

The Impact of the Single Market on the Effectiveness of ECB Monetary Policy

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Abstract

This paper studies the implications of Europe's single market. First, it is shown that small costs of international trade in goods and services may cause a large home bias in consumer spending and can explain seemingly excessive short-run exchange rate volatility. Second, I find that the European single market (declining costs of international trade between the euro area and the member states which have not adopted the single currency) will reduce the home bias in consumption. As a result, euro area monetary policy becomes less powerful in terms of stabilising consumption, but better able to influence the general price level.

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1 Introduction

Markets for goods and services in the European Union are becoming more and more integrated. This is the result of a variety of developments. In particular, border controls have been abolished, markets are being liberalised, public procurement has been opened to foreign firms and technical standards are being harmonised. Moreover, the internet makes it easier and cheaper to order goods and services from abroad. Head and Mayer (2000) provide empirical evidence that the bias towards buying domestically-produced products has been on a downward trend since the 1970s.

In spite of the trend towards more integration, markets for the same products continue to be segmented. This can be illustrated by the home bias in consumer spending. The aforementioned study by Head and Mayer finds that, in the period 1993-95, Europeans purchased twelve times more from domestic producers than from equally-distant (in a geographic sense) foreign producers. The costs of cross-border transactions are still larger than for transactions concluded between parties within the same country. These extra costs may arise from information costs, or from other implicit trade barriers. The importance of information costs was first highlighted by Stigler (1961) and has been explored further by Salop (1977), Bester and Petrakis (1995) and others. Examples are the costs of finding out the quality of foreign goods and foreign counterparties, costs related to differences in distribution channels, costs of cross-border advertisements, etc. Prices are more transparent to buyers from the same country: consumers have better access to domestic price information, since newspapers, magazines and tv programmes are distributed largely within national borders. Other implicit trade barriers include different product standards and national regulations which require firms to comply with specific rules in order to enter another national market. In Europe, several steps have been taken to reduce the costs involved in cross-border transactions, but many obstacles remain.

This paper analyses the consequences of the declining barriers to cross-border competition for the effectiveness of monetary policy. This question is highly relevant for the European Central Bank (ECB), which operates in a changing environment. The analysis involves an extension of the Obstfeld and Rogoff (1995) framework. This framework allows for imperfect competition and nominal rigidities. I explicitly incorporate 'transportation costs' for trade between two countries into the model. 'Transportation costs' is a catch-all term: it can be interpreted as any kind of barrier to trade. Hence, the terms transportation costs and trade costs will be used interchangeably in this paper. The introduction of costs for international trade implies that the model deviates from the standard Obstfeld and Rogoff (1995) model. First, the law of one price need not hold. Second, trade costs lead to an endogenous home bias in consumer spending.

I obtain the following results. First, for realistic values of the price-elasticity parameter, small trade costs lead to a substantial home bias in international trade. I will show numerically that the large decline in the home bias for European countries since the late 1970s found in the literature can be explained by a

relatively small reduction in trade costs. The policy implication is the existence of a window of opportunities for the completion of the European Union's Single Market.

Second, the large short-run exchange rate volatility that we observe in practice can be explained by the presence of international trade costs in the goods market. I will show numerically that when the costs associated with international trade are substantial, short-run exchange rate movements in response to monetary shocks can become extremely large.

Third, European integration may have important consequences for the transmission of ECB monetary policy. The completion of the European Single Market should eliminate any remaining implicit trade barriers between the euro area and the non-participating member states (United Kingdom, Sweden, Denmark). The EU accession of new member states will reduce trade costs between the euro area and the accession countries. In this environment of declining costs of international trade, ECB monetary policy becomes less powerful in terms of affecting consumption, but more effective in terms of influencing the general price level.

A related paper is Warnock (1999), who incorporates a home bias in Obstfeld and Rogoff's model. He imposes an exogenous home bias in preferences: consumers derive more utility from consuming domestically-produced goods than from foreign-produced goods. By contrast, there is no home bias in preferences in this paper: the home bias is endogenous and is caused by the interplay of costs of international trade and imperfect competition (a finite price-elasticity of demand). A second paper in this field is Hau (2000), who introduces a home bias in spending by adding non-tradable goods to the model. By contrast, there are only tradable goods in the model in this paper.

Another paper which is related to the current one is Obstfeld and Rogoff (2000). They focus on the cost of international trade and its possible implications for several empirical puzzles in international macroeconomics, including the home bias in consumer spending. However, they do not study the possible implications for the effectiveness of monetary policy. Moreover, their paper studies a number of special cases for a small country, without developing and solving a fully-edged model, as this paper does. Their two-good model leads to a remarkable discontinuity in prices. This is caused by their assumption that the home country is a small open economy, which may either import or export the good that it is endowed with. Since the world price of the home good is supposed to be given, the presence of trade costs implies that the home price of this good is below the price on the world market when the home country is a net exporter, whereas it is above the world market price when the home country is a net importer. As a result, there is a discrete jump in prices at the point where the home country changes from a net importer to a net exporter. My results, derived in the context of a model with two large countries and a continuum of goods, do not suffer from this peculiarity.

The remainder of this paper is organised as follows. Section 2 presents the basic model and derives the equilibrium conditions assuming optimal behaviour by households and firms. Section 3 presents a steady state solution and analyses the dynamics in a log-linearised version of the model. Section 4 discusses money

shocks. Section 5 concludes.

2 The model

2.1 Market structure and preferences

The world consists of two countries, Home and Foreign, which are completely symmetric.¹ Both countries are inhabited by a continuum of consumer-producers. Producers in the home country are indexed by $z \in [0; \frac{1}{2}]$, producers in the foreign country are indexed by $z \in (\frac{1}{2}; 1]$. Each of them produces a single differentiated good.

Household preferences are defined over an intertemporal utility function which includes a consumption index, real money balances and work effort:

$$U_t = \sum_{s=t}^{\infty} \beta^{s-t} [\log C_s + \bar{A} \log \left(\frac{M_s}{P_s} \right) + \frac{\gamma}{2} L_s^2]; \quad (1)$$

where U is the lifetime utility of a representative household in the home country, C is real composite consumption index, M is the amount of nominal money balances held by the representative household, P is a consumption-based price deflator, L is the amount of labour used in production, β is the discount factor, \bar{A} is a parameter which captures the benefit from holding real money balances and γ captures the disutility from work effort. Finally, s and t denote the moment in time. Time subscripts will be suppressed whenever possible.

All goods are tradable and sold in the world market. The Home consumption index of the composite good is defined by

$$C = \int_0^1 [c(z)]^{\frac{\mu-1}{\mu}} dz^{\frac{\mu}{\mu-1}}; \quad (2)$$

The parameter μ is assumed to be larger than one. In the remainder of this paper, Foreign variables are denoted with an asterisk (*) and a different indexation of producers ($z = f$ for Foreign and $z = h$ for Home). Apart from that, the mathematical expressions for Foreign variables are identical to those found for the Home country, unless explicitly stated otherwise.

The consumption-based price index (defined as the minimum nominal amount of money needed to purchase one unit of C) is:

$$P = \int_0^1 [p(z)]^{1-\mu} dz^{\frac{1}{1-\mu}}; \quad (3)$$

where $p(z)$ is the money price of good z .

There is a single financial asset, an internationally traded riskless real bond denominated in the composite consumption good. There is no capital in the

¹'Home' can be thought of as the euro area. 'Foreign' represents 'the rest of Europe', i.e. the UK, Sweden, Denmark and the twelve accession countries in Central and Eastern Europe.

model, hence firms' profits consist entirely of monopoly rents. Firms are entirely domestically owned and profits are immediately handed back to the owners (households). Labour is immobile between countries, so that labour income remains in the own economy. The period budget constraint (in nominal terms) for a representative household of Home can then be written as

$$P_t F_t + M_t = P_t(1 + r_{t-1})F_{t-1} + M_{t-1} + W_t L_t + \pi_t - P_t C_t - P_t T_t; \quad (4)$$

where F_t is the stock of bonds held by the representative household on date t , r_{t-1} is the real interest rate on bonds between $t-1$ and t , W_t is the nominal wage rate, π_t is its firm's profits and T_t is a lump-sum tax or transfer. Interest rates and taxes are denominated in terms of the composite good.

The government budget is balanced at all times and there is no government spending. All seigniorage revenues are redistributed in the form of transfers $0 = T_t + (M_{t-1} - M_t) = P_t \pi_t$. Further, the nominal interest rate i_t is given by $1 + i_t = (1 + r_t)P_{t+1} = P_t$:

2.2 Maximisation of household utility

The household's maximisation problem is not directly affected by international trade costs. Individual Home consumption of good z is given by [see Obstfeld and Rogoff (1996, p. 664) for a derivation]:

$$c(z) = \frac{p(z)}{P} \pi_i^\mu C; \quad (5)$$

The demand for good z is decreasing in its relative price, with a price elasticity of μ .

The representative household maximises life-time utility (1), subject to the period budget constraint (4) which must be satisfied in every single period. The first-order conditions are (see Appendix A for the derivation):

$$C_{t+1} = -(1 + r_t)C_t \pi_i^\mu; \quad (6)$$

$$\frac{M_t}{P_t} = \hat{A} C_t \frac{1 + i_t}{i_t}; \quad (7)$$

$$L_t^s = \frac{1}{\sigma} \frac{W_t}{P_t} \frac{1}{C_t}; \quad (8)$$

Equation (6) is the standard Euler equation, equation (7) is the money demand equation and equation (8) represents the equilibrium condition for labour supply.

2.3 Maximisation of firm profits

Goods markets are imperfectly competitive (this follows from $\mu < 1$). The representative home-country firm z is a monopolist in the production of a good z .

The firm uses only one input: labour. Labour is homogeneous. The production process exhibits constant returns to scale

$$y(z) = \phi l(z); \quad (9)$$

where ϕ is labour productivity and $y(z)$ is output of good z .

The costs of international trade take the form of a 'melting loss'. I assume $0 < \lambda < 1$, i.e. a strictly positive fraction of exports $(1 - \lambda)$ reaches its destination and a non-negative fraction λ fails to reach its destination. The goods markets clearing condition, which I will use to solve the firms' optimisation problem below, takes into account this 'melting loss':²

$$y(z) = c(z) + \frac{1}{1 - \lambda} c^*(z); \quad (10)$$

The labour market is assumed to be competitive. I assume that labour is immobile internationally, but fully mobile within national borders. It follows directly that, in equilibrium, there will be a single wage rate W (W^*) in each country. I assume that firms can price-discriminate between countries.

Firm profits are

$$\pi(z) = p(z)c(z) + X p^*(z)c^*(z) - W l(z); \quad (11)$$

where X is the nominal exchange rate, i.e. the price of one unit of Foreign currency expressed in the Home currency.

The representative Home firm z chooses $p(z)$ and $p^*(z)$ in order to maximise profits (11), subject to the demand function (5) and its Foreign counterpart, the production function (9) and clearing of goods markets (10). The firm takes Home and Foreign aggregate demand C and C^* as given. International trade costs enter the profit function implicitly: observe that 'melted' exports cause production costs, but do not generate revenues.³ The first-order conditions are (see Appendix B for derivation):

$$p(z) = \frac{\mu}{\mu - 1} \frac{1}{\phi} \frac{W}{\phi}; \quad (12)$$

$$p^*(z) = \frac{1}{X(1 - \lambda)} \frac{\mu}{\mu - 1} \frac{1}{\phi} \frac{W}{\phi}; \quad (13)$$

These equations represent the optimal pricing rules for the representative Home firm (i.e. for $z \in [0, \frac{1}{2}]$) under monopolistic competition. The prices

²The melting loss for Home-produced good z is a fraction λ of Home exports of good z , i.e.: $ml(z) = \lambda[y(z) - c(z)]$. Foreign imports are a fraction $(1 - \lambda)$ of Home exports: $c^*(z) = (1 - \lambda)[y(z) - c(z)]$. Therefore, the melting loss for the Home-produced good must be a fraction $\frac{\lambda}{1 - \lambda}$ of Foreign imports: $ml(z) = \frac{\lambda}{1 - \lambda} c^*(z)$. The goods market clearing condition for Home-produced good z is $y(z) = c(z) + c^*(z) + ml(z)$, which can be simplified to equation (10) in the main text.

³I will use the terms 'output' and 'income' interchangeably. Strictly speaking, the former includes melted exports whereas the latter does not, but (as will be seen further on in this subsection) optimal price setting guarantees that the higher price received for exports precisely offsets the negative impact of the melting loss on income.

in equations (12)-(13) are expressed in local currency, i.e. $p^*(z)$ is in Foreign currency. Firms set the Home price equal to unit labour costs plus a mark-up of $\frac{1}{\mu-1}$. They set the Foreign price equal to the Foreign currency equivalent of the Home product price multiplied by $\frac{1}{1-\zeta}$. As the goods market moves towards full competition ($\mu \rightarrow 1$) profit margins tend to zero.

Combining the Home and Foreign optimal pricing rules yields:

$$\chi p^*(z) = \frac{1}{1-\zeta} p(z); \text{ for } z \in [0; \frac{1}{2}]; \quad (14)$$

$$p(z) = \frac{1}{1-\zeta} \chi p^*(z), \text{ for } z \in (\frac{1}{2}; 1]; \quad (15)$$

It is optimal for firms to price-discriminate between markets. Optimal price setting implies that firms fully pass on the costs of international trade to consumers abroad. Thus, the law of one price does not hold.⁴

Labour demand follows directly from the production function (9):

$$l^d(z) = \frac{1}{\mu} y(z); \quad (16)$$

I will assume that the labour market clears in equilibrium.

2.4 The home bias

Combining the consumer demand equation (5) and its Foreign counterpart with the price relationships (14)-(15) and assuming symmetry between producers in the same country yields the expressions for Home consumption of Home-produced and Foreign-produced goods

$$c(h) = \frac{\mu p(h)}{P} \Gamma_i^\mu C;$$

$$c(f) = \frac{\mu \chi p^*(f)}{P(1-\zeta)} \Gamma_i^\mu C;$$

In equilibrium, under international symmetry:

$$\frac{c(h)}{c(f)} = (1-\zeta)^{\mu-1} > 1; \quad (17)$$

Thus, transportation costs and the price-elasticity of demand together determine the distribution of consumer spending over domestically-produced and imported goods. Let \pm be the share of income spent on domestically-produced goods:

$$\pm = \frac{c(h)}{y(h)} = \frac{c(h)}{c(h) + \frac{1}{1-\zeta} c(f)} = \frac{1}{1 + (1-\zeta)^{\mu-1}}; \quad (18)$$

⁴The firm income per unit produced for the foreign market is the same as per unit produced for the domestic market. In terms of firm revenue, the price charged abroad, which is a fraction ζ higher than the price charged in the domestic market, precisely offsets the melting loss, which amounts to a fraction ζ of the volume of exports.

where I have used equations (10), (17) and international symmetry.

The home bias τ is defined as the share of income spent on domestically-produced goods in excess of the 'neutral' level, where the neutral level of spending on domestically-produced goods is the share of the Home country in world output. In the special case of two countries of equal size, the neutral spending ratio is equal to 1=2. Thus:

$$\tau = \pm \lambda \frac{1}{2}$$

When markets are fully integrated ($\lambda = 0$), both countries consume identical goods baskets ($\tau = \frac{1}{2}$, so that $\tau = 0$). When markets are less than fully integrated ($\lambda > 0$), there is a bias towards spending on domestically-produced goods ($\tau > \frac{1}{2}$, so that $\tau > 0$), since firms charge a higher price to foreign customers and since consumers are sensitive to relative prices.

When the price-elasticity of demand is very low ($\mu \rightarrow 1$), there is no home bias ($\lim_{\mu \rightarrow 1} \tau = 0$). The consumers' 'love for variety' is strong enough to overcome even high costs to international trade. By contrast, when the price-elasticity of demand is very high ($\mu \rightarrow \infty$), positive transportation costs ($\lambda > 0$) imply that firms are unable to compete in foreign markets. Consumers are very sensitive to prices, so they are unwilling to pay more for the variety that foreign goods bring.⁵ They will spend all money on domestically-produced goods (the home bias attains its maximum value $\lim_{\mu \rightarrow \infty} \tau = \frac{1}{2}$) and no international trade will take place. Even in less extreme cases, small transportation costs can cause a large home bias, as we will see below.

Table 1 shows the sensitivity of the home bias with respect to the price-elasticity of demand (μ) and the costs of international trade (λ). The literature provides some (implicit) estimates for the price-elasticity of consumption. Obstfeld and Rogo® (2000) cite a number of papers that have estimated product mark-ups. According to their survey, most authors find results that correspond to a price-elasticity of demand (μ) in a range between 3.5 and 6, but some find a price-elasticity as high as 20 for OECD countries. The literature also provides a basis to quantify trade costs (λ). Smith and Venables (1988) estimate the tari®-equivalent of intra-EC trade barriers to be between 23 and 44%. Verwaal and Cnossen (2000) conclude that the compliance costs of new VAT and statistical requirements alone have a lower bound of 5% of the value of intra-EU trade. Rose and Van Wincoop (2001) find that the tari®-equivalent of not using the same currency is 26%. These findings in the literature explain the choice of the parameters in the Table.

Table 1 illustrates that the higher the price-elasticity of demand and the higher the costs of international trade, the larger the home bias. Small trade costs can cause a large home bias. For the average price-elasticity reported in the literature ($\mu = 5$), a 20% cost is sufficient to lead to a substantial home bias ($\tau = 21\%$). In the case of $\mu = 20$, trade costs of just over 7% are sufficient to generate a similar home bias.

⁵When the degree of substitutability (μ) increases, the product variety is lower. Therefore, the additional variety that foreign goods bring is also lower.

The quantitative results in Table 1 are relevant only for large economic areas.⁶ But even for regions like the euro area and the United States, the quantitative results from a model with two countries of equal size can only give a very rough indication.

[TABLE 1 ABOUT HERE]

Several recent papers focus on the ratio of consumer spending on home-produced and imported goods, as defined by equation (17): the 'spending ratio'. The spending ratios reported in the empirical literature vary greatly. McCallum (1995) finds that, after controlling for population size and distance, Canadian consumers are 22 times more likely to buy from a Canadian producer than from a US producer. At the other end of the spectrum, Wei (1996) reports a spending ratio of 2.5 for OECD countries, after controlling for economic size, distance between countries, geographic location and a possible linguistic tie. Wolf (1997) examines whether the home bias is also present at the sub-national level. He concludes affirmatively, but also finds that the international home bias is larger (by a factor five) than the intra-national home bias. A recent study by Head and Mayer (2000) puts the spending ratio for European countries at 12, down from 21 in the late 1970s.

What reduction in the costs of international trade is required to explain the substantial decline in the home bias for European countries between the late 1970s and the late 1990s reported by Head and Mayer? If $\mu = 5$ (the average price-elasticity reported in the literature) is believed to be realistic (it is probably even lower for luxury goods), then Head and Mayer's empirical finding that the spending ratio for European countries has declined from twenty-one to twelve implies that the cost of international trade has declined from 45% to 40% of the value of the traded products. However, if we believe $\mu = 20$ to be more realistic (as may be the case for commodities, like wheat), the implied decline in the cost of international trade is from 14% to 12%. This suggests that a decline of two to three percentage points in trade costs would be sufficient to explain the observed reduction in the home bias over a twenty-year period. But, again, one should not overstress the validity of the exact numbers for real-world countries.

Two results emerge. First, for realistic values of the price-elasticity parameter, small trade costs lead to a substantial home bias in international trade. Thus, small trade costs are sufficient to explain the empirical finding that only a relatively small part of income is spent on foreign-produced goods. Second, the substantial decline in the home bias for European countries since the late 1970s can be explained by a relatively small reduction in trade costs. The policy implication is the existence of a window of opportunities for the completion of the Single Market.

⁶In this model, both countries account for half of world output, so that in the absence of trading costs (i.e. when $\zeta = 0$), the share of trade in national income is 50%. Small open economies, such as the Netherlands and Belgium, account for only 1-2% of world output. Therefore, in the absence of trading costs, the share of trade in national income should be 98-99% for these countries. Thus, the home bias caused by the costs of international trade needs to be measured against another (higher) baseline value for small countries.

3 Loglinearising the model

The model does not yield simple closed-form solutions for general paths of exogenous variables, due to monopoly pricing and the endogeneity of output. Therefore, in order to study the dynamics, the model will be linearised around a symmetric steady state. The first step in this direction is deriving the solution for the initial symmetric steady state.

3.1 A symmetric steady state

In a steady state, all exogenous variables are constant. Steady-state values will be represented by overbars. It follows directly from (6) that real interest rate equality holds across countries in the steady state. The steady state world real interest rate \bar{r} equals $(1 + \bar{i})^{-1}$.

From the household budget constraint (4), it follows that steady state consumption is (see Appendix C for derivation):

$$\bar{C} = \bar{r}\bar{F} + \frac{\bar{P}^P}{\bar{P}}\bar{Y}; \quad (19)$$

where \bar{P}^P is the output deflator and \bar{P} is the consumption-based price index of goods in the Home country.

Following Obstfeld and Rogo[®] (1995), we impose the starting condition of zero net foreign assets ($\bar{F}_0 = 0$), which closes the model in the sense that the solution is uniquely determined.

Combining (8), (9), (12) yields

$$\bar{Y}_0 = \left(\frac{\mu + 1}{\mu} \right)^{\frac{1}{2}}; \quad (20)$$

$$\bar{C}_0 = \left(\frac{\mu + 1}{\mu} \right)^{\frac{1}{2}} \frac{1}{2} [1 + (1 + \bar{i})^{\mu} g^{-1}]; \quad (21)$$

The expression for output corresponds to the result reported by Obstfeld and Rogo[®] (1995). Steady state output increases as the economy moves towards more competition ($\mu \downarrow$). In the absence of transportation costs ($\bar{\zeta} = 0$), output and consumption are equal in the steady state ($\bar{Y}_0 = \bar{C}_0$). However, in general, steady state consumption will be smaller than (or equal to) output, due to the presence of costs of international trade.⁷

The shape of the money demand equation is unaffected by the costs of international trade. Using equation (19) and the starting condition of zero net

⁷Note that steady state output is not affected by the transportation costs. This is explained by the fact that higher transportation costs lead to lower Foreign import demand, but also lead to higher iceberg transportation losses, which require shipments in excess of Foreign import demand. The lower Foreign import demand is precisely offset by the higher excess shipments required. In terms of firm profits, lower Foreign import demand and higher export prices exactly offset each other. Thus, transportation costs are borne entirely by consumers. This feature greatly simplifies the algebra.

foreign assets, it follows immediately that:

$$\frac{\bar{C}_0}{\bar{Y}_0} = \frac{\bar{P}_0^P}{\bar{P}_0} = \frac{1}{2} [1 + (1 + \zeta)^{\mu_i - 1}] g^{\frac{1}{\mu_i - 1}} \cdot 1:$$

Due to the presence of transportation costs, the consumption-based price index will be higher than the production-based price index in equilibrium: $\bar{P}_0 > \bar{P}_0^P$. An increase in the costs of international trade affects the consumption-based price index (\bar{P}_0) via two channels. First, it has an upward impact on the price of imports (as costs are passed on to the consumer). Second, an increase in trade costs enhances the home bias, thus reducing the import weight in total consumption. Whereas higher priced imports push up the consumption-based price index, the increase in the home bias has a moderating impact. The first effect dominates. Thus, an increase in the costs of international trade unambiguously leads to an increase in the general price level. The implication is that the completion of the European Single Market (i.e. a reduction in trade costs) will lead to a permanent decline in the general price level (and a temporarily lower inflation rate).

It is directly clear that a reduction in trade costs is welfare-enhancing in a steady state equilibrium: the equilibrium levels of consumption and real money balances increase, whereas the equilibrium level of work effort is unaffected.

3.2 Dynamics

Next, we study the model's dynamics. To allow for asymmetries between the two countries, the model is log-linearised around the initial steady state. Define $\hat{z}_t = dz_t / \bar{z}_0$, so that variables with a hat denote percentage changes from the initial steady state. Wages are assumed to be fixed for one period and fully flexible after this period. After a shock in period $t - 1$, the economy arrives at the short-run equilibrium in period t . The economy reaches its long-run equilibrium in $t + 1$ and remains in this new steady state thereafter. Shocks are assumed to be small, so that both the short-run equilibrium and the new long-run steady state are sufficiently close to the initial steady state to justify a linear approximation of the model. The costs of international trade (ζ) are assumed to be constant. Trade costs enter the equations of the log-linear model via \pm (which positively depends on trade costs and on the price-elasticity of demand).

I will discuss the general form of the long-run steady state equilibrium and the short-run equilibrium, before I turn to solving the model explicitly for money shocks in Section 4.

Comparing steady states

The difference between national consumer price indices depends on the national output deflators and the exchange rate (see Appendix F for derivation):

$$\hat{P}^d = (2 + \mu_i - 1) (\hat{P}^P)^d + 2(1 + \mu_i) \hat{\tau} \quad (22)$$

where a superscript d denotes country differences, i.e. $\pi^d = \pi_H - \pi^*$ and \pm is defined as in equation (18). In the basic Obstfeld and Rogo[®] model, consumer spending is equally divided over Home and Foreign output. The somewhat unrealistic result of this assumption is that the difference between consumer price indices and the difference between national output deflators are uncorrelated in their model (as can be seen by setting $\pm = \frac{1}{2}$ in the equation above). Here, the difference between consumer price indices and the difference between national output deflators are positively correlated ($2\pm - 1 > 0$), as one would expect. The exchange rate has a positive, but less than proportionate ($0 < 2(1 - \pm) < 1$) impact on the CPI difference.

The difference between national outputs is:

$$\pi^d = \pm 4(1 - \pm)\mu(\pi^p)^d + 4(1 - \pm)\mu\pi^* + (2\pm - 1)\pi^d \quad (23)$$

The first term on the right-hand side indicates that output is declining in its own relative price: if the relative price of Home output increases, lower demand for the Home product will induce lower Home output. The existence of positive trade costs has a moderating impact on the own-price effect [$\pm > \frac{1}{2}$ implies $4(1 - \pm)\mu < \mu$]. The reason is that positive trade costs imply a home bias in consumer spending ($\lambda > 0$) $\pm > \frac{1}{2}$, so that the general price level is more strongly correlated with the price of domestic output. This limits the real price increase of Home output, which is the relevant price for consumer demand [see equation (5)]. The second term on the right-hand side shows that an appreciation of the Foreign currency ($\pi^* > 0$) will stimulate Home output, by reducing the price of Home output for Foreign consumers. Positive trade costs reduce the impact of exchange rate movements [again: $\pm > \frac{1}{2}$ implies $4(1 - \pm)\mu < \mu$]. The intuition is that positive trade costs lead to a home bias in consumer spending, which means that a smaller share of consumption involves cross-border transactions (i.e. the transactions affected by exchange rate movements). The third term on the right-hand side in equation (23) is new. This term would not arise when consumer spending were equally divided over home and foreign output (i.e. when $\pm = \frac{1}{2}$). The presence of a home bias implies that most of an increase in consumer spending falls on the domestic economy. Therefore, a relative increase in Home consumer spending induces a larger positive impact on Home than on Foreign output. In the basic Obstfeld and Rogo[®] model, the consumption differential and the output differential are uncorrelated. Here, I obtain the more plausible result that there is a positive correlation between both ($2\pm - 1 > 0$).⁸

Short-run equilibrium

⁸For all OECD countries for which data are available, the difference between national GDP growth and US GDP growth is positively correlated to the difference between national consumption growth and US consumption growth over the 1961-2000 period. The (unweighted) average correlation coefficient is .70. This result appears to be robust for the choice of the benchmark country (here: the US).

Given a constant mark-up and constant labour productivity, the assumption of short-run nominal wage stickiness directly implies short-run stickiness of output prices [see equation (12)]. However, the consumption price index also incorporates imported goods. Therefore, it will change whenever the exchange rate changes (see Appendix F for the full short-run model):

$$p^d = 2(1 - \alpha)\mu \cdot \epsilon; \quad (24)$$

where the inequality follows directly from $\alpha \leq \frac{1}{2}$. Thus, the presence of trade costs implies that the exchange rate has a less than proportionate impact on the international CPI difference. Short-run aggregate output is:

$$y^d = 4\alpha(1 - \alpha)\mu \epsilon + (2\alpha - 1)\epsilon^d; \quad (25)$$

For $\alpha = \frac{1}{2}$, this equation reduces to $y^d = \mu \epsilon$. In the more general form, the impact of the exchange rate on the output differential is reduced by the home bias (since the home bias in consumption reduces the relative importance of imported goods). This is more satisfactory than the somewhat uneasy finding from the basic Obstfeld and Rogo (1995) model that exchange rate movements have a strong impact on output differentials. Moreover, the home bias introduces a positive feedback of the consumption differential on the output differential ($2\alpha - 1 > 0$), which adds another element of realism to the model.

4 Money shocks

This section focuses on monetary shocks, because the role of nominal rigidities is best illustrated in the case of monetary shocks and it is this kind of disturbance that flexible-price models are least well-equipped to handle. See Lane (2001). I will take the case of an unanticipated permanent increase in the Home money supply, i.e. $M = \bar{M}$.

4.1 Long-run impact

The consumption differential is

$$\epsilon^d = \frac{2\mu\alpha + 1}{2(\mu - 1)\alpha + 1} \frac{rd\bar{F}}{\bar{C}_0} > \frac{\mu + 1}{\mu} \frac{rd\bar{F}}{\bar{C}_0}; \quad (26)$$

where the inequality follows from $\alpha > 0$ (which implies $\alpha > \frac{1}{2}$). Thus, for positive trade costs, the consumption differential is larger than the value reported by Obstfeld and Rogo (1995). The reason is that the home bias induces the additional consumption caused by a wealth transfer to be mainly spent on Home goods. Thus, any additional Home consumption does not generate income abroad to the same extent as when the additional consumption were equally divided over Home and Foreign goods.

As will be seen below, an expansion of the Home money supply induces a short-run depreciation of the Home currency and a short-run current account

surplus for the Home country, which is balanced by a net transfer of financial assets from Foreign to Home. The accumulation of net foreign assets implies that, in the long run, Home residents can afford themselves to consume more and work less. The long-run terms of trade improve, which reinforces the possibility for Home residents to consume more. Thus, equation (26) implies that a money supply shock, via the wealth effect, has an upward effect on the long-run consumption differential. In other words, money can have real effects in the long-run via the intertemporal consumption smoothing channel (Obstfeld and Rogoff, 1996, p. 680).⁹

International trade costs imply that monetary policy becomes more effective with respect to the international consumption differential. The intuition is as follows. First, positive costs of international trade imply that a money impulse leads to a larger accumulation of net foreign assets. Trade costs cause a home bias in consumption, making the general price level less sensitive to the exchange rate [see equation (22)]. Therefore, a larger short-run exchange rate depreciation is required to reach equilibrium in the money market. The larger short-run exchange rate depreciation induces a larger current account surplus, i.e. more net foreign assets are accumulated. The additional interest income on net foreign assets facilitates a larger long-run consumption differential. Secondly, the home bias implies that the additional Home consumption caused by the wealth transfer is mainly spent on Home goods (i.e. there is a smaller 'import leak'). This re-inforces the long-run terms of trade improvement, which widens the consumption differential further. Thus, the presence of trade costs reinforces the transmission from money to consumption via the accumulation of net foreign assets and via the terms of trade.

Next, we turn to the international CPI differential. From equation (26) and the loglinearised version of equation (7):

$$\bar{P}^d = \bar{M}^d \left[\frac{2\mu\pm + 1}{2(\mu_i - 1)\pm + 1} \frac{rd\bar{F}}{\bar{C}_0} \right] \cdot \bar{M}^d \left[\frac{\mu + 1}{\mu} \frac{rd\bar{F}}{\bar{C}_0} \right]; \quad (27)$$

where, again, the inequality follows from $\zeta > 0$ (which implies $\pm > \frac{1}{2}$). The wealth effect which causes money to affect long-run real consumption differentials, also implies that the long-run CPI differential changes less than proportionately to a permanent money shock: $\bar{P}^d < \bar{M}^d$. The presence of positive trade costs reduces the influence of monetary policy on the international price differential. The intuition is as follows. A monetary impulse affects prices via wages and via the exchange rate.¹⁰ Trade costs imply that more net foreign assets are accumulated after a Home money expansion (see above). The larger accumulation of net foreign assets implies a larger net demand for Foreign-produced products and a larger decline in long-run Home output (and therefore

⁹The long-run effect of money on consumption should not be overstated. It is in the order of magnitude of the real interest rate, which is explained by the fact that it derives from the yield on net foreign assets accumulated in the short run.

¹⁰The long-run price differential can be rewritten as: $\bar{P}^d = a\bar{W}^d + (1 - a)\bar{X}$; where $a = 2\pm - 1$:

a larger decrease in Home labour demand). This reduces the required long-run depreciation of the Home currency and reduces the increase in Home wages caused by the money expansion. Thus, trade costs reduce the impact of a Home money shock on the international wage differential and on the exchange rate. Therefore, trade costs also reduce the effectiveness of a money shock with respect to the international price differential.

It follows that in an environment of declining costs of international trade, monetary policy becomes less effective with respect to consumption, but more effective with respect to the general price level.

Trade costs do not affect the long-run value of world aggregates (see appendix F).¹¹ As with zero trade costs, money is neutral at the world level in the long run. World money shocks will translate one-for-one into world price increases.

4.2 Short-run impact

In the short run, wages cannot adjust to money shocks. As a result, money is able to affect output and consumption. As shown in appendix F, trade costs do not affect short-run world aggregates. The reduced-form solutions for international differences are:

$$\psi^d = \left[1 + \frac{2(2\pm\mu - 1)}{2 + \tau(2\pm\mu + 1)}\right] \bar{\psi}^d; \quad (28)$$

$$\theta^d = \frac{\tau(2\pm\mu - 1)(2\pm\mu + 1)}{[2\pm(\mu - 1) + 1][2 + \tau(2\pm\mu + 1)]} \bar{\theta}^d. \quad (29)$$

It is easy to show that $\psi^d > \bar{\psi}^d$. The intuition is that output is demand-determined when wages are rigid. Under monopolistic competition, prices are set above the marginal cost of production. Therefore, at the margin, it is profitable for firms to accommodate additional demand by producing more output. This means that output becomes demand-determined when wages are rigid. As will be seen below, a money expansion in the Home country causes a depreciation of the Home currency ($\lambda > 0$). This induces net Foreign demand for Home goods ($\psi^d > \bar{\psi}^d$). Both ψ^d and θ^d are increasing in \pm , i.e. the output differential and consumption differential increase in trade costs. The intuition is as follows. First, we have already seen that the long-run consumption differential is increasing in trade costs. Intertemporal consumption smoothing implies that the short-run consumption differential must also be increasing in trade costs. Secondly, a larger short-run exchange rate depreciation is required to achieve money market equilibrium. The larger exchange rate depreciation leads to a larger net Foreign demand for Home goods, i.e. the net Foreign demand for Home goods is also increasing in trade costs. If the short-run consumption differential and the net Foreign demand for Home goods are both increasing in trade costs, this must also be the case for the output differential.

¹¹This does not imply that trading costs only have distributive effects in this model. Recall that in this section, I consider small changes in variables. From equation (21), trading costs do have a negative impact on the equilibrium value of consumption.

The short-run current account (which equals the change in net foreign assets) has the following reduced form (see Appendix F):

$$\frac{d\bar{F}}{\bar{C}_0} = \frac{2\pm\mu_i - 1}{2 + \tau(2\pm\mu + 1)} \bar{M}^d. \quad (30)$$

An expansion of the Home money supply leads to a short-run surplus on the Home current account. The larger the trade costs (ζ), the larger \pm , the larger the short-run current account surplus [the coefficient of \bar{M}^d on the right-hand side of equation (30) is increasing in \pm]. The intuition is that the larger the home bias, the larger the short-run exchange rate depreciation required to reach equilibrium in the money market (as the price differential become less responsive to the exchange rate). The larger exchange rate depreciation induces a larger current account surplus.

4.3 Exchange rate dynamics

The exchange rate plays a substantial role in this model. The reason is that the assumptions of short-run nominal wage rigidity and a constant mark-up directly imply that short-run relative prices (\bar{p}^d) can only change due to exchange rate movements. As pointed out before, the impact of a given exchange rate movement on the price differential is smaller, the larger the home bias.

The long-run solution for the exchange rate is:

$$\bar{\mathcal{E}} = \bar{M}^d_i \left[1 + \frac{\pm}{(1 - i \pm)[2(\mu_i - 1)\pm + 1]} \right] \frac{\tau d\bar{F}}{\bar{C}_0} < \bar{M}^d_i \frac{1 + \mu \tau d\bar{F}}{\mu \bar{C}_0};$$

where the expression on the right-hand side of the inequality is the solution in the absence of trade costs ($\zeta = 0$) $\pm = \frac{1}{2}$) and the inequality itself follows from the presence of positive trade costs ($\zeta > 0$) $\pm > \frac{1}{2}$). Thus, the home bias in consumption reduces the impact of money shocks on the long-run value of the exchange rate. The reduced-form solution is

$$\bar{\mathcal{E}} = \frac{1}{2 + \tau(2\pm\mu + 1)}^{\frac{1}{2}} \frac{\tau \pm (2\pm\mu_i - 1)}{(1 - i \pm)[2\pm(\mu_i - 1) + 1]}^{\frac{3}{4}} \bar{M}^d. \quad (31)$$

It is straightforward to show that the Home currency will show a long-run depreciation in response to a money shock, unless \pm is sufficiently large, that is unless trade costs are above a certain value (see below).

The short-run solution for the exchange rate is

$$\mathcal{E} = \frac{1}{2 + \tau(2\pm\mu + 1)}^{\frac{1}{2}} \frac{1}{1 - i \pm} + \frac{\tau(2\pm\mu + 1)}{2\pm(\mu_i - 1) + 1} \bar{M}^d. \quad (32)$$

It is easy to show that exchange rate overshooting occurs in this model (i.e. $\mathcal{E} < \bar{\mathcal{E}}$: see Appendix H). Theoretical explanations for the empirical observation that exchange rate movements are much more volatile than goods prices go

back to Dornbusch (1976). The basic Obstfeld and Rogo[®] (1995) model has no exchange rate overshooting, but several extensions of this model (which are part of the so-called New Open Macroeconomics) do. As in Dornbusch's paper, the overshooting result in the New Open Macroeconomics literature depends on the assumption that goods prices (or wages) adjust slowly relative to financial asset prices. In Hau (2000) and Cavelaars (2001), overshooting is caused by the presence of non-tradables. Given wage stickiness and a constant mark-up, the price of Home and Foreign non-tradables cannot adjust in the short run. Thus, the adjustment of Home and Foreign general price levels depends on the exchange rate passthrough and monetary equilibrium requires a relatively large short-run adjustment of the nominal exchange rate. In these papers, exchange rate volatility is inversely related to openness (the share of tradables). The present model contains only tradable goods, as in Warnock (1999). There, a bias in consumer preferences causes a home bias in consumer spending. Here, a home bias in consumer spending is caused by the presence of trade costs. The intuition behind the overshooting in both papers is similar to Hau (2000) and Cavelaars (2001): output prices cannot adjust in the short run, so the relative price level can only change due to short-run exchange rate changes. A larger home bias in spending (caused by either asymmetric preferences or trade costs) implies that a small share of goods are affected by exchange rate movements. Thus, a larger short-run exchange rate movement is required to attain short-run money market equilibrium.

When the costs associated with international trade are substantial, short-run exchange rate movements in response to monetary shocks can become extremely large. Thus, the presence of international trade costs can explain large short-run exchange rate volatility. In fact, when trade costs are sufficiently large ($\tau \neq 1$), the short-run depreciation of the Home currency in response to a Home money shock becomes so large ($\Delta e > 0$) that a long-run appreciation of the Home currency ($\Delta e < 0$) is required in order to achieve general equilibrium. Thus, the impact of money on the long-run exchange rate is ambiguous in general.

Table 2 illustrates these characteristics numerically. In all the results in this Table, I have assumed $r = 3\%$ and $dM^d = 1\%$. From Table 2, the exchange rate response to an increase in the Home money supply is quite sensitive to the elasticity of substitution (μ) and the costs of international trade (τ). Let us take the costs of international trade to be 20% of the value of traded goods. Then, if we regard $\mu = 5$ as plausible, a one percent increase in the Home money supply will lead to a 0.9% increase in the long-run exchange rate. Short-run exchange rate overshooting will occur, but only to a limited degree: the short run exchange rate will increase by 1.6%. If we regard $\mu = 20$ to be more plausible, a one percent increase in the Home money supply will have a negative, but almost negligible impact on the long-run value of the exchange rate. However, the short-run exchange rate will increase by over 20%.

When the costs associated with international trade are substantial, short-run exchange rate movements in response to monetary shocks can become extremely large. Thus, the presence of costs to international trade and imperfect compe-

tition can explain quite high short-run exchange rate volatility in response to money shocks.

[TABLE 2 ABOUT HERE]

5 Conclusion

This paper analyses the consequences of the remaining barriers to cross-border competition in the context of the Obstfeld and Rogo[®] (1995) framework. This framework allows for imperfect competition and nominal rigidities. I explicitly incorporate 'transportation costs' for trade between two countries into the model. The introduction of costs for international trade implies that the model deviates from the standard Obstfeld and Rogo[®] (1995) model. First, the law of one price need not hold. Second, trade costs lead to an endogenous home bias in consumer spending. In other papers, the home bias in consumer spending is related to the presence of non-tradable goods [Hau (2000) and Cavelaars (2001)] or to the existence of a home bias in consumer preferences [Warnock (1999)]. In the current article, the home bias follows from the presence of costs to international trade.

This approach leads to the following results. First, for realistic values of the price-elasticity parameter, small trade costs lead to a substantial home bias in international trade. This result is in line with the more general finding in the literature that even small transaction costs can have significant economic effects. Numerically, I have shown that the large decline in the home bias for European countries since the late 1970s found in the literature can be explained by a relatively small reduction in trade costs. The policy implication is the existence of a window of opportunities for the completion of the Single Market.

Second, the further European integration may have important consequences for the transmission of ECB monetary policy. The completion of the Single Market eliminates any remaining trade barriers between the euro area and the member states not participating in the single currency, whereas the EU accession of twelve new member states also reduces barriers to trade. In this environment of declining costs of international trade, monetary policy becomes less powerful in terms of affecting consumption, but more effective in terms of influencing the general price level. The intuition is as follows. Positive costs of international trade lead to a home bias in spending. This implies that a monetary expansion will lead to a larger surplus on the short-run current account, so that a larger accumulation of net foreign assets takes place, facilitating a larger long-run consumption differential. Intertemporal consumption smoothing ensures that the short-run consumption differential is also larger. Moreover, a smaller share of the resulting consumption increase 'leaks' to other countries, re-inforcing the increase in the terms of trade, thus enhancing further the transmission from money to consumption. It follows that a decline in the costs of international trade reduces the effectiveness of monetary policy with respect to consumption.

The effectiveness of monetary policy with respect to the general price level is the flip-side of its effectiveness with respect to consumption (this follows from the long-run equilibrium conditions in the money market). Therefore, a decline in the costs of international trade enhances the effectiveness of monetary policy with respect to the general price level.

Third, the presence of international trade costs in the goods market can explain large short-run exchange rate volatility. The intuition is as follows. In the presence of wages stickiness and a constant markup (as in the current paper), the short-run relative price level can only adjust if the exchange rate changes. All goods are tradable, but costs of international trade lead to a home bias in spending, which implies that only a small share of goods is affected by exchange rate movements. As a result, a large short-run exchange rate movement is required to attain short-run money market equilibrium. I have shown numerically that when the costs associated with international trade are substantial, short-run exchange rate movements in response to monetary shocks can become extremely large.

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Table 1: Transportation costs and home bias

	trade cost τ	home bias β	trade share $1 - \beta$	spending ratio $c(h)/c(f)$
$\mu = 3 :$	5%	3%	47%	1.2
	20%	11%	39%	2.0
	50%	30%	20%	8.0
$\mu = 5 :$	5%	5%	45%	1.3
	20%	21%	29%	3.1
	50%	44%	6%	32.0
$\mu = 10 :$	5%	11%	39%	1.7
	20%	38%	12%	9.3
	50%	50%	0%	>200
$\mu = 20 :$	5%	23%	27%	2.8
	20%	49%	1%	86.7
	50%	50%	0%	>200

Table 2: Exchange rate response to a 1% Home money shock, under positive costs to international trade

	trade cost ζ	short-run XR response Δ	long-run XR response $\bar{\Delta}$
$\mu = 3 :$	5%	1.00%	0.96%
	20%	1.22%	0.95%
	50%	2.32%	0.90%
$\mu = 5 :$	5%	1.0%	0.9%
	20%	1.6%	0.9%
	50%	7.4%	0.7%
$\mu = 10 :$	5%	1.1%	0.8%
	20%	3.3%	0.7%
	50%	>100%	-5.0%
$\mu = 20 :$	5%	1.3%	0.7%
	20%	21.9%	-0.0%
	50%	>100%	<-100%