign firms, instead, could in principle set prices in their own currency and let the local currency price of their products vary with the nominal exchange rate. There is ample evidence, however, that multinational firms engage in substantial pricing to market activities through their sales facilities overseas (Lipsey, 1999). Optimal pre-determined prices for goods produced in the sales markets are set as a mark-up on expected nominal marginal costs:

[6] 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).

$$\begin{aligned} \overline{P}_{Ht} &= \Phi E_{t-1}(W_t)\ \overline{P}^*_{HFt} = \Phi E_{t-1}(W^*_t) \\ \overline{P}^*_{Ft} &= \Phi^* E_{t-1}(W^*_t)\ \overline{P}_{FHt} = \Phi^* E_{t-1}(W_t) \end{aligned} \tag{17}$$

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. Following Corsetti and Pesenti (2005), we assume that firms set the foreign-currency price for their products according to the following scheme:

$$\begin{aligned} P^*_H(h) &= \widehat{P}_H(h)\varepsilon^{-\eta^*} \\ P_F(f) &= \widehat{P^*}_F(f)\varepsilon^{\eta} \end{aligned} \tag{18}$$

where $\widehat{P}_H(h)$ is the pre-determined price for good h in home currency and $\widehat{P^*}_F(f)$ 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 traded goods yields:

$$\overline{P}^*_{HHt} = \frac{\Phi\tau E_{t-1}(W_t P^*_t C^*_t \varepsilon_t^{1+\eta^*})}{\varepsilon_t^{\eta^*} E_{t-1}(P^*_t C^*_t \varepsilon_t)} \tag{19}$$

$$\overline{P}_{FFt} = \frac{\Phi^* \tau E_{t-1}(W_t^* P_t C_t \varepsilon_t^{-1-\eta})}{\varepsilon_t^{-\eta} E_{t-1}(P_t C_t \varepsilon_t^{-1})}$$

In foreign markets, the ex post mark-up is inversely related with nominal marginal costs and the nominal exchange rate. This implies that exporters will consider both movements in nominal marginal costs and the exchange rate in the future when setting prices. Whenever they expect the domestic currency to appreciate, a fall in ε, thereby reducing sales revenue in foreign currency, they will set foreign-currency prices at a premium and 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:

$$\begin{array}{rcl} \overline{P}_H & \geq & W \quad \widehat{P}_H \geq W\tau \quad \overline{P}^*_{HF} \geq W^* \\ \overline{P}^*_F & \geq & W^* \quad \widehat{P^*}_F \geq W^*\tau \quad \overline{P}_{FH} \geq W \end{array} \tag{20}$$

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:

$$\int_0^1 M_{it} - M_{it-1} di + \int_0^1 T_{it} di = 0 \tag{21}$$

Governments affect the stock of domestic monetary assets by controlling the short-term interest rate. Following Corsetti and Pesenti (2005), it is useful to define an index of monetary stance μ in the home country such that:

$$\frac{1}{\mu_t} \equiv \beta(1 + i_{t+1}) E\left[\frac{1}{\mu_{t+1}}\right] \tag{22}$$

In equilibrium, it is immediate to derive μ as the inverse of the marginal utility of consumers' wealth, PC.[7] Expression (22) links a given time path of μ to a corresponding sequence of home nominal interest rates: a monetary expansion is associated with a higher μ and a lower i.

2.5 Aggregate resource constraints

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

$$\int_0^1 B_{Ht}^i di + \int_0^1 B_{Ht}^{*i} di = 0 \quad \int_0^1 B_{Ft}^i di + \int_0^1 B_{Ft}^{*i} di = 0 \tag{23}$$

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

$$Y_H \geq C_H + C_H^* \tag{24}$$

Finally, equilibrium in the labour market yields:

$$L \geq C_H + C_{HH}^* + C_{FH} \tag{25}$$

where $L = \int_0^1 L^i di$ is the aggregate labour force.

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:

$$PC = P_H C_H + \varepsilon P_H^* C_H^* + W C_{FH} - \varepsilon W^* C_{HF}^* \tag{26}$$

where use has been made of the assumption of initial financial autarky in each country, i. e. $B_{H0} = B_{F0}^* = 0$. As usual in the class of models that

[7] We have recursively used the index of monetary stance in the Euler equation (14).

use log utility, net assets are zero in any point in time provided initial non-monetary wealth is zero as well. [8] After some manipulations, the current account equation (26) can be reformulated in the more familiar form:

$$(1-\Psi)\,\varepsilon P^*_{HH}C^*_{HH} - (1-\Psi^*)\,P_{FF}C_{FF} + \left(\Psi - \frac{\phi-1}{\phi}\right)\varepsilon P^*_{HF}C^*_{HF} - \left(\Psi^* - \frac{\phi^*-1}{\phi^*}\right)P_{FH}C_{FH} = 0$$

where the first two terms represent the trade balance and the last two terms are net factor payments, which in our model coincide with the profits of home multinationals operating abroad less the profits of foreign multinationals in the home country.

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:

$$\widetilde{\varepsilon} = \frac{1-\gamma}{\gamma}\frac{\mu}{\mu^*}\frac{(1-\frac{\Psi^*)}{\Phi^*})}{(1-\frac{\Psi)}{\Phi})} \tag{27}$$

With flexible prices, the nominal exchange rate is proportional to the relative monetary stance and a domestic monetary expansion, an increase in μ, leads to an exchange rate depreciation, an increase in $\widetilde{\varepsilon}$.

Replacing $\mu = PC$ in the home labour supply (15), using optimal prices (10) and (18) and repeating the same steps for the foreign country, we derive world prices as follows:

$$\begin{aligned} \widetilde{P}_H &= \Phi\kappa\mu \\ \widetilde{P}^*_{HH} &= \frac{\Phi\tau\kappa\mu}{\varepsilon} \end{aligned} \tag{28}$$

[8] 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.

$$
\begin{aligned}
\widetilde{P}^*_{HF} &= \Phi\kappa^*\mu^* \\
\widetilde{P}_{FF} &= \Phi^*\tau\varepsilon\kappa^*\mu^* \\
\widetilde{P}_{FH} &= \Phi^*\kappa\mu \\
\widetilde{P}^*_{F} &= \Phi^*\kappa^*\mu^*
\end{aligned}
$$

Consumption and labour in the world economy are derived using μ and μ^* into, respectively, the price index (9) and the labour market clearing equation (25) in the home and foreign country, yielding:

$$
\begin{aligned}
\widetilde{L} &= \frac{a_0}{\kappa} \\
\widetilde{L}^* &= \frac{a^*_0}{\kappa^*}
\end{aligned}
\tag{29}
$$

$$
\begin{aligned}
\widetilde{C} &= a_1 \left(\frac{1}{\kappa}\right)^{\gamma+(1-\gamma)\Psi^*} \left(\frac{1}{\kappa^*}\right)^{(1-\gamma)(1-\Psi^*)} \\
\widetilde{C}^* &= a^*_1 \left(\frac{1}{\kappa}\right)^{\gamma(1-\Psi)} \left(\frac{1}{\kappa^*}\right)^{1-\gamma+\gamma\Psi}
\end{aligned}
\tag{30}
$$

where the constants are defined as follows:

$$
\begin{aligned}
a_0 &\equiv \tfrac{\gamma}{\Phi} + \tfrac{(1-\gamma)(1-\Psi)(1-\frac{\Psi^*)}{\Phi^*})}{\Phi\tau(1-\frac{\Psi}{\Phi})} + \tfrac{(1-\gamma)\Psi^*}{\Phi^*} \\
a^*_0 &\equiv \tfrac{1-\gamma}{\Phi^*} + \tfrac{\gamma(1-\Psi^*)(1-\frac{\Psi}{\Phi})}{\Phi\tau(1-\frac{\Psi^*}{\Phi^*})} + \tfrac{\gamma\Psi}{\Phi} \\
a_1 &\equiv \tfrac{1}{\Phi_W}\left(\tfrac{(1-\gamma)(1-\frac{\Psi^*}{\Phi^*})}{\tau\gamma(1-\frac{\Psi}{\Phi})}\right)^{(1-\Psi^*)(\gamma-1)} \\
a^*_1 &\equiv \tfrac{1}{\Phi_W}\left(\tfrac{(1-\gamma)(1-\frac{\Psi^*}{\Phi^*})}{\tau\gamma(1-\frac{\Psi}{\Phi})}\right)^{(1-\Psi)\gamma}
\end{aligned}
$$

3.1 The international transmission of shocks

In the flexible-price benchmark, employment is exclusively determined by *country-specific* real shocks and global monopoly distortions. A negative shock to home productivity, an increase in κ, leads to a fall in employment as a result of the choice on the part of home agents to smooth labour effort

along time. Employment is negatively associated with monopolistic distortions in domestic and foreign goods markets, with the latter playing a role whenever countries serve foreign markets through subsidiaries of multinational enterprises.

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 in the terms of trade ensure that the benefits and costs from country-specific productivity shocks spread around the world, changing the composition of world spending. Movements in the prices of goods produced in the sales market, on the contrary, affect local markets only and do not transmit worldwide. From (30), it appears that spillovers on consumption are positive as long as countries trade between each others:

$$\begin{aligned} \frac{\partial C/C}{\partial \kappa^*/\kappa^*} &= (1-\gamma)\left(\Psi^*-1\right) \\ \frac{\partial C^*/C^*}{\partial \kappa/\kappa} &= \gamma\left(\Psi-1\right) \end{aligned}$$

An increase in home productivity, for instance, by reducing the price of all goods produced in the home country will deteriorate the home terms of trade, thereby shifting world spending towards home goods. As a consequence, consumption will increase in both countries. The home productivity shock does not affect the price of home goods produced by multinationals in the foreign country, hence leaving foreign consumption unaltered when foreign customers are mainly served through this channel ($\Psi = 1$).

3.1.1 International prices

In order to see more clearly how the mode of foreign market access affects the international transmission of shocks, consider the relative price of home

goods in international markets , $\widetilde{Q} = \varepsilon \widetilde{P}_H^* / \widetilde{P}_F$, [9]:

$$\widetilde{Q} = \tau^{\Psi^* - \Psi} \frac{\Phi}{\Phi^*} \left(\frac{(1 - \frac{\Psi^*}{\Phi^*})(1-\gamma)\kappa^*}{(1 - \frac{\Psi}{\Phi})\gamma\kappa} \right)^{\Psi - 1 + \Psi^*} \tag{31}$$

Observe first, that countries that mainly host foreign multinationals, $(\Psi^* > \Psi)$, might be vulnerable to a policy of trade liberalisation as represented by a symmetric, worldwide decrease in iceberg-type transport costs. A drop in transportation costs τ, in fact, reduces the price of the home good in international markets, implying that more labour effort on the part of home agents is needed in order to buy a given unit of the foreign good. This is not to say, however, that trade liberalisation is always counter-productive for countries, like developing economies, where production is less or not at all internationalised. The negative wealth effect of trade liberalisation, in fact, might be more than compensated in welfare terms by the boost in domestic consumption.

Second, country-specific shocks to productivity are associated with rising or falling prices in international markets, depending on the mode of foreign market access in the world economy. In less integrated and symmetric economies, namely when $\Psi^* = \Psi \simeq 0$, a decline in domestic productivity improves the home terms of trade, $\varepsilon \widetilde{P}_{HH}^* / \widetilde{P}_{FF}$ rises, partially shifting the costs of the productivity slowdown abroad.[10] Among highly integrated and similar economies ($\Psi^* = \Psi \simeq 1$), instead, high marginal costs at home

[9] The international relative price $\widetilde{Q}$ is calculated as a weighted average of the terms of trade, $\varepsilon \widetilde{P}_{HH}^* / \widetilde{P}_{FF}$, and the relative price of the goods sold by multinationals, $\varepsilon \widetilde{P}_{HF}^* / \widetilde{P}_{FH}$, where the weights are, respectively, the share of exporters and the share of multinationals in each country.

[10] It is worth noticing that consumption is fully stabilised in the world economy whenever production is not internationalised, $\Psi = \Psi^* = 0$,:

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

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.

raise prices in the home market only, yet leaving foreign-currency prices unaffected. The relative price of the home good in international markets, $\varepsilon \widetilde{P}^*_{HF}/\widetilde{P}_{FH}$, will consequently decrease, de facto obscuring the expenditure switching channel of international cyclical transmission. Domestic consumption turns out to be effectively isolated from world cyclical conditions when bilateral multinational sales are large.

Third, equation (31) further shows that the response of international prices to country-specific disturbances is almost nil when countries access foreign markets through different channels. Consider, as a way of example, the case where home firms mainly export their products abroad while foreign firms operate through subsidiaries located in the home country, $(\Psi^* \simeq 1; \Psi \simeq 0)$. Since home exports and foreign multinational sales have identical marginal costs, a fall in productivity, wherever it is originated, has no consequences for the relative price of the home good in international markets. The result is consistent with the evidence showing that, despite lower trend productivity, less developed countries do not experience a secular deterioration in their terms of trade relative to the developed world.[11] In our framework, this is due to the fact that trading with partners characterised by a much higher degree of multinational production provides a hedge against unfavourable changes in world demand. A slowdown in home productivity, by raising the home-currency price for home and foreign goods in the same percentage, will not switch expenditure in favour of foreign goods. As a consequence, the home economy is effectively insulated from world cyclical conditions.

[11] The long-lasting debate on the secular deterioration of the terms of trade of developing countries was 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).

3.1.2 The consumption-output anomaly

One notable feature of our equilibrium outcome is that gross domestic product is much more correlated across countries than consumption in strongly integrated and symmetric economies, as it is true in the data for most industrialised countries. A 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 consumption to be equalised across countries through trade in financial assets. Perfect risk-sharing in a world with complete asset markets automatically yields perfect correlation among consumption differentials across countries, as predicted by standard real business cycle models (Backus, Kehoe and Kydland (1992)).[12]

In order to see the point, consider the extreme case where there is no trade and foreign markets are served through sunsidiaries of multinational enterprises, $\Psi = \Psi^* = 1$.[13] It is easy to verify that GDP coincides with domestic spending and is stabilized across countries:

$$\frac{Y^D}{Y^{*D}} = \frac{\gamma}{1-\gamma}\frac{\frac{\phi-1}{\phi}}{\frac{\phi^*-1}{\phi^*}}$$

while consumption depends on relative productivity shocks:

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

In our framework of effectively complete markets, less than perfect risk-sharing in consumption is the result of market segmentation due to direct

[12] 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)).

[13] In our model, GDP is defined as $Y^D \equiv Y_H + Y_{HF}$. In general, the GDP ratio is given by:

$$\frac{Y^D}{Y^{*D}} = \frac{\gamma(\frac{\phi-1}{\phi})\left((2-\Psi)PC + \varepsilon P^* C^* \Psi\right) + (1-\gamma)(\frac{\phi^*-1}{\phi^*})PC\Psi^*}{(1-\gamma)(\frac{\phi-1}{\phi})(\varepsilon P^* C^* \Psi) + \gamma(\frac{\phi^*-1}{\phi^*})\left((2-\Psi^*)\varepsilon P^* C^* + \Psi^* PC\right)}$$

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. Cross-country output correlation, on the other hand, is positively associated with the degree of internationalisation in production, since a slowdown in home productivity will reduce the amount of goods produced out of domestic labour services in domestic firms as well in foreign multinationals.

3.1.3 The failure of the PPP

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

$$\widetilde{R} = \frac{1-\gamma}{\gamma} \frac{(1-\frac{\Psi^*)}{\Phi^*})}{(1-\frac{\Psi)}{\Phi})} \left(\frac{\kappa}{\kappa^*}\right)^{-\Psi\gamma-\Psi^*(1-\gamma)} \tau^{(1-\Psi)\gamma-(1-\Psi^*)(1-\gamma)} \tag{32}$$

Despite price flexibility, purchasing power parity may not hold, $R \neq 1$. Many studies document that real exchange rate movements are highly persistent, so much that the hypothesis of unit roots in real exchange rate data can hardly be rejected for most industrialised and developing countries, thereby violating the parity condition.[14] The convergence to parity remains very slow even when structural changes in long-horizon time series are accounted for: 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 arise from transport costs and

[14] 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.

multinational sales 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:

$$\widetilde{R} = \tau^{2\gamma-1}$$

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

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:

$$\widetilde{R} = \frac{(1-\gamma)\,\phi\kappa^*}{\gamma\phi^*\kappa}$$

4 The short-run equilibrium

Following the same steps as before and using pre-determined prices (19) and (17), we can derive the short-run equilibrium allocation:

$$\overline{\varepsilon}_t = \frac{1-\gamma}{\gamma}\frac{\mu_t}{\mu_t^*}\frac{(1-\frac{\Psi^*\kappa\mu_t}{\Phi^* E(\kappa\mu_t)})}{(1-\frac{\Psi\kappa^*\mu^*}{\Phi E(\kappa^*\mu^*)})} \tag{33}$$

$$\begin{aligned}
\overline{P}_H &= \Phi E_{t-1}\left(\kappa_t\mu_t\right) \\
\overline{P}^*_{HH} &= \frac{\Phi\tau E_{t-1}(\kappa_t\mu_t\kappa^*\mu_t^*\varepsilon_t^{1+\eta^*})}{\overline{\varepsilon}_t^{\eta^*} E_{t-1}(\kappa^*\mu_t^*\varepsilon_t)} \\
\overline{P}^*_{HF} &= \Phi E_{t-1}(\kappa^*\mu_t^*) \\
\overline{P}^*_{F} &= \Phi^* E_{t-1}(\kappa^*\mu_t^*) \\
\overline{P}_{FF} &= \frac{\Phi^*\tau E_{t-1}(\kappa_t\mu_t\kappa^*\mu_t^*\varepsilon_t^{-1-\eta})}{\overline{\varepsilon}_t^{-\eta} E_{t-1}(\kappa_t\mu_t\varepsilon_t^{-1})} \\
\overline{P}_{FH} &= \Phi^* E_{t-1}(\kappa_t\mu_t)
\end{aligned} \tag{34}$$

$$\overline{L} = \left(\frac{\gamma\mu_t}{\overline{P}_H} + \frac{(1-\Psi)\,\gamma\mu_t^*}{\overline{P}^*_{HH}} + \frac{\Psi^*\,(1-\gamma)\,\mu}{\overline{P}_{FH}}\right) \tag{35}$$

$$\overline{L}^* = \left(\frac{(1-\gamma)\,\mu_t^*}{\overline{P}_F^*} + \frac{(1-\Psi^*)\,\gamma\mu_t}{\overline{P}_{FF}} + \frac{\gamma\Psi\mu_t^*}{\overline{P}_{HF}^*} \right)$$

$$\begin{aligned} \overline{C} &= a_2 \frac{\mu_t \overline{\varepsilon}_t^{\,-(1-\gamma)\eta(1-\Psi^*)}}{\Phi_W} \\ \overline{C}^* &= a_2^* \frac{\mu_t^*\, \overline{\varepsilon}^{\gamma\eta^*(1-\Psi)}}{\Phi_W} \end{aligned} \tag{36}$$

where the constant are defined as follows:

$$a_2 \equiv \left((E_{t-1}(\kappa_t\mu_t))^{\gamma+(1-\gamma)\Psi^*} \left(\frac{\tau E_{t-1}(\kappa_t\mu_t\kappa^*\mu_t^*\overline{\varepsilon}_t^{-1-\eta})}{E_{t-1}(\kappa_t\mu_t\overline{\varepsilon}_t^{-1})} \right)^{(1-\gamma)(1-\Psi^*)} \right)^{-1}$$

$$a_2^* \equiv \left((E_{t-1}(\kappa^*\mu_t^*))^{1-\gamma+\gamma\Psi} \left(\frac{\tau E_{t-1}(\kappa_t\mu_t\kappa^*\mu_t^*\overline{\varepsilon}_t^{1+\eta^*}}{E_{t-1}(\kappa^*\mu_t^*\overline{\varepsilon}_t)} \right)^{\gamma(1-\Psi)} \right)^{-1}$$

4.1 The international monetary transmission

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.[15]

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 crucially depends on the pricing strategies of the firms active in foreign markets, while the mode of foreign market access is key to the employment spillovers throughout the world.

[15] 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, Galì and Gertler (1999).

In a high pass-through environment, i.e. when $\eta = \eta^* \simeq 1$, a domestic monetary expansion raises consumption worldwide. The depreciation of the home currency, by deteriorating the home terms of trade, switches world expenditure in favour of home goods. Since domestic prices are predetermined, home consumer prices rise and foreign consumer prices fall with the depreciation of the exchange rate, thereby raising consumption in both countries.

Worldwide employment need to increase in the wake of a monetary expansion so as to provide a larger amount of goods for consumption. When production is not integrated worldwide, $\Psi = \Psi^* \simeq 0$, domestic employment bears the whole burden of adjustment. This implies that the domestic monetary expansion certainly benefits foreign residents, who can consume more for a given level of work effort. By the same token, the monetary easing may turn potentially harmful for domestic consumers.[16] 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 spillovers may be not negligible. First, a home monetary easing leads to an increase in foreign employment as long as there are home multinationals located abroad. Second, there is the expectation channel of monetary transmission. Any change in the expected monetary stance, say, for example, a monetary policy regime shift as the move from flexible to fixed exchange rates, by changing expected

[16] The monetary expansion is "beggar myself " whenever the welfare loss from increasing labour effort outweighs the welfare gain from higher consumption.

marginal costs, can affect the level and volatility of consumption and employment worldwide.

4.1.1 Nominal exchange rate overshooting

As well-known since Dornbush (1983), the nominal exchange rate can temporarily deviate from its long-run equilibrium level. In our model, exchange rate overshooting is represented by the difference between the value of the exchange rate that prevails in the short and the long run as shown in equations (33) and (27), respectively.[17] As will be apparent soon, exchange rate overshooting materializes as a consequence of cross-border profit transfers by multinational enterprises.[18]

The nominal exchange rate in the short run, (33), may react to other cyclical conditions than monetary policy. Consider, for example, an increase in home productivity, a fall in κ. The exchange rate will temporarily depreciate as follows:

$$\frac{\partial \overline{\varepsilon}/\overline{\varepsilon}}{\partial \kappa/\kappa} = \frac{-\frac{\Psi^* \kappa \mu_t}{\Phi^* E(\kappa \mu_t)}}{(1 - \frac{\Psi \kappa^* \mu^*}{\Phi E(\kappa^* \mu^*)})}$$

and return to its long-run equilibrium level, (27), once prices adjust. The reason is that the demands for goods produced in the home country cannot change as long as home-currency prices are sticky, so that the main economic effect of the productivity rise 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, net factor payment towards the home country will decrease and the home currency needs to depreciate so as to maintain a balanced current account. In the

[17] Exchange rate deviations from fundamentals are temporary: inspection of equations (33) and (27) immediately reveals that the short-run and long-run exchange rates coincide once prices adjust.

[18] In our model, the current account coincides with the trade balance when production is entirely domestic.

long run, the exchange rate does not need to move as falling prices in the home country will balance the current account by re-directing world demand in favour of goods produced in the home market.

It is worth noticing that the exchange rate moves in the opposite direction following an *expected* change in productivity. The expectation of lower marginal costs, in fact, induces the firms active in the home market to charge lower prices. This in turn will shift world expenditure in favour of goods produced at home, thus appreciating the home currency.

Using equations (33) and (27), we can further show that the short-run exchange rate can over- or undershoot its long-run equilibrium value following a change in the global monetary stance. To see the point, consider a one per cent domestic monetary expansion, an increase in μ, that leads to a corresponding exchange rate depreciation in the long run (see equation (27)). As long as prices are sticky, the exchange rate might move by less than one per cent, as shown below:

$$\frac{\partial \overline{\varepsilon}/\overline{\varepsilon}}{\partial \mu/\mu} = 1 - \frac{\Psi^* \kappa \mu}{\left(\Phi^* E\left(\kappa \mu_t\right) - \Psi^* \kappa \mu_t\right)}$$

where it appears that undershooting occurs unless the home market is exclusively served through trade, $\Psi^* = 0$. The reason why the exchange rate moves less in the short than in the long run is due to the fact that the home monetary easing unexpectedly raises the nominal marginal costs faced by all the firms located in the home country when prices are sticky. As already argued, this will reduce the profits outflows towards the foreign country and help dampen the exchange rate. By the same token, the home currency will overshoot its long-run value when the monetary expansion originates abroad and foreign markets are served by subsidiaries of home multinational firms.

4.1.2 The link between real and nominal exchange rates

Finally, consider the following derivative:

$$\frac{\partial \overline{R}/\overline{R}}{\partial \overline{\varepsilon}/\overline{\varepsilon}} = 1 - \eta^* (1 - \Psi) \gamma - \eta (1 - \Psi^*) (1 - \gamma) \tag{37}$$

Equation (37) shows that a one percent increase in the nominal exchange rate depreciates the real exchange rate by less than one percent, with the real rate responding more the lower the degree of exchange rate pass-through in the world economy and the higher the degree of internationalised production.[19] This is consistent with a well-documented empirical evidence showing that there is high correlation between changes in nominal and real exchange rates among industrialised as well as developing countries.[20]

Cross-country asimmetries in the integration strategies play a key role in shaping the relation between real and nominal rates. Consider as a way of example the case where the home country sells its products abroad mainly through multinational firms while importing goods from the foreign country, ($\Psi = 1$ and $\Psi^* = 0$). The example captures a relevant difference in the mode of foreign market access between industrialised (home) and developing (foreign) countries. As apparent from (37), a one percent depreciation of the home currency is associated with a real depreciation between 1 and γ, depending on exchange rate pass-through. This implies that the domestic monetary expansion reduces the purchasing power of domestic consumers and may then turn counter-productive, particularly so in large and relatively closed countries, namely when $\gamma \to 1$. The welfare-based incentive to ease monetary policy might then be smaller in closed than open economies when foreign markets are mainly served through overseas branches of multinational firms. Accounting for multinational sales can help explain why

[19] When prices are set in the consumers' currency, $\eta^* = \eta = 0$ or $\Psi = \Psi^* = 1$, the real rate moves one to one with the nominal rate.

[20] Mussa (1986) documents that real exchange rates become much more volatile when nominal 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.

some countries do not seem to suffer the costs of exchange rate depreciation despite being highly integrated in the world economy, as it appears in the data for most industrialised countries. [21]

In countries that mainly trade with the rest of the world, like the foreign economy in our example, the real depreciation is higher the more open the economy. As apparent from (37), a one per cent depreciation of the foreign currency is in fact associated with a real depreciation between 1 and $1-\gamma$ percent. This implies that we should observe a negative relation between inflation and openness in this case.[22]

5 Conclusions

This contribution has incorporated multinational sales along with costly trade in a general-equilibrium open economy macroeconomic model with the aim of investigating the implications of firms' integration strategies for the international transmission of policy and productivity shocks. The mode of foreign markets access, whether via exports or via sales by overseas branches of multinational firms, is shown to play a key role in the way country-specific shocks spread their effects worldwide.

Asymmetric cyclical developments, as represented by cross-country productivity differentials, may originate rising or falling international prices in our model depending on the mode of foreign market access that prevails in the world economy. In countries that mostly trade between each-others, the costs and benefits of a change in domestic productivity are partially shifted outside the domestic borders through the movements in the terms of

[21] In a well-known paper, Romer (1993) documents that trade openness is inversely related with inflation in a large sample of countries, however no significant relation between the two variables appears in the sub-sample of industrialised countries.

[22] Terra (1998) documents that a significant negative relation between inflation and openness exists among developing countries with debt prolems.

trade. A rise in home productivity will deteriorate the home terms of trade, shifting world expenditure towards home goods. As a consequence of lower prices for home goods in the world economy, consumption will rise in both countries. When countries engage in large bilateral multinational activities, instead, foreign-currency prices are not affected by the change in domestic productivity, so that consumption spillovers worldwide are nil. The relative price of the home good in international markets will in fact *rise* following an increase in home productivity.

Our results further show that allowing for multinational sales improves the way the model fits to actual data in two relevant dimensions. First, our model can reconcile the well-known consumption-output puzzle, showing that the cross-country correlation of output is much higher than that of consumption in most industrialised countries. In our framework, this is due to the fact that some production costs can be incurred abroad, so that gross domestic ouput is highly correlated across countries, while prices can be (optimally) discriminated across market, so that domestic consumpion is insulated from world cyclical conditions. Second, in our model international prices turn out to be almost invariant to country-specific productivity shocks when there are significant differences in the integration strategies across countries. Despite lower productivity, countries that mainly host foreign multinationals need not experience a deterioration in the relative price of their products, as it is true in long-horizon terms of trade data between developing and industrialised economies. Trading with partners characterised by a much higher degree of internationalised production implies that the productivity slowdown at home will affect the price for home exports and foreign multinational sales in the same percentage, partially hedging domestic residents from an unfavourable shift in world demand.

As regards the transmission of monetary policy shocks worldwide, the paper shows that excess volatility in nominal exchange rates may occur

in a globalised world with nominal rigidities. Exchange rate overshooting (or undershooting) is the result of cross-country profit transfers operated by multinational firms. Intuitively, any unexpected change in nominal marginal costs, as due, for example, to a global monetary expansion, will mainly affect the profits of domestic and multinational firms as long as prices are fixed. As local affiliates of foreign multinationals repatriate their unexpectedly high (low) profits, net factor payment towards the home country will decrease (increase) and the home currency needs to further depreciate (appreciate) in order to maintain a balanced current account.

References

[1] Antràs P. and E. Helpman, 2004, Global Sourcing. *Journal of Political Economy* 112, 553-580

[2] Aizenman J. and N. Marion, 2004, The Merits of Horizontal versus Vertical FDI in the Presence of Uncertainty. *Journal of International economics*, 62, 125-148

[3] Backus D.K., P. Kehoe and F.E. Kydland, 1992, International Real Business Cycles. *Journal of Political Economy* 100, 745-775

[4] Campa J.M. and L. Goldberg, 2004, Exchange Rate Pass-trough into Import Prices. *CEPR working paper* no.439, forthcoming *Review of Economics and Statistics*

[5] Cavallari L., 2004, Optimal Monetary Rules and Internationalized Production. *International Journal of Finance and Economics* 9, 1-12

[6] Cavallari L., 2005, How to sell in foreign markets? A macroeconomic theory of the decision to go multinational. Unpublished manuscript, University of Rome III

[7] Clarida, R, J. Galì and M. Gertler, 1999. The Science of Monetary Policy: A New Keynesian Perspective. *Journal of Economic Literature* 37, 1661-1707

[8] Cole H. L. and M. Obstfeld, 2001, Commodity Trade and International Risk Sharing: How Much do Financial Markets Matter? *Journal of Monetary Economics*, 28, 3-24

[9] Corsetti G., Martin P. and P. Pesenti, 2005, Productivity Spillovers, Terms of Trde and the "Home Market Effect", *Federal Reserve Bank of New York Staff Reports* no. 201

[10] Corsetti G. and P. Pesenti, 2002, Welfare and Macroeconomic Interdependence. *Quarterly Journal of Economics,* 116, 2, 421-46

[11] Corsetti G. and P. Pesenti, 2005, International Dimensions of Optimal Monetary Rules. *Journal of Monetary Economics 52, 2, 281-305*

[12] Devereux M. and C. Engel, 2001, The Optimal Choice of Exchange Rate Regime: Price Setting Rules and Internationalized Production, in Magnus Blomstrom and Linda Goldberg, eds., *Topics in Empirical International Economics*, University of Chicago Press: Chicago, IL

[13] Engel C., 1999, Accounting for US Real Exchange Rate Changes. *Journal of Political Economy* 197, 507-38

[14] Engel C and J. H. Rogers, 1996, How Large is the Border? *American Economic Review* 86, 1112-25

[15] Engel C. and J. H. Rogers, 1998, Regional Patterns in the Law of one Price: the Roles of Geography versus Currencies, in Frankel J. A. ed., *The Regionalisation of the World Economy*, University of Chicago Press: Chicago, IL

[16] Froot K. A. and K. Rogoff, 1996, Perspectives on PPP and Long-run Real Exchange Rates in G. Grossman and K. Rogoff, eds. *Handbook of International Economics*, vol.3. Amsterdam: Elsevier Press

[17] Ghironi F. and M. Melitz, 2005, International Trade and Macroeconomic Dynamics with Heterogeneous Firms, *Quarterly Journal of Economics* 120

[18] Goldberg P. and M. Knetter, 1997, Goods Prices and Exchange Rates: what have we learned? *Journal of Economic Literature*, 35, 1243-1272

[19] Helpman E., Melitz M. and S. Yeaple, 2004, Export versus FDI with Heterogeneous Firms, *American Economic Review,* 94, 1, 300-316

[20] Lipsey, R.E, 1999, The role of FDI in international capital flows, in Martin Feldstein ed., *International Capital Flows*, Chicago: University of Chicago Press

[21] Lothian and A. M. Taylor, 1996, Real Exchange Rate Behaviour. The Recent Float and the Perspective of the Past two Centuries, *Journal of Political Economy* 104, 488-509

[22] Mélitz M., 2003, The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity, *Econometrica*, 71 (6): 1695-1725

[23] Murray C. and D. H. Papell, 2002, The Purchasing Power Parity Persistence Paradigm", *Journal of International Economics* 56, 1-19

[24] Mussa M., 1986, Nominal exchange rate regimes and the behavior of real exchange rates: Evidence and implications. *Carnegie-Rochester Series on Public Policy* 25, 117-214

[25] Obstfeld M., 2001, International Macroeconomics: Beyond the Mundell-Fleming Model. *IMF Staff Papers* 47, 1-39

[26] Parsley D. and S. Wei, 2001, Explaining the Border Effect: the Role of Exchange Rate Variability, Shipping Costs and Geography. *Journal of International Economics* 55, 87-105

[27] Rogoff K., 1996, The Purchasing Power Puzzle. *Journal of Economic Literature* 34, 647-668

[28] Romer D., 1993, Openness and Inflation: Theory and Evidence. *Quarterly Journal of Economics*, 108, 4, 869-903

[29] Russ K., 2004, The endogeneity of the exchange rate as a determinant of FDI: a model of money, entry and multinational firms", unpublished paper, University of California, Davis

[30] Salvatore D., 2001, *International Economics*, John Wiley & Sons, Inc

[31] Singer H., 1950, The Distribution of Gains between Investing and Borrowing Countries. *American Economic Review*, May, 473-485

[32] Terra C., 1998. Openness and Inflation: a New Assessment. *Quarterly Journal of Economics*, 113, 642-648

[33] Yeaple, S. R., 2003, The Complex Integration Strategies of Multinationals and Cross-Country Dependencies in the Structure of FDI. *Journal of International Economics*, 60, 293-314