Firms’ integration strategies and the international business cycle *

Lilia Cavallari
University of Rome III

Abstract

This paper provides a framework for the analysis of firms’ integration strategies that incorporates the endogenous determination of the number of firms that serve foreign markets through exports and the number of multinational firms that rather engage in horizontal foreign direct investments. We find that firms’ integration strategies play a key role in propagating productivity and monetary policy shocks. In addition, we show that accounting for multinational sales along with trade allows to shed light on a number of puzzling features in terms of trade and exchange rate data. Differences in firms’ integration strategies can account for persistent deviations from the purchasing power parity and the lack of a secular deterioration in the terms of trade of countries with lower productivity. In our setup with endogenous integration strategies, we finally show that monetary stabilisation might

*Lilia Cavallari, University of Rome III, Dipartimento di Istituzioni, Economia e Società, Via C. Chiabrera, 193, 00145 Rome, Italy, email: cavallar@eco.uniroma3.it. The author thanks two anonymous referees for very helpful comments. The usual disclaimer applies.
involve a policy trade-off between the desire to smooth fluctuations in producers’ prices and the need to facilitate adjustments in consumers’ prices.

**Keywords**: multinational firms, foreign direct investments, firm entry, internationalised production, monetary policy, international business cycle

**JEL codes**: F41

### 1 Introduction

This paper provides a framework for the analysis of firms’ integration strategies that incorporates the endogenous determination of the number of firms that serve foreign markets through exports and the number of multinational firms that rather engage in horizontal foreign direct investments. Our aim is to investigate how differences in firms’ integration strategies affect the way productivity and monetary policy shocks spread their effects 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. Moreover, the volume of sales by affiliates of multinational enterprises has grown tremendously in the past two decades, even outpacing the noticeable expansion 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 the determinants of entry behaviour by multinational firms.\(^1\) Much less attention

---

\(^{1}\)Recent contributions that examine the choice of foreign market access include, among
has been devoted to the macroeconomic implications of different modes of serving foreign markets. Recent attempts in this direction have investigated several dimensions in which multinational activities can contribute to our understanding of the international business cycle and the role of monetary policy in a globalised world. A common drawback in most of these analyses is the lack of an explicit microeconomic foundation for the decision to go multinational. This paper fills the gap by examining the determinants of trade and horizontal foreign direct investments in a model where entry in foreign markets is endogenous.

The paper models a stylized two-country world economy characterised by monopoly distortions and price stickiness in the tradition of the new open economy macroeconomics. In our setup, each firm decides whether to export its products or invest in a production facility overseas, becoming a multinational enterprise. As usual in models with endogenous entry, choosing between trade and foreign direct investments requires to strike a balance between fixed and variable costs. International trade involves a fixed cost of participating in the export market as well as a variable transport cost,


Multinational activities are found to have relevant implications for a number of monetary policy issues, as, for instance, the choice of the most appropriate exchange rate regime (Devereux and Engel (2001)), the gains from international monetary coordination (Cavallari (2004)), the relation between exchange rate volatility and FDI (Russ, 2004) and the monetary transmission worldwide (Cavallari (2005)).

A non-exhaustive list of contributions that analyse the macroeconomic implications of firm entry and exit decisions includes Bilbiie, Ghironi and Mézit (2005), Bergin and Corsetti (2005), Ghironi and Mézit (2005), Corsetti, Pesenti and Martin (2005) and Bergin and Glick (2003a, 2003b)).
while foreign direct investments entail only a fixed cost for the setup of an affiliate overseas. Fixed costs are sunk in the usual sense that they must be paid prior to production. Our model rests on the basic premise that traded goods and goods produced by multinationals are imperfect substitutes. The assumption captures the fact that producing in the sales market helps tailor a firm’s product to the tastes of local consumers. In so doing, we depart from the treatment of multinational activities that is conventionally taken in the literature, where the existence of multinational enterprises is typically related to the presence of economies of scale and love for variety. Our goal here is to show how we can improve our understanding of the international business cycle by simply appealing to cross-country differences in the mode of serving foreign markets.

Remarkably, we find that firms’ integration strategies play a key role in propagating productivity and monetary policy shocks. Moreover, accounting for multinational sales along with trade allows to shed light on a number of puzzling features in terms of trade and exchange rate data.

We first analyse the equilibrium where prices are flexible and show that cross-country differences in productivity may lead to rising, falling or unchanged prices in international markets 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 trade. A rise in home productivity, by reducing the price of home exports, switches world expenditure towards home goods, favouring home and foreign consumers as well. As long as countries engage in large bilateral multinational activities, instead, the boost in domestic productivity reduces the price that home consumers face for foreign goods yet
leaving foreign-currency prices unaffected. The price of domestic goods in international markets effectively rises. We finally stress that relative goods prices are almost invariant to country-specific productivity levels in countries characterised by asymmetric integration strategies, as developing and industrialised economies. This in turn implies that despite lower productivity, less developed economies need not experience a secular deterioration in their terms of trade vis à vis industrialised countries, as documented in long-horizon terms of trade data for the two groups of countries.

In addition, we find that movements in international goods prices may give rise to persistent deviations from the purchasing power parity, as apparent in real exchange rate data for most developing and industrialised economies. The failure of the parity is the result of segmentation in international goods markets arising from costly trade and multinational activities. In our setup with endogenous entry, cross-country differences in productivity may exacerbate market segmentation and lead to asymmetric integration strategies in the world economy. A rise in domestic productivity, for instance, by attracting new export firms and multinationals in the home country will reduce the price for domestic goods, with the consequence that the real exchange rate in home currency appreciates whenever the weight of traded goods in world consumption is high and depreciates otherwise.

We then consider the equilibrium with pre-set prices and evaluate monetary policies in the class of linear rules. As long as prices are fixed, a change in the global monetary stance affects world consumption and output by changing the terms of trade and re-directing spending across countries. In our setup with firms’ entry, the effects of monetary policy on output are magnified by the change in the investment demand for new firms. An easing of the global monetary stance has the potential to attract or discourage new
investors, depending on which one between two opposing effects prevails. On the one side, a monetary expansion, wherever it is originated, is associated with lower discount rates, thereby increasing the present value of future profits for both national and multinational firms. On the other side, however, a domestic monetary expansion might discourage entry in the home country insofar as it is associated with lower mark-ups in home exports and foreign multinational sales. We show that a policy of complete stabilisation can replicate the allocation that would prevail in an equilibrium where prices are flexible, extending to a framework with endogenous integration strategies the results in Corsetti and Pesenti (2002). Our analysis, however, highlights that a policy trade-off may materialise when stabilisation is not complete between the need to reduce fluctuations in producers’ prices and the desire to allow for adjustments in consumers’ prices. A policy of incomplete stabilisation, by reducing the volatility of marginal costs and therefore of profits, induces firms to demand a lower premium in pre-determined prices. The expectation of lower producers’ prices, on the other hand, might discourage entry of new firms, thereby reducing the varieties that will be available for consumption. The opposed trade-off arises when a pro-cyclical monetary policy is in place. A monetary expansion when cyclical conditions turn favourable might be justified on the ground that it helps reduce consumers’ prices by fostering competition among the producers of different varieties. The adjustment in consumers’ prices, however, may come at the cost of higher and more variable producers’ prices.

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 equilibrium in the world economy when prices are sticky and analyses the
effects of different degrees of monetary stabilisation. Section 5 concludes.

2 The model

The world economy comprises two countries, home and foreign, each populated by a continuum of agents of unit mass. Each agent in the world economy owns and operates a firm which produces a unique variety of a differentiated traded good. Production requires labour as the sole input. We consider exports and horizontal foreign direct investments as alternative modes of serving foreign markets. Exports entail both a variable iceberg-type transport costs and a fixed cost of participating in the export market. A firm that decides to invest in a production facility located abroad, becoming a multinational enterprise, incurs only in the sunk entry cost.

2.1 Consumers

Expected lifetime utility of a typical home agent $i$ is given by:

$$\Omega_i = E_t \sum_{t=1}^{\infty} \beta^{t-t} U_i^t (C_i, \frac{M_i}{P_t}, L_i)$$

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

$$U_i^t = \ln C_i^t + \chi \ln \frac{M_i^t}{P_t} - \kappa L_i^t$$

with $\chi > 0$ and $\kappa > 0$. Foreign agents’ preferences are expressed in an analogous way, but are defined over consumption of goods sold in the foreign
country, $C^*$, foreign money balances, $M^*/P^*$, and foreign labour, $L^*$.

Each agent in the world economy consumes a basket that comprises a non traded resource good, $X$, whose price, $P_X$, is normalised to one, and a differentiated traded good, $Z$, as follows:

$$
C = \frac{X^\gamma Z^{1-\gamma}}{\gamma^\gamma (1 - \gamma)^{1-\gamma}} 
$$

$$
C^* = \frac{X^*\gamma Z^{*1-\gamma}}{\gamma^\gamma (1 - \gamma)^{1-\gamma}} 
$$

with $\gamma \in (0, 1)$. Traded goods can be either exported or they can be produced in the sales market by local subsidiaries of multinational firms. We assume that goods produced in different locations are perceived as imperfect substitutes by final consumers, with elasticity of substitution equal to one:

$$
Z = \frac{Z_N^{1-\Psi} Z_M^\Psi}{\Psi^\Psi (1 - \Psi)^{1-\Psi}} 
$$

$$
Z^* = \frac{Z_N^{*1-\Psi} Z_M^{*\Psi}}{\Psi^\Psi (1 - \Psi^*)^{1-\Psi}} 
$$

where $\Psi \in (0, 1)$. In our notation, the subscript indicates whether the good is exported by a national firm, $N$, or produced in the sales market by a multinational firm, $M$, so for instance, $Z_N^*$ represents foreign consumption of imported goods. The consumption index (4) captures a peculiar type of love for variety, where goods’ varieties depends on where production is located. The idea is that consumers realize that foreign goods can be better tailored to

---

4For future reference, 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.

5In our specification, consumers derive the same utility from consuming additional units of a given basket of foreign goods and spreading consumption over a basket that includes more varieties. This in turn implies that supplying more varieties raises welfare whenever
their tastes once they are produced in their own country. Local subsidiaries of multinational firms can, in fact, customize their products across locations, for instance by incorporating non-tradable inputs or passing through local distribution services.

Traded goods appear in a finite mass of imperfectly substitutable varieties indexed by $\omega \in (0, m + n)$ for home goods and by $\omega^* \in (0, m^* + n^*)$ for foreign goods, where $m$ is the number of home multinational firms and $n$ the number of home export firms and a similar interpretation holds for $m^*$ and $n^*$. The number of firms active in the world economy in each period will be determined endogenously in the model. All varieties exhibit a constant elasticity of substitution $\phi > 1$:

\begin{align}
Z_N &= \left[ \int_0^{n^*} Z_N(\omega^*)^{\frac{\phi-1}{\phi}} d\omega^* \right]^{\frac{1}{\phi-1}} \\
Z_M &= \left[ \int_0^{m^*} Z_M(\omega^*)^{\frac{\phi-1}{\phi}} d\omega^* \right]^{\frac{1}{\phi-1}} \\
Z_N^* &= \left[ \int_0^{n^*} Z_N^*(\omega)^{\frac{\phi-1}{\phi}} d\omega \right]^{\frac{1}{\phi-1}} \\
Z_M^* &= \left[ \int_0^{m^*} Z_M^*(\omega)^{\frac{\phi-1}{\phi}} d\omega \right]^{\frac{1}{\phi-1}}
\end{align}

In such an environment trade is entirely intra-industry in varieties of $Z$.

### 2.2 Firms

All firms in the world economy have access to a linear technology where labour is the only input. A firm located on the home soil faces the following production function:

the additional varieties are effectively consumed. See the discussion in Bilbiie, Ghironi and Mélitz (2005).
\[ Y_Z(\omega) = \alpha L_Z(\omega) \]  
\[ Y_{Z^*}(\omega^*) = \alpha L_Z(\omega^*) \]

where \( Y_Z(\omega) \) is domestic output of the home variety \( \omega \), \( Y_{Z^*}(\omega^*) \) is domestic output of the foreign variety \( \omega^* \) and \( \alpha \) is a stochastic term capturing labour productivity.

Similar expressions hold in the foreign country:

\[ Y_Z^*(\omega^*) = \alpha^* L_Z^*(\omega^*) \]  
\[ Y_Z^*(\omega) = \alpha^* L_Z^*(\omega) \]

### 2.2.1 Firms’ entry

Entry into the traded sector is free, but to produce a variety of \( Z \) a firm must bear a fixed cost, becoming the sole producer of a unique variety. In order to start production at time \( t + 1 \), each entrant pays a sunk (fixed) cost of \( q_t \) effective labour units at home and \( q_t^* \) in the foreign country \(^6\). These costs capture a variety of fixed costs which are associated with both exporting and investing overseas. Examples of fixed costs of participating in the export market include export licences and other administrative fees as well as outlays involved in obtaining information about the foreign market. Fixed costs related to foreign investments include property taxes for subsidiaries abroad and the costs for the setup of local marketing and distribution networks.

In each period, home export firms and foreign multinationals need to employ \( 1/\alpha_t \) units of home labour in order to start production in the subsequent period, thus facing the following entry costs:

\(^6\)Without loss of generality, we assume that a home exporter and a foreign multinational enterprise will face the same entry cost on the home soil.
$$q_t = \frac{W_t}{\alpha_t}$$

Similarly, the entry cost faced by firms that produce in the foreign country is:

$$q_t^* = \frac{W_t^*}{\alpha_t^*}$$

As it is common in proximity-concentration models, 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 while not associated with foreign direct investments.\(^7\)

In each period, there is a finite mass of active firms at home and in the foreign country, $m_t^* + n_t^*$ and $m_t + n_t$, respectively, as well as an unbounded mass of prospective entrants, $m_t^{*E} + n_t^{*E}$ and $m_t^E + n_t^E$. Entrants are forward-looking and will access a market insofar as their future expected profits will cover entry costs. At the end of the period, after production has taken place, all firms exit the market and a new production process is initiated in every period. The number of active firms in each period is therefore pre-determined as follows:

$$m_t = m_t^{E} \quad n_t = n_t^{E}$$
$$m_t^* = m_t^{*E} \quad n_t^* = n_t^{*E}$$

\(^7\)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 types of goods.
2.3 Individual and government’s budget constraints

In each period, the representative agent holds home currency, two international bonds, $B_{iH}$ and $B_{iF}$, respectively denominated in home and foreign currency, and shares in domestic export firms, $s^N$, and multinational enterprises, $s^M$. He receives labour income at the wage rate $W$ for services provided to all firms active on the home soil, a share in the profits of home national and multinational firms, $\Pi_N$ and $\Pi_M$, respectively, and pays non-distortionary net taxes, $T$, to the government. The budget constraint of agent $i$ is therefore:

$$B_{iHt+1} + \varepsilon B_{iFt+1} + M_{it+1} + \int_0^{t+1} s^N_t(\omega) q_t d\omega + \int_0^{t+1} s^M_t(\omega) \varepsilon t^* d\omega \leq B_{iHt}(1+i_{t+1}) +$$

$$T_{it} + \Pi_NtL_{it} + \Pi_MtM_{it} - P^i_tC_t - T_t$$

(8)

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

The government simply rebates all seigniorage revenue in lump-sum transfers to households, so that its budget constraint is as follows:

$$\int_0^1 M^i_t - M^i_{t-1} dt + \int_0^1 T^i_t dt = 0$$

(9)

2.4 The equilibrium allocation

2.4.1 First order conditions

Home agents maximize utility (2) with respect to $C_t$, $X_t$, $Z_{Ni}(\omega^*)$, $Z_{Mi}(\omega^*)$, $L_t$, $M_t$, $s^N_t(\omega)$, $s^M_t(\omega)$, $B_t$ and $B^*_t$ subject to their budget constraint (8). The
first order conditions are:

\[ \frac{1}{C_t} = \lambda_t P_t \]  \hspace{1cm} (10)

\[ X_t = \gamma \frac{1}{\lambda_t P_{N_t}} \]

\[ Z_{N_t}(\omega^*) = \frac{(1 - \Psi)(1 - \gamma)}{\lambda_t P_{N_t}} \left( \frac{p_{Nt}(\omega^*)}{P_{Nt}} \right)^{-\phi} \]  \hspace{1cm} (11)

\[ Z_{M_t}(\omega^*) = \frac{\Psi(1 - \gamma)}{\lambda_t P_{M_t}} \left( \frac{p_{Mt}(\omega^*)}{P_{M_t}} \right)^{-\phi} \]  \hspace{1cm} (12)

\[ W_t = \kappa \]  \hspace{1cm} (13)

\[ \lambda_t M_t = \chi \frac{1 + i_{t+1}}{i_{t+1}} \]  \hspace{1cm} (14)

\[ \lambda_t q_t = E_t [\beta \lambda_{t+1} \Pi_{t+1}^N(\omega)] \]  \hspace{1cm} (15)

\[ \lambda_t \varepsilon_t q_t^* = E_t [\beta \lambda_{t+1} \Pi_{t+1}^M(\omega)] \]  \hspace{1cm} (16)

\[ \lambda_t = \beta E_t (\lambda_{t+1} (1 + i_{t+1})) \]  \hspace{1cm} (17)

\[ \lambda_t \varepsilon_t = \beta E_t (\lambda_{t+1} \varepsilon_{t+1} (1 + i_{t+1}^*)) \]  \hspace{1cm} (18)

where the Lagrange multiplier \( \lambda \) measures the marginal utility of home currency and the utility-based price indices are defined as follows:

\[ P = P_X^\gamma P_Z^{1-\gamma} \]  \hspace{1cm} (19)

\[ P_Z = P_{ZM}^\Psi P_{ZN}^{1-\Psi} \]  \hspace{1cm} (20)
\[ P_{ZM} = \left[ \int_0^{m^*} p_{ZM}(\omega^*)^{1-\phi} d\omega^* \right]^{\frac{1}{1-\phi}} \]
\[ P_{ZN} = \left[ \int_0^{n^*} p_{ZN}(\omega^*)^{1-\phi} d\omega^* \right]^{\frac{1}{1-\phi}} \]

Following Corsetti and Pesenti (2005), it is useful to define an index of the monetary stance \( \mu \) such that a monetary expansion, i. e. a rise in \( \mu \), is associated with a lower interest rate:

\[ \mu_t \equiv P_tC_t = \frac{1}{\lambda_t} \quad (22) \]

### 2.4.2 Free entry conditions

Using (22), (13) and (12) as well as their foreign analogues, we can write the free entry conditions for foreign and home multinational firms as follows:

\[ \frac{\kappa \mu_t}{\alpha_t} = E_t \left[ \beta \frac{\mu_t}{\mu_{t+1}} \left( p_{ZM}^*(\omega^*) - \frac{\kappa \mu_{t+1}}{\alpha_{t+1}} \right) (m_{t+1})^{\frac{\omega}{1-\phi}} \frac{\Psi (1-\gamma) \mu_{t+1}}{P_{ZM}^*} \right] \quad (23) \]

\[ \frac{\kappa \mu_t^*}{\alpha_t^*} = E_t \left[ \beta \frac{\mu_t^*}{\mu_{t+1}^*} \left( p_{ZM}^*(\omega) - \frac{\kappa \mu_{t+1}^*}{\alpha_{t+1}^*} \right) (n_{t+1})^{\frac{\omega}{1-\phi}} \frac{\Psi (1-\gamma) \mu_{t+1}}{P_{ZM}^*} \right] \]

The above expressions say that multinational enterprises will invest in a foreign facility abroad as long as the expected present value of operative profits in the subsequent period, on the right hand side, will cover entry costs.

The free entry conditions for export firms are similarly given by:

\[ \frac{\kappa \mu_t}{\alpha_t} = E_t \left[ \beta \frac{\mu_t}{\mu_{t+1}} \left( p_{ZM}(\omega) - \tau \frac{\kappa \mu_{t+1}}{\alpha_{t+1}} \right) (n_{t+1})^{\frac{\omega}{1-\phi}} \frac{(1-\Psi) (1-\gamma) \mu_{t+1}}{P_{ZM}} \right] \quad (24) \]
2.4.3 Optimal Prices

Monopolistic competitors set prices so as to maximize the expected present value of profits given market demand (11) and (12). In the absence of nominal rigidities, optimal prices are set at a constant mark up on nominal marginal costs:

\[
\frac{k \varepsilon_t \mu_t^*}{\alpha_t^*} = E_t \left[ \beta \frac{\mu_t^*}{\mu_{t+1}^*} \left( p_{Z^*N^*}(\omega^*) - \frac{k \mu_{t+1}^*}{\alpha_{t+1}} \right) (n_{t+1}^*)^{-\phi} (1 - \Psi)(1 - \gamma) \frac{\mu_{t+1}^*}{\varepsilon_{t+1} P_{Z^*N^*}^*} \right]
\]

\[
\frac{e_{t+1}^*}{\mu_{t+1}^*} = \left( 1 + \frac{\kappa}{\phi} \right) - (1 - \phi) \frac{\mu_{t+1}^*}{\alpha_{t+1}}
\]

\[
\frac{\mu_{t+1}^*}{\alpha_{t+1}} = \frac{\mu_{t+1}^*}{\alpha_{t+1}} + \frac{\mu_{t+1}^*}{\alpha_{t+1}}
\]

where $\phi \equiv \phi_k/(\phi - 1)$ is an index of monopoly distortions in the world economy, $\mu/\alpha$ and $\mu^*/\alpha^*$ are nominal marginal costs, respectively, at home and abroad and a tilde over a variable indicates that it is calculated with flexible prices.

Our model allows for nominal rigidities by assuming that firms set the price of their product at the beginning of each period, before shocks and entry 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, despite subsidiaries of multinational 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. The assumption is consistent with an ample evidence showing that multinational firms do engage in substantial pricing to market activities through their sales facilities overseas (Lipsey,
Optimal pre-determined prices for goods produced in the sales markets are set as follows:

\[
\bar{p}_{ZM}(\omega) = \frac{\Phi E_{t-1}\left(\frac{(\mu_t^i)^2}{\alpha_t^i}\right)}{E_{t-1}(\mu_t^i)} \tag{26}
\]

\[
\bar{p}_{Z^{*}M^{*}}(\omega^*) = \frac{\Phi E_{t-1}\left(\frac{(\mu_t^i)^2}{\alpha_t^i}\right)}{E_{t-1}(\mu_t^i)}
\]

where a bar over a variable indicates that it is derived with fixed prices. It is worth noticing that preset prices incorporate a risk premium over expected marginal costs which arises from the covariance of profits with the marginal utility of consumption.

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:

\[
p_{Z^N}(\omega) = \hat{p}_{N}(\omega)e^{-\eta^*}
\]

\[
p_{Z^{*}N^{*}}(\omega^*) = \hat{p}_{N^{*}}(\omega^*)e^{\eta^*} \tag{27}
\]

where \(\hat{p}_{N}(\omega)\) is the pre-determined price for variety \(\omega\) of the home traded good in home currency and \(\hat{p}_{N^{*}}(\omega^*)\) is the pre-determined foreign-currency price for variety \(\omega^*\) of the foreign traded good. 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:

$$
\bar{p}^*_{ZN} (\omega) = \frac{\Phi_T E_{t-1}(\mu_t \mu_t^{1+\eta^*})}{\varepsilon_t^{\eta^*} E_{t-1}(\mu_t \varepsilon_t)}
$$

$$
\bar{p}^*_{ZM} (\omega^*) = \frac{\Phi_T E_{t-1}(\mu_t \mu_t^{1-\eta})}{\varepsilon_t^{-\eta} E_{t-1}(\mu_t \varepsilon_t^{-1})}
$$

Optimal prices (28) and (26) are valid for any distribution of the underlying shocks, provided the participation constraints are not violated:

$$
\hat{p}_N (\omega) \geq \frac{\mu_t}{\alpha_t} \bar{p}^*_{ZM} (\omega) \geq \frac{\mu_t^*}{\alpha_t^*}
$$

$$
\bar{p}^*_{ZM} (\omega^*) \geq \frac{\mu_t}{\alpha_t} \hat{p}_N^* (\omega^*) \geq \frac{\mu_t^*}{\alpha_t^*}
$$

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

### 2.4.4 Resource constraints

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

$$
\int_0^1 B_{Ht}^i di + \int_0^1 B_{Hi}^* di = 0 \quad \int_0^1 B_{Pi}^i di + \int_0^1 B_{Pi}^{*i} di = 0
$$

Market clearing on goods markets requires that the world supply coincides with world demand:
Finally, equilibrium in labour markets yields:

\[
\begin{align*}
L &\geq \frac{1}{\alpha} (Y_{ZM} + Y_{ZM}^*) \\
L^* &\geq \frac{1}{\alpha^*} (Y_{ZN}^* + Y_{ZN}^*)
\end{align*}
\]

where \( L \equiv \int_0^1 L'di \) and \( L^* \equiv \int_0^1 L'^*di \) are home and foreign labour force, respectively, and the terms in brackets represent home and foreign GDP.

### 2.4.5 Solution strategy

The model is solved in a symmetric equilibrium where firms set identical prices for the different varieties, implying the following price indices:

\[
\begin{align*}
P_{ZMt}^* &= (n_t)^{\frac{1}{\sigma_t}} P_{ZMt}^* \\
P_{ZMt}^* &= (m_t)^{\frac{1}{\sigma_t}} P_{ZMt}^*
\end{align*}
\]

We assume initial financial autarky in each country, i.e. \( B_{H0} = B_{F0} = 0 \), so that net assets will be equal to zero in any point in time, as usual in this class of models. \(^8\)

\(^8\)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.
Aggregating the budget constraints (8) across home agents and using the government (9) and resource constraints (31) and (32), yields the aggregate accounting identity for the home economy:

\[ P_t C_t + m_t^E \epsilon_t q_t^* + n_t^E q_t = W_t L_t + m_t \Pi_{Mt} + n_t \Pi_{Nt} + P_{Xt} X_t \] (33)

where consumption plus investment in new firms, on the left-hand side, must be equal to total income, i.e. labour income plus dividend income and the endowment of the non traded resource. Re-arranging the above expression, we can write the balance of payments in terms of home currency as follows:

\[ \epsilon_t P_{Zt}^* Z_{Nt}^* - P_{Zt} Z_{Nt} - \frac{W_t}{\alpha_t} Z_{Mt}^* - \frac{\epsilon_t W_t^*}{\alpha_t^*} Z_{Mt}^* + m_t^E q_t - m_t^E \epsilon_t q_t^* = 0 \] (34)

The first two terms constitute the trade balance, i.e. home exports less home imports. The third term is labour income that home agents receive from foreign multinationals and the fourth term is labour income that home multinationals pay in their affiliates abroad, their difference is therefore net factor payments. The sum of the trade balance and net factor payments constitutes the current account. The last two terms are the financing of foreign direct investments towards and from the home economy and their difference is the capital account of the balance of payments.

The balance of payments equilibrium (34) together with the free entry conditions (23) and (24) allow to jointly determine the endogenous \( \epsilon_t, m_t^E \), \( m_t^*, n_t^E \), and \( n_t^*E \). The remaining variables are easily obtained using optimal pricing (25) for the flexible price equilibrium, (26) and (28) in the equilibrium with nominal rigidities, and deriving \( C \) and \( L \) from, respectively, (10) and (13).
3 The flexible price benchmark

In this section we characterise the equilibrium when prices are flexible.

First, we write the operative profits of a typical multinational firm as a share of global sales:

\[
\Pi_t^M (\omega^*) = \frac{\Psi (1 - \gamma) \mu_t}{\phi m_t^*} \\
\Pi_t^M (\omega) = \frac{\Psi (1 - \gamma) \varepsilon_t \mu_t^*}{\phi m_t}
\]

The above expressions highlight that the profits of a multinational enterprise are negatively associated with the total number of multinationals active in the market. Intuitively, this is a consequence of increased competition among the producers of similar varieties, which induces each firm to try and expand its market share by reducing the price for its own variety. In a symmetric equilibrium where all prices are cut by the same amount, firms’ revenues and therefore profits will then decline. At the macroeconomic level, aggregate profits are independent on the number of firms as the drop in consumers’ prices is matched by a corresponding rise in aggregate spending (recall that the elasticity of demand is one in our model). Similarly, the profits of export firms are a constant share of the total revenues from selling their products.

We then use the above equations and their analogues for export firms in (23), (24) and (34), yielding:

\[
\tilde{\alpha}_t^E = \frac{\beta (1 - \gamma) \Psi}{\phi \kappa} \alpha_t \\
\tilde{\alpha}_t^* = \frac{\beta (1 - \gamma) \Psi}{\phi \kappa} \alpha_t^*
\]
Comparing (35) and (36), it appears that the choice whether to access foreign markets through exports or multinational sales crucially depends on the balance between trade and entry costs at home and abroad: the share of home firms that decide to invest in a subsidiary located abroad is positively associated with trade costs and relative productivity $\alpha^*/\alpha$. Moreover, the capacity of a multinational enterprise to save on trade costs and take advantage of cross-country differences in productivity is magnified whenever agents prefer to consume goods produced in their own market, i.e. when $\Psi$ is high.

The number of entrants each period is positively associated with current productivity levels: a rise in home productivity $\alpha$ will attract foreign multinationals and home export firms by reducing the costs of establishing a new production facility on the home soil. It is noteworthy to stress that variables which in principle could affect profits in the subsequent period do not play any role in firms’ entry whenever prices are flexible. Despite the expectation of, say, a rise in marginal costs in the future, national and multinational enterprises will not reduce their investments as they will be able to maintain a constant mark-up by charging higher prices onto consumers.

A fluctuation in marginal costs will rather affect the intensive margins. We can easily show that the level of employment is constant in equilibrium,
as given by:

\[
\tilde{\gamma}_L = (1 - \gamma) \left( \frac{(1 - \Psi) n_t^{\frac{1}{\alpha}} + \Psi m_t^{\frac{1}{\alpha}}}{\Phi} + \frac{\beta}{\phi_K} (\Psi + (1 - \Psi)) \right) \tag{38}
\]

\[
\tilde{\gamma}_L^* = (1 - \gamma) \left( \frac{(1 - \Psi) n_t^{\frac{1}{\alpha}} + \Psi m_t^{\frac{1}{\alpha}}}{\Phi} + \frac{\beta}{\phi_K} (\Psi + (1 - \Psi)) \right)
\]

implying that a rise in home productivity, an increase in \( \alpha \), will just lead to an increase in output per firm. Variable intensive margins along the cycle are a consequence of smoothing labour effort across time.

A change in world output must be matched by a corresponding change in world consumption. As will be apparent soon, the way fluctuations in world consumption spread among home and foreign consumers depends crucially on international integration strategies. Consider the equilibrium levels of consumption at home and abroad as given by:

\[
\tilde{C} = a_1 (\alpha)^{(1-\gamma)\Psi} (\alpha^*)^{(1-\gamma)(1-\Psi)} \tag{39}
\]

\[
\tilde{C}^* = a_1^* (\alpha^*)^{(1-\gamma)\Psi} (\alpha)^{(1-\gamma)(1-\Psi)}
\]

where constants are defined as follows:

\[
a_1 \equiv \frac{1}{\lambda^{1-\gamma}} (\tau)^{(\gamma-1)\Psi - (1-\Psi)} \left( n_t^{\frac{1-\Psi}{\alpha}} m_t^{\frac{1-\Psi}{\alpha}} \right)^{(1-\gamma)}
\]

\[
a_1^* \equiv \frac{1}{\lambda^{1-\gamma}} (\tau)^{(\gamma-1)\Psi - (1-\Psi)} \left( n_t^{\frac{1-\Psi}{\alpha}} m_t^{\frac{1-\Psi}{\alpha}} \right)^{(1-\gamma)}
\]

Consumption is high whenever monopoly distortions are low and the number of active firms is large in the world economy. A rise in domestic productivity raises consumption both at home and abroad, with substantial international spillovers among open economies.\(^9\)

\(^9\)In our model, trade openness is captured by the parameters \((1 - \gamma) (1 - \Psi)\).
In countries with strong bilateral trade ties, namely when $\Psi \to 0$, movements in the terms of trade ensure that the benefits and costs from country-specific productivity shocks disseminate around the world, changing the composition of world spending. The rise in home productivity, in fact, by reducing the price of goods produced in the home country will deteriorate the home terms of trade \( \varepsilon \tilde{P}_{ZN}^*/\tilde{P}_{Z* N*} \) decrease - thereby shifting world spending towards home goods. As a consequence, consumption will increase at home as well as abroad.

Home productivity shocks, on the contrary, do not spill-over onto foreign consumers whenever firms mainly operate through subsidiaries abroad, $\Psi \to 1$. The only consequence of the productivity rise at home will be a lower price for the products of foreign multinationals, implying that the relative price \( \varepsilon \tilde{P}_{ZM}^*/\tilde{P}_{Z* M*} \) in international markets will rather increase. Goods markets become effectively insulated when countries engage in large bilateral multinational activities.

### 3.1 Firms’ integration strategies and macroeconomic interdependence

#### 3.1.1 Rich versus poor countries

Our model has interesting implications for countries that are characterised by asymmetric integration strategies, as industrialised and developing economies.

Suppose that entry costs are close to zero at home (the developing economy) and prohibitively high abroad (the industrialised country), so that most firms decide to locate production in the home country \(^{10}\). In such a situation,

\(^{10}\)It is immediate to realise from (35) and (36) that both $n_t^*$ and $m_t$ are close to zero whenever $\alpha_{t-1}^*/\alpha_{t-1}$ tends to infinity, implying that home firms will serve foreign markets
country-specific shocks to productivity, wherever they are originated, do not affect the relative price $\varepsilon \tilde{P}_{ZN}^{*}/\tilde{P}_{Z^*M^*}$ that home and foreign consumers face for different types of traded goods. Consequently, world expenditure will hardly react to international productivity differentials. The finding is consistent with the evidence showing that, despite lower trend productivity, less developed countries need not experience a secular deterioration in their terms of trade relative to the developed world.\textsuperscript{11}

Moreover, a drop in transportation costs $\tau$, by reducing the price of traded goods, will deteriorate the terms of trade in countries, like the home economy in our example, that mainly serve foreign markets through exports. This implies that a policy of trade liberalisation, as represented by a symmetric, worldwide decrease in iceberg-type transport costs, reduces the purchasing power of consumers in less developed economies, who need to supply more labour effort in order to buy a given unit of the foreign good. This is not to say, however, that trade liberalisation is necessarily counter-productive for developing economies. The negative wealth effect of trade liberalisation, in fact, might be more than compensated in welfare terms by the boost in the external demand for their products.

3.1.2 The failure of the PPP

In our model, the purchasing power parity may not hold, despite flexible prices. Many studies document that real exchange rate movements are highly through exports, while foreign firms will engage in multinational activities.

\textsuperscript{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).
persistent, so much that the hypothesis of unit roots in real exchange rate data can hardly be rejected for most industrialised and developing countries. Deviations from PPP introduce a further distortion in the economy on top of that arising from monopolistic competition. As long as a change in the nominal exchange rate leads to small movements in consumer prices, moving the real exchange rate, in fact, there will be an inefficient change in the price of very similar bundles of goods.

Consider the real exchange rate $R \equiv \varepsilon P^* / P$, as defined using the consumption-based price indices in the two economies:

$$
\hat{R} = \left[ \frac{n_t^{1-\Psi} m_t^\Phi}{n_t^{1-\Psi} m_t^\Phi} \right]^{1-\Phi} \left( \frac{\alpha_t}{\alpha_t^*} \right)^{-(1-\gamma)(1-2\Psi)}
$$

(40)

As apparent from the above equation, deviations from the purchasing power parity, i.e. movements in $R$, may arise as a result of changes in the varieties of goods available for consumption in the world economy. A rise in the number of varieties exchanged with the rest of the world is associated with an appreciation of the real exchange rate in home currency, i.e. a fall in $R$. Tougher competition among home exporters and multinational enterprises will in fact reduce the foreign-currency price of home goods.

The parity may also fail due to cross-country differences in productivity levels, as well known since Balassa (1964) and Samuelson (1964). The Balassa-Samuelson effect says that countries with higher productivity in tradables with respect to non-tradables tend to have higher price levels and therefore their exchange rate appreciates in real terms. In equation (40), a rise in

---

12 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. 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)).
home productivity is associated with a real appreciation in home currency as long as the weight of traded goods in world consumption is large enough, namely whenever $\Psi < 1/2$. This is consistent with the evidence showing that movements in real exchange rates are mainly driven by changes in the terms of trade.\textsuperscript{13} Furthermore, in our setup with endogenous entry, cross-country differences in productivity may exacerbate deviations from the parity by leading to asymmetric integration strategies worldwide. Insofar as a rise in home productivity attracts new entrants in the home country, in fact, home firms will mainly serve foreign markets through exports while foreign firms will mainly operate through local branches of multinational enterprises. Consequently, the rise in productivity may appreciate or depreciate the real exchange rate in home currency depending on the weight of traded goods in world consumption.

4 The short-run equilibrium

In this section we characterise the equilibrium when monopolistic competitors set prices in advance of shocks and before entry takes place. The solution strategy follows the same steps as before except for the fact that optimal pre-set prices (26) and (28) will replace their flexible price counterparts.

4.1 Firms’ entry and exchange rates

The number of entrants and the exchange rate in economies with sticky prices are given by:

\textsuperscript{13}Engel (1999) documents that the relative price of non tradable goods hardly matters for real exchange rates. Fluctuations in the nominal exchange rate, on the other side, appear to be highly correlated with terms of trade movements.
First, observe that the number of entrants in equations (41) and (42) may differ from the one that prevails with flexible prices. Entry behaviour is identical in the two pricing regimes only when pre-determined prices are set as a mark-up on expected marginal costs. As already noted, this will not generally be the case and prices will rather incorporate a premium (or a discount) as a hedge against the risk of a decline in profits. Firms’ profits, in fact, depend on the future realisations of marginal costs, $\mu/\alpha$ at home and $\mu^*/\alpha^*$ in the foreign country, as well as on the covariance between

\begin{align}
\overline{m}_t^E &= \frac{\beta (1 - \gamma) \Psi}{\kappa} \alpha_t \left[ 1 - \frac{E_t(\frac{\mu_{t+1}}{\alpha_{t+1}})}{\overline{P}_{Z^t M^t t+1}} \right] \tag{41} \\
\overline{m}_t^E &= \frac{\beta (1 - \gamma) \Psi}{\kappa} \alpha_t^* \left[ 1 - \frac{E_t(\frac{\mu_{t+1}}{\alpha_{t+1}})}{\overline{P}_{Z^t M^t t+1}} \right] \\
\overline{n}_t^E &= \frac{\beta (1 - \gamma) (1 - \Psi)}{\tau \kappa} \left[ \left( 1 - \frac{E_t(\frac{\mu_{t+1}}{\alpha_{t+1}})}{\overline{P}_{Z^t N^t t+1}} \right) \right] \alpha_t^* \tag{42} \\
\overline{n}_t^E &= \frac{\beta (1 - \gamma) (1 - \Psi)}{\tau \phi \kappa} \left[ \left( 1 - \frac{E_t(\frac{\mu_{t+1}}{\alpha_{t+1}})}{\overline{P}_{Z^t N^t t+1}} \right) \right] \alpha_t \\
\overline{\pi}_t &= \frac{\mu_t}{\mu_t^*} \left[ \frac{(1 - \gamma) (1 - \Psi) - \overline{m}_t^E \kappa}{(1 - \gamma) (1 - \Psi^*) - \overline{m}_t^E \kappa \alpha_t^*} \right] \tag{43}
\end{align}

Note that the term in square brackets blurs to $1/\phi$ when prices mark-up nominal marginal costs.

The pre-determined price for, say, foreign multinational sales, can be written as follows:

$$
\overline{P}_{Z^t M^t} = \Phi \left[ E_{t-1}(\frac{\mu_t}{\alpha_t}) + \frac{\text{cov}(\frac{\mu^*}{\alpha^*}, \mu_t)}{E_{t-1}(\mu_t)} \right]
$$

where the second term in brackets is the risk premium. Similar expressions hold for the other pre-set prices.
these variables and nominal spending, respectively, $\mu$ and $\mu^*$. Whenever a rise in home productivity is associated with an increase in $\mu$, as under a counter-cyclical monetary rule, nominal marginal costs are at least partially stabilised and firms can consequently demand a lower premium. By the same token, a higher risk-premium will be demanded when marginal costs are negatively associated with nominal spending. This in turn implies that the distance between $\tilde{m}_t^E$ and $\tilde{n}_t^E$ on the one side and $\tilde{m}_t^E$ and $\tilde{n}_t^E$ on the other side is increasing with the covariance between nominal spending and nominal marginal costs. As will be apparent in the following section, this has relevant implications for monetary policy.

Additionally, we stress that differently from the entry behaviour under flexible prices, a rise in expected marginal costs might affect entry as long as it is not matched by a corresponding rise in pre-set prices. As a consequence, an insufficient or excessive number of varieties might be produced in the equilibrium with nominal rigidities.

The possibility that expectations affect entry of multinational enterprises and therefore foreign direct investments has important implications for the nominal exchange rate, as evidenced by the presence of $\tilde{m}_t^E$ and $\tilde{m}_t^E$ in equation (43). In order to see the point, suppose to start from an equilibrium characterised by balanced current and capital accounts and then expectations of a deterioration in home marginal costs materialise. With flexible prices, this would have no implications for firms’ entry, as prospective entrants know \footnote{Taking the derivative of $\tilde{m}_t^E$ with respect to $E(\frac{\mu}{\sigma})$ and re-arranging the resulting expression, we obtain:$$\text{sign} \left( \frac{\partial \tilde{m}_t^E}{\partial E(\frac{\mu}{\sigma})} \right) = \text{sign} \left( -\frac{\text{cov}(\frac{\mu}{\sigma}, \mu)}{\left( E(\mu) + E(\frac{\mu}{\sigma}) \right)^2} \right)$$A rise in marginal costs is associated with a fall in the number of entrants whenever the covariance term is positive.}
that they will be able to raise prices in the following period should the rise in marginal costs effectively occur. The story is different when prices are set in advance of shocks: entry in the home market might be discouraged and foreign direct investments will flow away from the home country, $m_t^E$ will decrease. This in turn implies that the home currency needs to depreciate so as to maintain the balance of payments equilibrium. The finding that short-run fluctuations of exchange rates may be driven by non-fundamental forces is a well-known fact in international macroeconomics.

4.2 International spillovers

The levels of consumption and employment in the equilibrium with predetermined prices are given by:

\[
\begin{align*}
\bar{C} &= a_2 \mu t \bar{z}_t^{-(1-\gamma)\eta(1-\Psi)} \\
\bar{C}^* &= a_2^* \mu t^* \bar{z}^{\eta(1-\Psi)(1-\gamma)}
\end{align*}
\]

\[
\begin{align*}
\bar{L} &= \frac{(1-\gamma)}{\alpha_t} \left( \frac{(1-\Psi) \bar{z}_t^{\eta} \mu_t^*}{\bar{P}_{ZM}} + \frac{\Psi \mu_t^*}{\bar{P}_{Z^*M^*}} \right) + \frac{m_t^E + \bar{m}_t^E}{\alpha_t} \\
\bar{L}^* &= \frac{(1-\gamma)}{\alpha_t^*} \left( \frac{(1-\Psi) \mu_t^*}{\bar{z}^{\eta} \bar{P}_{Z^*N^*}^{\eta}} + \frac{\Psi \mu_t^*}{\bar{P}_{ZM}} \right) + \frac{m_t^E + \bar{m}_t^E}{\alpha_t^*}
\end{align*}
\]

where the constants are defined as follows:

\[
\begin{align*}
a_2 &\equiv \left( \left( \frac{\bar{P}_{Z^*M^*}}{\bar{P}_{Z^*N^*}} \right)^\Psi \left( \frac{\bar{P}_{Z^*N^*}}{\bar{P}_{ZM}} \right)^{(1-\Psi)} \right)^{-(1-\gamma)} \\
a_2^* &\equiv \left( \left( \frac{\bar{P}_{Z^*}}{\bar{P}_{ZM}} \right)^\Psi \left( \frac{\bar{P}_{ZM}}{\bar{P}_{ZN}} \right)^{(1-\Psi)} \right)^{-(1-\gamma)}
\end{align*}
\]

As long as prices are sticky, consumption, employment and output in the world economy are positively associated with global monetary conditions. Monetary policy is transmitted in the world economy through changes in
world demand and the terms of trade. Equations (44) and (45) highlight that monetary transmission crucially depends on firms’ integration strategies worldwide, as captured by the parameter $\Psi$.

The capacity of monetary authorities to affect international prices and re-direct expenditure across countries is magnified in a high pass-through environment, i.e. when $\eta = \eta^* \simeq 1$ and the share of multinational enterprises is small, $\Psi \to 0$. A monetary expansion at home, by depreciating the home currency, will deteriorate the home terms of trade, thereby switching world expenditure in favour of less expensive home goods. Consumption will consequently rise in both countries. Worldwide employment needs to increase as well so as to provide a larger amount of goods for consumption.\footnote{Evaluating (45) with $\Psi = 0$, it appears that a one percent increase in the home money supply leads to a $\eta^*$ percent rise in $L$ and a $1 - \eta$ percent rise in $L^*$.}

An easing of the home monetary stance, instead, will have no consequences for the foreign economy when prices are invariant to exchange rate movements, as it is the case when prices are mainly set in the consumers’ currency and foreign markets are mainly served by multinational enterprises.

Finally, we stress that productivity shocks have a minor role in the equilibrium with pre-set prices, where both the intensive and extensive margins are constant. A productivity rise in the home country leads to a corresponding reduction in the level of employment according to (45), leaving output per firm unchanged. The finding is consistent with the so-called New Keynesian view of the business cycle, as synthesised by Clarida, Galí and Gertler (1999), showing that aggregate consumption and output are mainly driven by fluctuations in aggregate demand.
4.3 Monetary stabilisation

Monetary policy, by controlling nominal spending, can help reduce the distortions due to nominal rigidity and even replicate the equilibrium allocation that would prevail with flexible prices. In order to see the point, we consider the most favourable scenario for monetary policy where exchange rate pass-through is complete and evaluate the class of simple linear rules:

\[
\begin{align*}
\mu_t &= \alpha_t^\rho \\
\mu_t^* &= \alpha_t^{*\rho}
\end{align*}
\]

where \( \rho \in (-1, 1) \) measures the degree of monetary intervention in the economy. A positive \( \rho \) implies a counter-cyclical policy, namely a situation where a rise in marginal costs is associated with a monetary expansion. The monetary rule is pro-cyclical when \( \rho \) is negative.

We first establish that a policy of full stabilisation, namely a rule such that \( \rho = 1 \), can restore the flexible price allocation, as apparent after substituting the above rule into (41), (42), (44) and (45). The finding generalises to a framework where firms can choose between different modes of foreign market access a similar result in Corsetti and Pesenti (2002).\(^\text{18}\) When a policy of complete stabilisation is in place, monetary authorities move nominal spending so as to offset any change in domestic productivity and bridge the output gap. This in turn implies that nominal marginal costs will be stabilised in the world economy and firms will have no incentive to change prices even if they were allowed to do so. In a fully stabilised economy, producers’ prices are constant while consumers’ prices may vary with the number of firms that enter home and foreign markets. A fall in world entry costs, as

\(^{18}\text{Bergin and Corsetti (2005) also find that linear monetary rules can replicate the flexible price equilibrium in a closed-economy model with firms’ entry.}\)
a drop in $\kappa$, by attracting export firms and multinational enterprises, will reduce (with one period lag) the price that consumers will face for traded goods and multinational sales.

Second, we consider a Friedman-type rule such that money supply follows a deterministic path independent of current cyclical conditions, as captured by $\rho = 0$ in (46). Inspection of equations (41) and (42) reveals that the entry behaviour under such a rule is the same as in the equilibrium with flexible prices. Intuitively, this is due to the fact that nominal marginal costs and therefore profits are not correlated with nominal spending when a deterministic monetary rule is in place, implying that prices simply mark-up expected nominal marginal costs. Expected profits will then be the same independently of whether firms will be able to change their prices in the subsequent period. Despite the number of varieties available for consumption is the same as when prices are flexible, producers’ prices will be higher than in a stabilised economy and the more so the more volatile productivity levels.\(^{19}\) This in turn implies that consumption and employment will be sub-optimally low when productivity is high and the opposite is true in case of a decline in productivity.

In the intermediate case where monetary policy partially stabilises the economy, i.e. when $0 < \rho < 1$, we stress that a policy trade-off may materialise between the need to reduce fluctuations in producers’ prices on the one hand and the desire to facilitate adjustments in consumers’ prices on the other hand. Compared to the lack of stabilisation, a policy of incomplete stabilisation has the advantage of reducing both the level and volatility of producers’ prices. Firms, in fact, realise that the risk of a decline in profits is

\(^{19}\)When the simple rule is in place, the price for goods produced at home is $\Phi E(\frac{1}{\alpha})$. With iid shocks, this price is increasing with the variance of $\alpha$.\)
lower when a counter-cyclical policy is in place and will consequently demand a lower premium (or a higher discount) on pre-set prices. On the other side, however, the fall in producers’ prices might discourage entry, as evidenced in equations (41) and (42), thereby reducing the varieties of goods that will be available for consumption in the following period.

An opposite conclusion can be drawn for a pro-cyclical policy, $\rho < 0$. Easing monetary policy when cyclical conditions turn favourable might be justified by the desire to attract new firms so as to mimic the consumption bundle that would prevail in an economy with flexible prices. Replicating the flexible-price investment dynamics, however, comes at the cost of higher and more variable producers’ prices.

5 Conclusions

This contribution has incorporated multinational sales along with trade in a general-equilibrium open economy macroeconomic model with endogenous entry so as to investigate the role of firms’ integration strategies in propagating business cycle fluctuations. The analysis has focused on productivity and monetary policy shocks.

In the benchmark model where prices are flexible, we find that differences in firms’ integration strategies can help explain a number of puzzling features in long-horizon data for key international prices. First, we show that a rise in domestic productivity can be associated with a permanent rise or a fall in the relative price for domestic goods in international markets, consistently with the evidence showing that correlations between relative prices and output vary significantly across countries (Backus and Crucini (2000). In our setup, domestic goods prices are positively associated with domestic
productivity levels whenever countries engage in large bilateral multinational activities. An increase in domestic productivity leads to an increase in domestic output and a fall in the relative price of domestic goods, thereby raising the relative price for home multinational sales. Second, international prices are found to be almost invariant to relative productivity in countries characterised by asymmetric integration strategies, as industrialised and developing economies. This in turn implies that despite lower productivity, less developed economies need not experience a secular deterioration in their terms of trade with industrialised economies, as documented in long-horizon terms of trade data for the two groups of countries. Finally, we stress that in our model with endogenous entry, cross-country differences in productivity may exacerbate segmentation in international goods markets and lead to persistent deviations from the purchasing power parity.

In the regime where prices are pre-set, we find that firms’ integration strategies play a key role in propagating monetary policy shocks. An easing of the home monetary stance is shown to boost consumption and output mainly at home whenever consumers’ prices are invariant to a change in the nominal exchange rate, as when firms serve foreign markets through local affiliates and set prices in local currency. Moreover, in our setup with endogenous entry, monetary policy can also affect the investment demand for new firms, both national and multinational enterprises, thereby changing the varieties of goods that will be available for world consumption. We find that a policy of complete stabilisation can replicate the allocation that prevails when prices are flexible, extending to a framework with firms’ entry an analogous result in Corsetti and Pesenti (2002). Our analysis, however, suggests that the finding may not be robust. We show that a policy trade-off may materialise when stabilisation is not complete between the desire to smooth fluctuations
in producers’ prices on the one hand and the need to facilitate adjustments in consumers’ prices on the other hand. The advantage of lower and less variable producers’ prices, by discouraging entry of new firms, may come at the cost of lower varieties being consumed (at higher prices) in the world economy.

References


35


37


[30] Russ K., 2004, The Endogeneity of the Exchange Rate as a Determinant of FDI: a Model of Money, Entry and Multinational Firms”, *mimeo*, University of California, Davis


Derivation of (28) Not to be published

The optimal pre-determined price for variety $\omega$ of home exports is found by maximizing the the expected value of home-currency profits from sales overseas with respect to $\hat{p}_{N_t}(\omega)$ conditional on market demand (11). The Lagrangian is given by the following expression:

$$E_{t-1} \left[ \left( \frac{(\varepsilon_{t}^{-\eta} \hat{p}_{N_t}(\omega))^{1-\phi}}{(\varepsilon_{t}^{-\eta} \hat{P}_{ZN_t})^{-\phi}} - \frac{W_t}{\alpha_t} \left( \frac{\hat{p}_{N_t}(\omega)}{\hat{P}_{ZN_t}} \right)^{-\phi} \right) (1 - \gamma) (1 - \Psi) \frac{\varepsilon_{t} P_{t} C_{t}^{*}}{P_{ZN_t}} \right]$$

The first order condition is:

$$E_{t-1} \left[ \left( (1 - \phi) \varepsilon_{t}^{-\eta} \left( \frac{\hat{p}_{N_t}(\omega)}{\hat{P}_{ZN_t}} \right)^{-\phi} + \tau \frac{W_t}{\alpha_t} \left( \frac{\hat{p}_{N_t}(\omega)}{\hat{P}_{ZN_t}} \right)^{-\phi} \right) \frac{\varepsilon_{t} P_{t} C_{t}^{*}}{P_{ZN_t}} \right] = 0$$

In a symmetric equilibrium where $\hat{p}_{N_t}(\omega) = \hat{p}_{N_t}, \hat{P}_{ZN_t} = n^{\frac{1}{\gamma-1}} \hat{p}_{N_t}$ and $P_{ZN_t}^{*} = \varepsilon_{t}^{-\eta} \hat{P}_{ZN_t}$, the expression above simplifies to the following:

$$E_{t-1} \left[ (1 - \phi) \varepsilon_{t} P_{t} C_{t}^{*} \frac{1}{P_{N_t}} + \phi \frac{W_t}{\alpha_t} \varepsilon_{t}^{1+\eta} P_{t} C_{t}^{*} \left( \frac{1}{\hat{p}_{N_t}} \right)^{2} \right] = 0$$

Factoring out $\hat{p}_{N_t}$, we get:

$$\hat{p}_{N_t} = \frac{\phi \frac{W_t}{\alpha_t} \varepsilon_{t}^{1+\eta} P_{t} C_{t}^{*}}{\phi - 1} \frac{E_{t-1} \left[ \varepsilon_{t} P_{t} C_{t}^{*} \right]}{E_{t-1} \left[ \varepsilon_{t} P_{t} C_{t}^{*} \right]}$$

and using (27), $P_{t} C_{t}^{*} = \mu_{t}$ and $W = \kappa_{t}$, we derive equation (28) in the text.

The other preset prices are derived in a similar way.