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**NEW OPEN ECONOMY
MACROECONOMICS**

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ABSTRACT

New Open Economy Macroeconomics*

'New open economy macroeconomics' (NOEM) refers to a body of literature embracing a new theoretical framework for policy analysis in open economy, aiming to overcome the limitations of the Mundell-Fleming model while preserving the empirical wisdom and policy friendliness of traditional analysis. NOEM contributions have developed general equilibrium models with imperfect competition and nominal rigidities, to reconsider conventional views on the transmission of monetary and exchange rate shocks; they have contributed to the design of optimal stabilization policies, identifying international dimensions of optimal monetary policy; and they have raised issues about the desirability of international policy coordination.

JEL Classification: F33, F40, F41 and F42

Keywords: exchange rates, international policy coordination, Mundell-Fleming model, open economy models and stabilization policy

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Introduction

The new open economy macroeconomics (NOEM) is a leading development in international economics that began in the early 1990s. Its objective is to provide a new theoretical framework for open economy analysis and policy design, overcoming the limitations of the Mundell–Fleming model, while preserving the empirical wisdom and the close connection to policy debates of the traditional literature. The new framework consists of choice-theoretic, general-equilibrium models featuring nominal rigidities and imperfect competition in the markets for goods or labour. In this respect, the NOEM has close links with related agendas pursued in closed-economy macro, such as the ‘new neoclassical synthesis’ and the ‘neo-Wicksellian’ monetary economics. The assumption of imperfect competition is logically consistent with the maintained hypothesis that firms and workers optimally choose prices and wages subject to nominal frictions, as well as with the idea that output is demand-determined over some range in which firms (workers) can meet demand at non-negative profits (surplus).

NOEM models differ from the Mundell–Fleming approach in at least two notable dimensions. First, all agents are optimizing, that is, households maximize expected utility and managers maximize firms’ value. The expected utility of the national representative consumer thus provides a natural welfare criterion for policy evaluation and design. Second, general-equilibrium analysis paves the way towards further integration of international economics as a unified field, bridging the traditional gap between open macroeconomic and trade theory.

From a historical perspective, NOEM was launched by Obstfeld and Rogoff (1995), although Svensson and van Wijnbergen (1989) had also worked out a model with NOEM features as an open economy development of Blanchard and Kiyotaki (1987).

A specific goal of the NOEM agenda is to achieve the standards of tractability which made traditional models so popular and long-lived among academics and policymakers. For instance, many contributions have adopted the model specification by Corsetti and Pesenti (2001), which admits a closed-form solution by virtue of some educated restrictions on preferences (Tille, 2001, explains the relation of this model to Obstfeld and Rogoff, 1995). At the same time, the NOEM literature has promoted the

construction of a new generation of large, multi-country quantitative models by international institutions and national monetary authorities. A leading example is the Global Economic Model (GEM) of the International Monetary Fund (see, for example, Laxton and Pesenti, 2003).

This article first introduces a stylized NOEM model. Based on this model, it then provides a short selective survey of the NOEM literature, and its main advances in the analysis of the international transmission mechanism and policy design in open economies.

1. A stylized NOEM model

To illustrate the basic features of NOEM models, highlighting similarities and differences with the Mundell–Fleming model, it is useful to refer to the model by Corsetti and Pesenti (2001; 2005a; 2005b) and Obstfeld and Rogoff (2000) (henceforth CP–OR). The economy consists of two countries, Home and Foreign, specialized in the production of one type of tradable goods, denoted H and F, respectively. Home consumption falls on both local goods and imports, that is, $C = C(C_H, C_F)$; the price level P includes both local goods and imports prices in Home currency, that is, $P = P(P_H, P_F)$. Preferences over local and imported goods are Cobb–Douglas with identical weights across countries: as the elasticity of substitution is equal to 1, any increase in domestic output is matched by a proportional fall in its price, so that terms of trade movements ensure efficient risk sharing. Furthermore, utility from consumption is assumed to be logarithmic, while disutility from labour ℓ is linear.

Let μ index the Home monetary stance. Specifically, μ is the nominal value of the inverse of consumption marginal utility – for example, with log utility, $\mu = PC$. Whatever the instruments used by monetary authorities, μ indexes its ultimate effect on current spending. With competitive labour markets, the Households’ optimality conditions imply that the nominal wage moves proportionally to μ , that is, $W = \mu$. Furthermore, abstracting from investment and government spending, μ indexes nominal aggregate demand. Similar definitions and conditions hold for the Foreign country, whose variables are denoted with a star, that is, $\mu^* = W^*$.

Let ε denote the nominal exchange rate, measured in units of Home currency per unit of Foreign currency. With perfect risk sharing, it is well known that the real exchange rate $\varepsilon P/P^*$ is equal to the ratio between the two countries' consumption marginal utilities (see Backus and Smith, 1993). Rearranging this condition, the nominal exchange rate is equal to the ratio of Home to Foreign monetary stance, that is, $\varepsilon = \mu/\mu^*$. A Home expansion depreciates ε . Goods are supplied by a continuum of firms, each being the only producer of a differentiated variety of the national good. For simplicity, production is linear in labour. With nominal rigidities, managers optimally set prices as to maximize the market value of the firm. (Since households are assumed to own firms, the discount factor used in calculating the present value is the growth in the marginal utility of consumption.) In the CP–OR model, prices are preset for one period and marginal costs coincide with unit labour costs $W/Z = \mu/Z$. In this model, optimal pricing actually takes a form that is very similar to textbook monopoly pricing: Home firms selling in the domestic market set p_H by charging the optimal markup over *expected* marginal costs, that is:

$$p_H = \text{markup} \cdot E \left(\overset{\text{marginal cost}}{\frac{\mu}{Z}} \right)$$

where E denotes conditional expectations. If prices were flexible, the above would hold with current instead of expected costs.

When modelling nominal rigidities in the exports market, however, the following issue arises: are export prices sticky in the currency of the producers or in the currency of the destination market? In the NOEM literature, this issue has fed an extensive debate on the international transmission mechanism and the design of optimal stabilization policies, discussed in detail in the next sections.

The equilibrium allocation can be characterized in terms of three equilibrium relationships, labelled AD, TT and NR. In Figure 1, these are drawn in the space 'consumption' vs. 'labour', C vs. ℓ . The horizontal AD locus represents the Home aggregate demand in real terms, given by the ratio of the monetary stance to the price level: $C = \mu/P$. The upward-sloping TT locus shows the level of consumption that Home agents obtain (at market prices) in exchange for ℓ units of labour. The slope of the TT locus depends on the (exogenous) productivity level Z , and the (endogenous) price of

domestic GDP ($Y = Z \ell$), in terms of domestic consumption τ , that is, $C = \tau \cdot Z \cdot \ell$. Since agents consume both local goods and imports, τ rises with an improvement in the terms of trade of the Home country, conventionally defined as the price of imports in terms of exports. The vertical NR locus marks the equilibrium employment in the flexible prices (or natural rate) allocation, ℓ^{flex} . Because of firms' monopoly power, ℓ^{flex} is inefficiently low. To stress this point, Figure 1 includes the indifference curve passing through the equilibrium point E, where it crosses the TT locus from above: with monopolistic distortions, the marginal rate of substitution between labour and consumption differs from the marginal rate of transformation.

With flexible prices, the macroeconomic equilibrium is determined by the NR locus and the TT locus. For a given μ , nominal prices adjustment ensures that demand is in equilibrium. With nominal rigidities, the equilibrium is instead determined by the AD locus and the TT locus. Depending on the level of demand, employment may fall short of or exceed the natural rate, opening employment and output gaps proportional to $(\ell^{\text{flex}} - \ell)$.

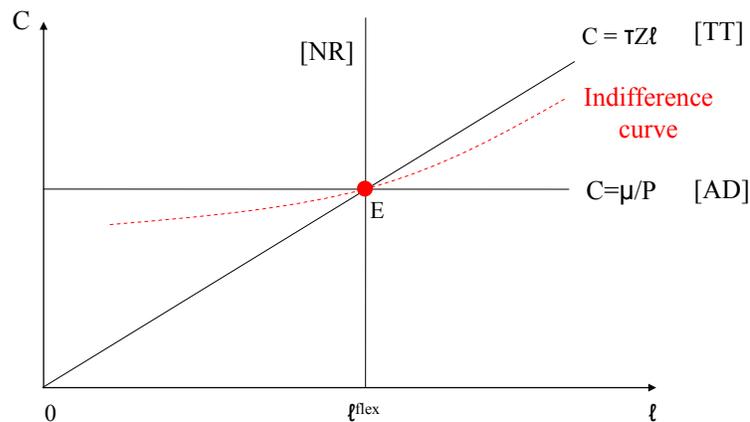
2. The international transmission mechanism and the allocative properties of the exchange rate

According to traditional open macroeconomic models, exchange rate movements play the stabilizing role of adjusting international relative prices in response to shocks, when frictions prevent or slow down price adjustment in the local currency. At the heart of this view is the idea that nominal depreciation transpires into real depreciation, making domestic goods cheaper in the world markets, hence redirecting world demand towards them: exchange rate movements therefore have 'expenditure switching effects'.

Consistent with this view, NOEM contributions after Obstfeld and Rogoff (1995) draw on the Mundell–Fleming and Keynesian tradition, and posits that export prices are sticky in the currency of the producers. Thus the nominal import prices in local currency move one-to-one with the exchange rate. This hypothesis is commonly dubbed 'producer currency pricing' (PCP).

Under PCP firms preset P_H and P_F^* , so the Home country's terms of trade $\varepsilon P_F^*/P_H$ deteriorate with unexpected depreciation. Moreover, as long as demand elasticities are identical in all markets, firms have no incentive to price discriminate: the price of exports obeys the law of one price, that is, $P_H^* = P_H/\varepsilon$ and $P_F = \varepsilon P_F^*$.

Figure 1



Monetary shocks have two distinct effects on the Home allocation and welfare. Expansions raise demand and output: because of monopolistic distortions in production, positive nominal shocks benefit domestic consumers by raising output towards its efficient (competitive) level. However, currency depreciation also raises the relative price of Foreign goods, reducing the real income of domestic consumers. In terms of Figure 1, monetary expansions shift the AD locus upward and, due to currency depreciation, cause the TT locus to rotate clockwise. The new equilibrium may lie either above or below the indifference curve passing through E, the initial equilibrium. In other words, Home welfare may rise or fall, depending on the relative magnitude of monopoly power in production, vis-à-vis the terms of trade externality, in turn related to openness and the degree of substitutability between Home and Foreign tradables. (The size of the monetary

shock also matters: by the same argument, by the theory of optimal tariffs a country never gains from monetary shocks which are large enough to raise output up to its competitive – Pareto-efficient – level.)

A noteworthy implication for policy analysis is that, in relatively open economies where terms of trade distortions are strong, benevolent policymakers may derive short-run benefits by implementing surprise monetary contractions, which appreciate the Home currency and boost the purchasing power of Home consumers. In these economies, monetary policy can have a deflationary bias.

In the Foreign country, welfare spillovers of a Home monetary expansion are unambiguously positive. Foreign consumers benefit from the terms-of-trade movement, which raises their income in real terms: the Foreign TT rotates counterclockwise. In addition, cheaper imports reduce inflation, raising aggregate demand for a given monetary stance μ^* : the Foreign AD shifts upward.

The high elasticity of import prices to the exchange rate underlying the above analysis is, however, at odds with a large body of empirical studies showing that the exchange rate pass-through on import prices is far from complete in the short run, and deviations from the law of one price are large and persistent (see, for example, Engel and Rogers, 1996; Goldberg and Knetter, 1997; Campa and Goldberg, 2005). This evidence has motivated a thorough critique of the received wisdom on the expenditure switching effects of the exchange rate. Specifically, Betts and Devereux (2000) and Devereux and Engel (2003), among others, posit that firms preset prices in the currency of the markets where they sell their goods. This assumption, commonly dubbed ‘local currency pricing’ (LCP), attributes local currency price stability of imports mainly to nominal frictions, with far-reaching implications for the role of the exchange rate in the international transmission mechanism (see Engel, 2003).

To the extent that import prices are sticky in the local currency, a Home depreciation does not affect the price of Home goods in the world markets; hence, it has no expenditure switching effects. Instead, it raises *ex post* markups on Home exports: at given marginal costs, revenues in domestic currency from selling goods abroad rise. In contrast with the received wisdom, nominal depreciation strengthens a country’s terms of trade: if P_F and P_H^* are preset during the period, the Home terms of trade

$P_F/\varepsilon P_H^*$ improves when the Home currency weakens. In Figure 1, with LCP, a Home monetary expansion shifts aggregate demand AD upward and rotates the TT counterclockwise.

It follows that monetary authorities cannot derive short-run welfare benefits from surprise contraction. As currency depreciation improves the terms of trade, the inflationary bias in policymaking is even stronger than in a closed economy.

International spillovers from Home monetary expansions are detrimental to Foreign welfare. If prices in local currency remain constant, a Home expansion does not at all affect the aggregate demand in the Foreign country. Yet the adverse terms of trade movement forces foreign agents to work more to sustain an unchanged level of consumption: for a given AD, the TT locus rotates clockwise.

An interesting case with asymmetric transmission is one in which the prices of exports are all preset in one currency, so that Home firms adopt PCP while Foreign firms adopt LCP (see, for example, Devereux, Engel and Tille, 2003).

While the NOEM literature has encompassed additional real and financial aspects in the analysis of the transmission mechanism, the PCP versus LCP debate identifies essential building blocks of optimal stabilization policy.

3. International dimensions of optimal monetary policies

A defining question of open economy macroeconomics is whether monetary and fiscal policy should react to international variables, such as the exchange rate or the terms of trade, beyond the influence that these variables have on the domestic output gap (for example, via external demand) and domestic inflation (for example, via import prices). This is a research area where choice-theoretic NOEM models have comparative advantages over the traditional literature. Indeed early NOEM contributions have established a set of original and provocative results, setting benchmarks for further analytical and quantitative studies.

To account for these results, consider the stabilization problem in a CP–OR economy with country-specific productivity uncertainty. In a flexible price environment (corresponding to the long run of the CP–OR model), a positive productivity shock in the Home country causes the world price of Home goods to fall. This raises both domestic

and foreign demand for Home output, and worsens the Home terms of trade. With sticky prices, by contrast, unexpected gains in productivity simply translate into lower employment: given μ and μ^* (hence given the exchange rate), current demand is satisfied with a lower labour input. (In Figure 1, a higher Z rotates the TT locus counterclockwise. With the AD and the TT loci held fixed, the equilibrium employment is below the natural rate. A fall in domestic prices would shift the AD locus up, while offsetting part of the rotation of the TT locus. The flexible price equilibrium always lies on the NR locus.)

However, under the hypothesis of PCP, it is easy to see that monetary policy in a sticky-price environment can support the flexible price allocation. Posit that monetary rules satisfy $\mu = \Gamma Z$, where Γ denotes a (possibly time-varying) variable indexing the level of nominal variables in the Home country. When such rules are implemented, any gain in productivity is matched by a proportional expansion of the monetary stance, which raises Home demand and depreciates the Home currency. Marginal costs remain constant in nominal terms (since $\mu/Z = \Gamma$): hence product prices in domestic currency would remain fixed even if there were no nominal rigidities. At the same time, however, exchange rate movements adjust international relative prices, as monetary policy moves ε in proportion to productivity changes.

A first benchmark result is that, in economies with the CP–OR features, monetary policy rules supporting the flexible price allocation are optimal: no rule welfare-dominates complete marginal cost and output gap stabilization. This is true under different assumptions regarding nominal rigidities, including staggered price setting and partial adjustment (see, for example, Clarida, Galí and Gertler, 2002). Optimal monetary rules are completely ‘inward-looking’: welfare-maximizing central banks stabilize the GDP deflator while letting the consumer price index (CPI) fluctuate with movements in the relative price of imports. There is no need for monetary policies to react to international variables.

The result that monetary rules supporting a flexible price allocation are optimal, however, does not hold in general. In the presence of multiple distortions monetary authorities are generally able to exploit nominal rigidities and improve welfare relative to such allocation (Benigno and Benigno, 2003; Corsetti and Dedola, 2005). Yet, holding

PCP, it is unclear whether and under which conditions deviating from full domestic stabilization could yield significant welfare gains.

A second result concerns the costs of inefficient stabilization. The New Keynesian theory has emphasized welfare costs from relative price dispersion when private pricing decisions are not synchronized (see, for example, Galí and Monacelli, 2003). Early NOEM contributions have instead pioneered the analysis of the effect of uncertainty on the level of prices and economic activity. A simple example illustrates this point. Suppose that monetary policy responds to productivity shocks according to rule: $\mu = \Gamma Z^\gamma$. When $\gamma < 1$, marginal cost uncertainty due to insufficient stabilization implies $E(\mu/Z) = \Gamma E(1/Z^{1-\gamma}) > \Gamma$: by a straightforward application of Jensen's inequality, expected marginal costs are higher than under complete stabilization. Higher costs transpire into higher prices both in nominal terms and relative to wages, reducing the average supply of domestic goods, thus exacerbating monopolistic distortions in the economy (see, for example, Sutherland, 2005, and Kollmann, 2002, for a quantitative assessment).

Similar effects, with potentially stronger welfare implications, are caused by a noisy conduct of monetary policy and exchange rate variability (Obstfeld and Rogoff, 1998). Notably, Broda (2006) provides evidence consistent with the (NOEM) prediction that incomplete stabilization *and* monetary/exchange rate noise transpire into higher price levels and real appreciation.

A third result, derived on the assumption of LCP, defines a clear-cut argument in favour of policies with an international dimension. To the extent that exporters' revenues and markups are exposed to exchange rate uncertainty, firms' optimal pricing strategies internalize the monetary policy of the importing country. In the CP-OR model, for instance, Foreign firms optimally preset the price of their goods in the Home market p_F by charging the equilibrium markup over expected marginal costs *evaluated in Home currency*, that is,

$$P_F = \text{markup} \cdot E\left(\varepsilon \frac{\mu^*}{Z^*}\right) = \text{markup} \cdot E\left(\frac{\mu}{Z^*}\right).$$

Clearly, the price of Home imports depends on the joint distribution of Home monetary policy and Foreign productivity shocks.

Suppose that Home monetary authorities ignore the influence of their decisions on the price of Home imports. For the reason discussed above, import prices will tend to be inefficiently high. On the other hand, if Home monetary authorities want to stabilize Foreign firms' marginal costs, they can only do so at the cost of raising costs and markup uncertainty for Home producers, resulting in higher Home good prices. It follows that, to maximize Home welfare, Home policymakers should optimally trade-off the stabilization of marginal costs of all producers (domestic and foreign) selling in the Home markets.

When foreign firms' profits are exposed to exchange rate uncertainty, optimal monetary rules are no longer inward-looking. The importance of Foreign shocks in the conduct of monetary policy depends on the degree of openness of the economy, measured by the overall share of imports in the CPI (see Corsetti and Pesenti, 2005a, and Sutherland, 2005, for a discussion of intermediate degrees of pass-through, and Smets and Wouters, 2002, and Monacelli, 2005, for models with staggered price setting).

Notably, the case for an international dimension in monetary policy described above transpires into limited exchange rate variability. Since with LCP optimal monetary policies respond to both domestic and foreign shocks, national monetary stances tend to be more correlated than in the case of inward-looking stabilization of output gaps. This implies lower exchange rate volatility. In the baseline CP-OR model, the optimal policy rules actually prevent *any* short-run fluctuations of the exchange rate, a point stressed by Devereux and Engel (2003). But this exact result holds only when the weights of Home and Foreign goods in final expenditure are assumed to be identical across countries: Home and Foreign monetary authorities de facto stabilize the same weighted average of marginal costs. The presence of non-traded goods or some Home bias in consumption would obviously imply asymmetries in the optimal monetary stances, which would be incompatible with a fixed exchange rate (Duarte and Obstfeld, 2007; Corsetti, 2006). Even if, with LCP, exchange rate variability does not perform any role in adjusting international prices, a fixed rate regime would impose unwarranted constraints on the efficient conduct of monetary policy.

A fourth result concerns the desirability of international policy coordination. Leading NOEM contributions have fed considerable scepticism on this issue. At the core of this scepticism is the disappointing quantitative assessment of welfare gains from

coordination. By using the CP–OR model, for instance, it is possible to build economies with either PCP or LCP behaviour, where optimal monetary rules are identical whether national policymakers act independently or cooperatively (maximizing an equally weighted sum of national welfare functions). When this exact result breaks down (depending on the elasticity of substitution between Home and Foreign tradables, and/or sector-specific shocks in the presence of non-tradables), gains from coordination usually remain quite small (see, for example, Pappa, 2004; Benigno and Benigno, 2006).

The lesson from the NOEM literature, stressed by Obstfeld and Rogoff (2002), is a new welfare-based argument against coordination: once policymakers independently pursue efficient stabilization policies in their own country (that is, they ‘keep their house in order’), the room for improving welfare through cooperation is quite limited (see Canzoneri, Cumby and Diba, 2005, for a discussion).

The results reviewed above were first derived in highly stylized economies. A critical question directing current NOEM research is whether they would still hold in richer models with good quantitative performance.

4. Challenges to the NOEM literature

The above debate on the role of exchange rate in the international transmission has motivated further empirical and theoretical work on market segmentation along national borders and on its implications for international macroeconomic adjustment. As stressed by Obstfeld and Rogoff (2001), despite the ongoing process of real and financial globalization, frictions and imperfections appear to keep national economies ‘insular’.

An important issue is the extent to which the evidence of local currency price stability of imports can be explained by nominal rigidities. It is well understood that the low elasticity of import prices with respect to the exchange rate is in large part due to the incidence of distribution (Burstein, Eichenbaum and Rebelo, 2007). Several macro and micro contributions have emphasized the role of optimal destination-specific markup adjustment by monopolistic firms depending on market structure (Dornbusch, 1987; Goldberg and Verboven, 2001), or vertical interactions between producers and retailers (Corsetti and Dedola, 2005).

The main point is that low pass-through is not necessarily incompatible with expenditure switching effects (see, for example, Obstfeld, 2002). In this respect, Obstfeld and Rogoff (2000) emphasizes that, in the data (and consistent with the received wisdom), nominal depreciation does tend to be associated with deteriorating terms of trade. This piece of evidence clearly sets an empirical hurdle for LCP models, if we assume a high degree of price stickiness in local currency (see Corsetti, Dedola and Leduc, 2005, for a quantitative assessment). Interestingly, estimates of LCP models downplaying price discrimination, distribution and other real determinants of incomplete pass-through predict that the degree of price stickiness is implausibly higher for imports than for domestic goods, a result suggesting model misspecification (see, for example, Lubik and Schorfheide, 2006).

Moreover, the currency denomination of exports prices should be treated as an endogenous choice by profit maximizing firms (see, for example, Bacchetta and Van Wincoop, 2005; Devereux, Engel and Storgaard, 2004). To appreciate the contribution by the NOEM literature on this issue, recall that, in the CP–OR model above, expansionary monetary shocks unrelated to productivity raise nominal wages and marginal costs while depreciating the currency. For a firm located in a country with noisy monetary policy, pricing its exports in foreign currency (that is, choosing LCP) is therefore quite attractive: it ensures that revenues from exports in domestic currency will tend to rise in parallel with nominal marginal costs, with stabilizing effects on the markup. This may help explain why exporters from emerging markets with relatively unstable domestic monetary policies prefer to price their exports to advanced countries in the importers' currency. The same argument, however, suggests that LCP is not necessarily optimal for exporters producing in countries where monetary policy systematically stabilizes marginal costs (see Goldberg and Tille, 2005, for empirical evidence).

New waves of studies are building models with trade costs where goods tradability is endogenous, and/or new varieties are created at business cycle frequencies. Trade and transaction costs are also at the heart of recent attempts to integrate current account and macroeconomic dynamics with international portfolio diversification in a unified analytical framework (see, for example, Devereux and Sutherland, 2007).

The discussion above is far from exhausting the range of topics and issues analysed by the NOEM literature, which has marked a radical change of paradigm in international macroeconomics. Many authors have undertaken a systematic reconsideration of classical themes in the new framework. A partial list of themes includes overshooting (for example, Hau, 2000); current account, debt and exchange rate dynamics (Cavallo and Ghironi, 2002; Ganelli, 2005; Ghironi, 2006), exchange rate uncertainty and trade (Bacchetta and Van Wincoop, 2000), and fiscal policy (Adao, Horta Correia and Teles, 2006). An important set of papers delves into empirical analysis of NOEM models (for example, Bergin, 2003; Lubik and Schorfheide, 2006).

Yet most NOEM contributions so far specify models which predict a counterfactually high degree of consumption risk sharing: even when financial markets are incomplete, intertemporal trade and terms of trade spillovers ensure that the consumption risk of productivity shocks is contained, and the market allocation is not too distant from the efficient one (see, for example, Chari, Kehoe and McGrattan, 2002). Not only this is inconsistent with a large body of evidence (see Backus and Smith, 1993); most crucially, a counterfactually high degree of risk sharing built in NOEM models may limit their capacity to comprehend significant cross-border spillovers and policy trade-offs. Similarly, in most models the exchange rate is tightly related to fundamentals, at odds with a large body of evidence showing that the relation between the exchange rate and virtually any macroeconomic aggregate is exceedingly weak – the so-called disconnect puzzle.

Further progress in these areas is crucial towards the fulfilment of the NOEM research agenda.

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